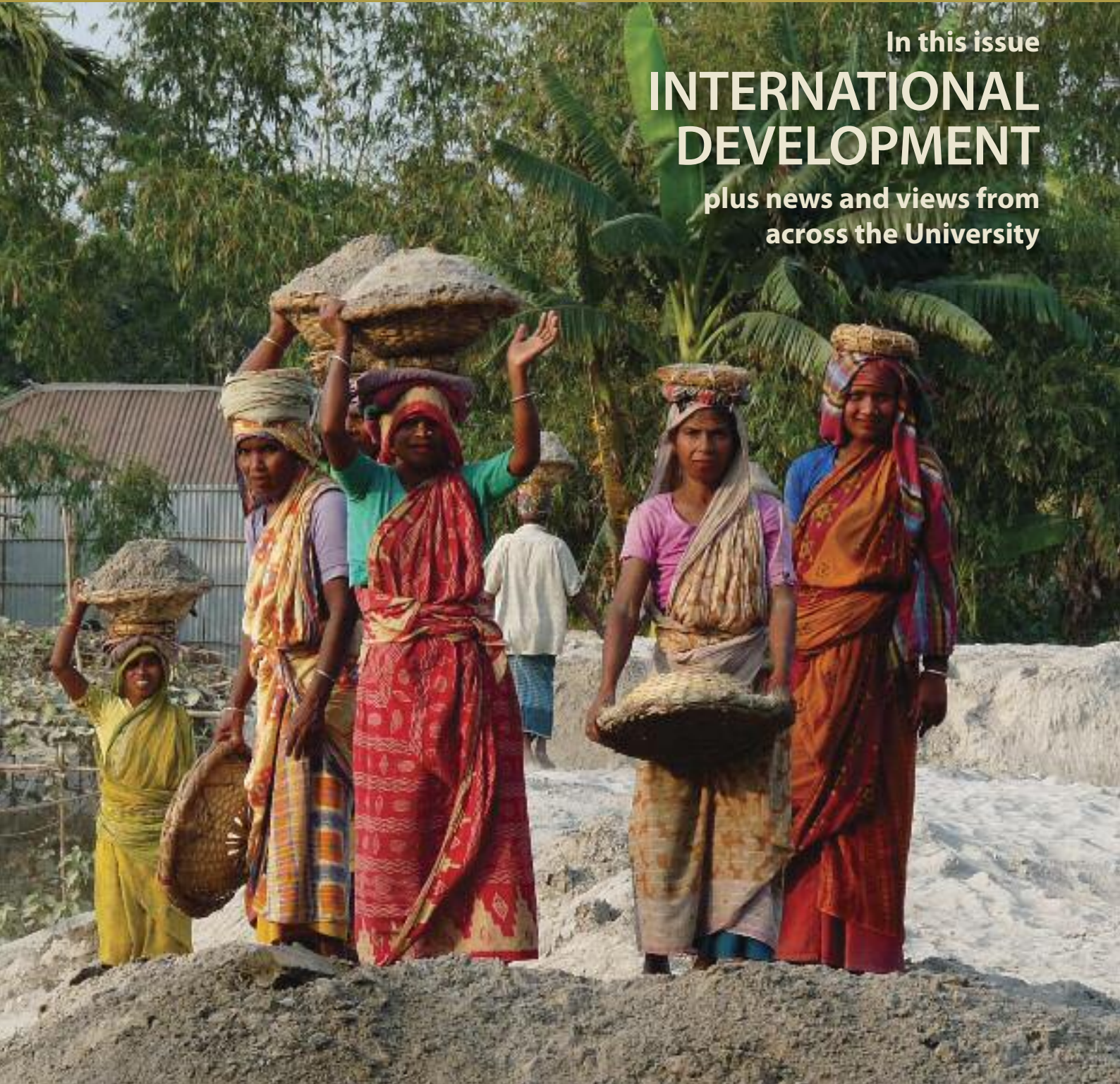


# RESEARCH HORIZONS

In this issue  
**INTERNATIONAL  
DEVELOPMENT**  
plus news and views from  
across the University



UNIVERSITY OF  
CAMBRIDGE

University of Cambridge research magazine  
[www.research-horizons.cam.ac.uk](http://www.research-horizons.cam.ac.uk)  
Issue 13

## 2 | Contents

Research news	3–5
<b>Spotlight:</b>	<b>6–17</b>
<b>International development</b>	
Safe water solutions	6
Lessons from learning studies	8
Democratising the airwaves	10
Stopping superbugs in their tracks	11
When disaster strikes	12
Out of poverty	14
Nature dialogues: whose ecosystem?	15
Helping African science to THRiVE	16
<b>In focus 18–19</b>	
Boeing	
<b>Preview 20–21</b>	
Magical illuminations	
<b>Features</b>	<b>22–31</b>
Reading the world's oldest libraries	22
Neural transplantation in Parkinson's disease: moving forward	24
Against all odds: archaic Greek in a modern world	26
Synthesis made simpler	28
Gender's many faces	29
Just press print	30
<b>Knowledge transfer</b>	<b>32–33</b>
Bridging research and industry	32
Connecting science and policy	33
<b>Inside out</b>	<b>34</b>
Professor Jane Clarke	
<b>Find us on YouTube EDU</b>	<b>35</b>
<b>The back page</b>	<b>36</b>

**Cover: The Chars Livelihoods Programme in Bangladesh is providing people with the resources to build a sustainable livelihood (see page 14 this issue). Photo: Professor Nick Mascie-Taylor.**

Editor: Dr Louise Walsh  
(research.horizons@admin.cam.ac.uk)  
Designed by Cambridge Design Studio  
(www.cambridgedesignstudio.org/).  
Printed by Falcon Printing Services Ltd  
(www.falcon-printing.co.uk/).  
©2010 University of Cambridge and Contributors as identified. All rights reserved.

## International development



PHILIP MYNOTT

All my working life I have been interested in how academic research can change human society for the better. In a great research university like Cambridge, brilliant research is easy to find – but what is less well appreciated outside universities is the extent to which our research changes the lives of people far beyond our precincts. The seemingly endless debate pitching applied research against blue-skies scholarship is sterile at the best of times, and within the pages of this edition of Research Horizons is evidence enough that fundamental research can change individuals and societies – sometimes profoundly.

Much of our daily life and work impacts most obviously on Cambridge, our city and region – in health, in architecture and urban planning, and in our museums, for example – and of course our students are hugely active in local affairs. But engagement with the most complicated challenges often means tackling global issues, sometimes in countries which lack a local research infrastructure.

Truth be told, in my own subject, medicine, there is no pure 'blue-skies research', in the sense that everything we do as clinical researchers has patient benefit in mind. There are examples of that mode of discovery here, in Sharon Peacock's superb work in pathogen resistance; like other research linked through the Cambridge Infectious Disease Initiative, her work is putting into place scientific discoveries that improve the quality of life of those who live in resource-poor countries.

Here too are examples of research which takes life in developing countries as its subject matter – the extraordinary sweep of the programmes in education are a case in point, with the explicit aim of understanding the benefits of education in the developing world and, by understanding, improving. Through our international partnerships, Cambridge is also well placed to build capacity overseas, to the long-term benefit of the world's citizens. The THRiVE consortium illustrates that wonderfully.

What is also evident from these case studies is the importance of a multidisciplinary approach to these problems. Bhaskar Vira's work on different stakeholder perspectives in ecosystem management shows this. His research, and the University's many engagements in biodiversity conservation, will gain strength and cohesion from the Cambridge Conservation Initiative, which is harnessing the potency of Cambridge's unrivalled concentration of researchers and NGOs in this area.

I am tremendously proud to have rejoined a University so comfortable with its mission to serve society – and so ambitious as to construe 'society' on this global scale.

Professor Sir Leszek Borysiewicz  
Vice-Chancellor

## The Book of Kings: the epic continues

**A millennium after its completion, an epic Persian poem is providing the springboard for a new centre of Persian studies in Cambridge.**

The Shahnama Centre at Pembroke College has opened its doors for the study of Persian culture and arts, marking a new phase for a project that has amassed the largest digital collection of one of the world's greatest literary epics: the 1,000-year-old Persian 'Book of Kings', or Shahnama.

Firdausi's stirring poem, which was completed in the year 1010, explores the Persian Empire's history, beliefs, myths and chivalrous code. For the next 800 years, successive court scribes copied and recopied the text, often using the richest of pigments to create exquisite illustrations (almost 100 of which have been brought together in the spectacular *Epic of the Persian Kings* exhibition currently at The Fitzwilliam Museum).

Professor Charles Melville, Director of the new Centre and an expert on Persian history in the Faculty of Asian and Middle Eastern Studies, has led a decade-long study of the Shahnama masterpiece, which is regarded as one of Iran's national treasures. Over the millennium, many of the manuscripts had become scattered worldwide, some as isolated pages. The aim of the Shahnama Project, initially funded by the Arts and Humanities Research Council, was to bring together the Book of Kings in an online environment.

First estimates indicated that there could be a few thousand illustrated pages in existence. But, as Professor Melville explains, the true number has surpassed all expectations. 'What began as a task that involved physically searching out, photographing and documenting each manuscript has taken on a life of its own. Curators and museums are beginning to send us new data, dispersed manuscripts are being reunited, and the corpus now contains over 12,000 images, and counting.'

With the opening of the Shahnama Centre, supported by the Aga Khan Development Network, the Iran Heritage Foundation and the Isaac Newton Trust, the Project can now enter a new phase. 'Just as this iconic text has nurtured many different fields of study,' says Professor Melville, 'the Centre will now nurture research and teaching in the fascinating and exotic world of Persian culture and the arts of the book.'

**For more information, please contact Professor Charles Melville (cpm1000@cam.ac.uk) or visit <http://shahnama.caret.cam.ac.uk/>**



**Key Kavus airborne, from a dispersed copy of the Shahnama dated c. 1435**

## Humanitarian focus on ICTs for international development

**New networking activities will help academic expertise in information and communications technology to benefit developing countries.**

A recently launched initiative of the Humanitarian Centre will focus activities on information and communications technologies for international development (ICT4D). Networking opportunities, learning events, training courses and an online directory will bring together academic, private sector and development practitioner audiences around the topic of ICT4D.

The Humanitarian Centre is a Cambridge networking organisation for international relief and development, and a registered society of the University. During the year-long focus on ICT4D, the Centre will be working in partnership with Cambridge-based ARM, a globally recognised company that designs the technology that lies at the heart of advanced digital products.

Ian Steed, Humanitarian Centre Manager, explains the importance of the new focus: 'ICT4D is a research growth area with exciting potential for creating innovative ways to alleviate global poverty and inequality. Our aim is to facilitate valuable and productive collaborations between groups that would not otherwise have the chance to connect.'

A number of research areas led by the University are already highlighting the potential of ICT4D. Among these, a scoping project with China Mobile is examining the benefits of mobile phones for medical care in China and beyond (page 5), the Centre for Commonwealth Education has been introducing open educational resources into Zambian primary schools (page 9, panel), and a

new project by the Centre of Governance and Human Rights working with FrontlineSMS will examine the impact of mobile technology on citizen-led governance in Africa (page 10).

The 2010–2011 focus on ICT4D will be reflected in the second of the Humanitarian Centre's *Cambridge and International Development* reports late in 2011. The first report, focusing on Cambridge innovation in international development, was published in November 2010.

**For more information, please contact Ian Steed, Humanitarian Centre Manager (ian.steed@humanitariancentre.org; Tel: +44 (0)1223 760885) or visit [www.humanitariancentre.org/](http://www.humanitariancentre.org/)**

# Blood pressure breakthrough for pre-eclampsia

Scientists have discovered a mechanism that raises blood pressure in pre-eclampsia, a potentially deadly condition in pregnancy.

After 20 years of research, scientists from the University of Cambridge have now cracked the first step in the main process that controls blood pressure. Their findings, published in the journal *Nature*, are likely to have significant implications for the treatment of pre-eclampsia as well as high blood pressure.

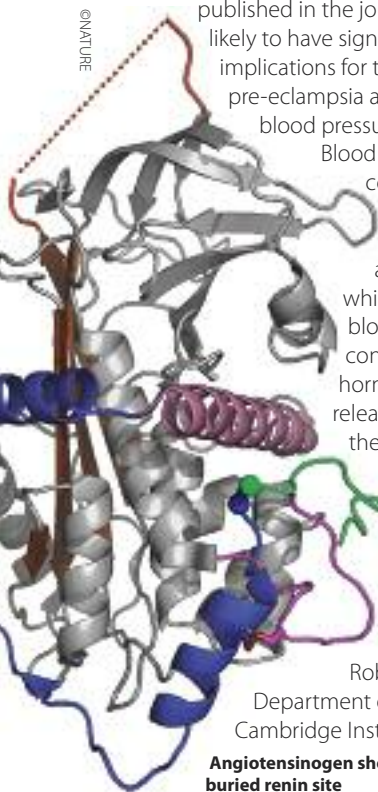
Blood pressure is controlled by hormones called angiotensins, which cause the blood vessels to constrict. These hormones are released by the protein angiotensinogen but, until now, it was not understood how this occurred.

The team led by Professor Robin Carrell at the Department of Haematology, Cambridge Institute for Medical Research, solved the structure of angiotensinogen with the help of an extremely intense X-ray beam produced by Diamond Light Source, the UK synchrotron. Their results revealed that the protein is oxidised and changes shape to permit ready access to angiotensinogen by an enzyme, renin. Renin cuts off the tail of the protein to release the hormone angiotensin, which then raises blood pressure.

Taking their lab results into the clinic at the University of Nottingham, the researchers showed that the amount of oxidised, and hence more active, angiotensinogen was increased in women with pre-eclampsia.

Drugs currently used to treat high blood pressure – such as angiotensin-converting enzyme inhibitors – focus on the later stages of the mechanism that controls blood pressure. These latest findings, which give insight into the previously mysterious early stages of the regulation process, provide scientists with new opportunities to research novel treatments for hypertension.

**For more information, please contact Professor Robin Carrell (rwc1000@cam.ac.uk). This research was largely funded by the British Heart Foundation.**



Angiotensinogen showing its buried renin site

# Managing the data deluge

A project at Cambridge University Library is developing services and resources to help academics manage their digital data.

The volume of digital data created during the lifetime of a research project is expanding rapidly. Scholars across all disciplines are increasingly able to access, share, transform and connect large and diverse sets of data. However, this 'data deluge' introduces new challenges, as the volume becomes difficult to manage, hardware and software become obsolete, and the original contexts of data are lost.

The 'Incremental' project, funded by JISC, is a collaboration between Cambridge University Library and the University of Glasgow, and aims to improve and increase research curation within UK higher education institutions. Both the Digital Curation Centre and Digital Preservation Coalition are providing support and guidance.

A scoping study conducted earlier this year identified the attitudes, experiences and needs of a range of researchers at both universities. Now the project is taking simple and pragmatic steps to meet these needs, including the creation of jargon-free web resources offering guidance on planning, organising, accessing and storing data in the long term.

'Managing data well ensures research integrity and replication, provides opportunities for researchers to discover and share information, and increases the longevity of research,' says Grant Young, the Library's digital preservation specialist. 'Incremental aims to provide researchers with the services and resources they need to ensure that their digital data can have a lasting impact.'

**For more information, please contact Catharine Ward, Incremental Project Manager (cw330@cam.ac.uk) or visit [www.lib.cam.ac.uk/dataman/](http://www.lib.cam.ac.uk/dataman/)**

# Just milk

A novel initiative aims to reduce HIV transmission to babies during breastfeeding.



Nipple shield modified to include replaceable inserts

Scientists in the Department of Chemical Engineering and Biotechnology, with collaborators from the United States, are developing a low-cost, modified nipple shield that dispenses antiviral compounds to reduce the transmission of HIV from mother to baby during breastfeeding.

Breastfeeding accounts for up to a third of all mother-to-child transmissions of HIV, approximately 200,000 babies every year, primarily in sub-Saharan Africa. The mothers often have no alternative but to breastfeed as formula use is typically even more deadly for the infant than the risk of HIV infection (owing

to the malnutrition and diarrhoea it often causes when used in low-resource settings).

Stephen Gerrard and Professor Nigel Slater are currently exploring the delivery of antiviral agents that reduce the likelihood of transmission by either reducing the infective load in the milk or providing partial protection within the infant against infection, as well as investigating the delivery of medications and nutritional supplements.

**For more information, please visit <http://justmilk.org/> (see page 35 for details of a video).**

JUSTMILK



## Mobile communications for medicine

Cambridge researchers in collaboration with China Mobile are examining the potential of mobile phones to deliver healthcare in China and worldwide.



CHINA MOBILE

The use of mobile communications for healthcare delivery and health promotion – so-called ‘mHealth’ – is already proving valuable both in the developed world and in developing countries, where clinics and health workers may be scarce. In Africa and India, for example, mobiles are being used for remote diagnosis and to track epidemics. But perhaps the greatest opportunities – and also maybe the least well understood – are in China.

Understanding the costs and benefits of mHealth in China – and beyond this, the global potential of new applications – is the aim of a project sponsored by China Mobile, which has the world’s largest telecoms network and 10% of the world’s subscribers. Experts from many relevant disciplines (including the Computer Laboratory, Judge Business School, Department of Engineering, School of Clinical Medicine and Centre for Science and Policy) will come together to forecast how mobile communications can contribute to global sustainable development in healthcare.

The study leader is Professor Ian Leslie from the Computer Laboratory. The global

reach of mobiles is staggering,’ says Professor Leslie. ‘Current estimates are that even in remote areas, 50% of people will have mobile phones by 2012. Factor in the opportunities for all kinds of sensors and tracking devices to communicate cheaply via the mobile network, and it’s clear that there are enormous potential for healthcare, in both urban and rural populations.’

‘This short project,’ he added, ‘is necessarily a scoping exercise that will highlight current practice, but more importantly canvass researchers across a range of disciplines about what new applications and sensor technologies might be brought to bear, and their implications for mobile operators and policy makers.’ The team will analyse original field studies of actual deployments in China, as well as examine the societal benefits and economic value of mHealth and explore innovative ways of delivery. The final report is scheduled for early 2011.

**For more information, please contact Dr Nick Gray (ng338@cam.ac.uk).**

## Blueprints for supercomputing success

The University’s High Performance Computing Service has formed a partnership with Dell to address key challenges in research computing.

High performance computing (HPC) has become a fundamental enabler of research that requires data handling on a massive scale. Helping this process is the focus of the University’s HPC Service (HPCS), which supports over 120 Cambridge research groups through its large-scale, state-of-the-art computational and storage technologies.

Now, following a significant partnership with Dell, the newly launched Dell/Cambridge HPC Solution Centre aims to tackle and resolve HPC challenges identified as important by the research community, and share the solutions worldwide through ‘how-to’ white papers and targeted outreach activities. ‘This is an exciting day for Dell as the Solution Centre marks a significant new collaboration aiming to accelerate discovery,’ commented Dell’s Vice-President, Troy West.

The new partnership brings the expertise of the HPCS team at the University in providing HPC solutions to the Cambridge research community over the past five years together with the deep computing knowledge of one of the largest information technology companies worldwide.

‘We want to ‘shrink wrap’ this collective knowledge into standardised HPC solutions that other research and non-research communities can use as a template to build their own fit-for-purpose solution, without having to go through the expensive and time-consuming exploration process,’ explains Dr Paul Calleja, Director of HPCS and the Dell/Cambridge HPC Solution Centre. ‘In partnering with Dell, we have launched a new concept in HPC solution development that can deliver best-in-class HPC blueprints back to the HPC community.’

The first white paper has been released and draws on the Centre’s experiences tackling the increasing need to store up to petabytes of data by setting out a detailed recipe describing how to build a ‘storage brick’. ‘Through providing a range of standardised tested solutions,’ Dr Calleja continues, ‘we can guide users through the complex matrix of processors, networks and storage components to build solutions to real-world situations.’

**For more information, please contact Kamila Lembrych (kl341@admin.cam.ac.uk), School HPC Administrator, or visit [www.hpc.cam.ac.uk/](http://www.hpc.cam.ac.uk/)**

## New ‘Innovation and Knowledge Centre’

**Funding has been announced for a major new research centre at the Department of Engineering.**

The Cambridge IKC on Smart Infrastructure and Construction will combine research in sensor and data management with innovative manufacturing processes. The aim is to transform the industry through a whole-life approach to achieving sustainability in construction and infrastructure, covering design and commissioning, the construction process, exploitation and use, and eventual decommissioning. Funded by £10 million from the Engineering and Physical Sciences Research Council and the Technology Strategy Board, with a further £7 million from industry, the IKC will be led by Professor Robert Mair and Professor Kenichi Soga, and complements the new Laing O’Rourke Centre for Construction Engineering and Technology at Cambridge.

## Safe water solutions

Research across the University is helping to clean up water in communities around the world.

Almost 900 million people worldwide lack access to safe water; polluted lakes and waterways diminish livelihoods and health; and 2.6 billion people (almost half the population of the developing world) lack access to adequate sanitation<sup>1</sup>.

In Cambridge, research groups from several disciplines are working in regions worldwide where dirty, polluted and inadequate supplies of water make drinking, cooking and cleaning an everyday challenge for the communities who live there. We take a look here at some of their solutions.

### Water cleaning with mussel power

Zoologist Dr David Aldridge is a keen advocate for the amazing abilities of mussels to clean up water. His work in China is using these remarkable organisms as cheap and sustainable water filters to improve water quality and, as a result, it is hoped that a local industry will develop to farm them.

China's Lake Dianchi was once a rich haven of aquatic species but increasing levels of pollution from a cocktail of fertilizer run-off, sewage and the effluent from factories has caused a huge deterioration in water quality. The water is undrinkable and a hazard to those using it for washing, and the native aquatic wildlife has all but died off. Where once underwater visibility was over 10 metres, on a good day it's now a mere 30 cm.

Using a set-up that could be replicated in many of the world's polluted freshwaters, Dr Aldridge from Cambridge's Department of

Zoology and colleagues at the Chinese Academy of Sciences have deployed specially bred giant mussels – once native to the lake – in experimental enclosures along the lakeside.

The mussels filter 50 litres of water a day, removing algae and suspended particles. 'In just a few months,' he explains, 'not only did the water become clearer but native plants suddenly began to emerge from seeds buried for decades on the lake bed. These, in turn, provide habitat for insects, and then fish, and the system stabilises back to clearer water.'

One challenge has been the tendency of people living locally to eat the mussels. The team's solution has been to turn to pearl farming to encourage the community to sustain the mussels in the lake. Chopsticks are used to insert a tiny bead of shell into the mussel, around which a pearl is formed. Recognising the potential impact of this idea on bolstering local industries, the World Bank awarded Dr Aldridge a Development Market Place Award to continue the work.

Dr Aldridge is also developing a means by which local authorities and managers of waterways can check the health of freshwater in their region, reducing the need for difficult and costly chemical testing. 'We're using the biology of the lake as an indicator of water quality. The number and type of organisms, or biotic index, provides a useful indication of the state of the water they live in. The guide book we are creating will enable users armed with only a hand net to monitor the condition of water in their province.'



Ganesh Harijan from Kasiya in Nepal, showing the improvement in water clarity after filtration

### Healthy water for households

Many people who lack access to safe water live in regions where conventional methods for supplying drinking water through water pipes are simply not possible or cost-effective. For these people, the alternative is to use household water treatment and safe storage systems (HWTS) based on chlorination, solar disinfection, ceramic filters or biosand filters.

As part of Dr Douglas Crawford-Brown's wide research interests in water policy, he has been examining the effectiveness of reducing microbes in drinking water using low-cost HWTS in the developing world. As Executive Director of the Cambridge Centre for Climate Change Mitigation Research, in the Department of Land Economy, his research interests have an environmental perspective: 'The problem of ensuring safe water provision in the face of environmental change is a global one. But for developing countries, where large investments in infrastructure are not possible, it's a massive concern.'

His work has been in collaboration with colleagues Dr Mark Sobsey and Dr Linda Venzcel at the University of North Carolina, from which he moved two years ago, and Dr Christine Stauber at Georgia State University. Dr Crawford-Brown's role in the long-term project has been to model the predicted human health impacts so that they can be compared against field epidemiological data in the Dominican Republic, Ghana, Honduras and Cambodia.

'Our results show clearly that there is significant reduction in microbes, but also a



DR DAVID ALDRIDGE

Giant mussel used in Lake Dianchi, China, to clean water

residual concentration that can be quite difficult to remove,' he explains. 'In one project funded by the International Rotarians, we found that a simple sand filtration HWTS in the Dominican Republic halved the incidence of diarrhoeal disease, a major cause of death among infants in poor communities worldwide.'

Given that affordability of water systems is a critical regulatory issue, his research has also looked more widely at health–health trade-offs. 'Trade-offs occur when the costs of water treatment in poor communities cause them to re-allocate limited finances, often away from buying medicine, unless public programmes are brought in to provide healthcare. Our goal is to provide policy makers with the evidence on which to base decisions on risk and in allocating budgets.'

### Improving outcomes

Having worked for several years in rural Nepal trying to implement the use of water filtration units, Tommy Ngai from the Department of Engineering knows only too well that, despite their benefits, the adoption and continued use of HWTS is not always straightforward.

For the past four years he has been investigating how to scale up the dissemination of HWTS. Working with Dr Dick Fenner in the Centre for Sustainable Development in the Department of Engineering, his research has taken him to Nepal, southern India and Ghana, where he has carried out extensive interviews with project management staff, community workers, government officials, shopkeepers and household end users.

### Sanitation innovation

**Ensuring access to safe water isn't the only challenge; it's also what you do with waste. An innovative study has come up with a prototype system that could improve sanitation in urban slums.**

The realities of high-density living in urban slums have made conventional approaches to improved sanitation practically impossible, with low-income families renting living space in tightly packed, unplanned settlements serviced by pit latrines.

Nate Sharpe's research in the Centre for Sustainable Development has come up with a solution for emptying pit latrines in the slums of Dar es Salaam, Tanzania, although his findings should be applicable to many other similar cities around the world. 'Pit latrines are filling up faster than ever and people are often forced to rely on unhygienic emptying methods,' he explains. 'If smaller amounts of the sludge could be removed more often, it becomes easy to transport – even on the back of a bicycle.'

Sharpe has designed a prototype bicycle-powered vacuum pump/tank system and a business model for small businesses to run a latrine-emptying service at a low enough price that even the poorest might be able to afford to make their latrine usable again. The next stage is to test the device in Tanzania and to put the device into production.

His research was completed as part of an MPhil in Engineering for Sustainable Development with Dr Heather Cruickshank, and is just one of around 35 similar projects annually that are finding innovative engineering solutions to a host of sustainability problems. Many focus on developing countries where, as Sharpe has highlighted, sometimes the solution lies not in the development of new technology but in the creation of a new business angle that works in the local community.

**For more information about these and other projects, please contact Dr Heather Cruickshank (hjc34@cam.ac.uk).**

'It's not uncommon for communities either to not take up HWTS or for the equipment to be found lying abandoned a year or so later,' he explains. 'There may be a lack of awareness among potential users, or the devices may be too expensive to operate and maintain, or the supply chain unavailable, or there may be technical difficulties and ineffective post-implementation support.'

### One target of the United Nations Millennium Development Goals is to halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation.

Ngai's research has, for the first time, captured the big picture of the many competing factors at play – from the technical and financial, to the social and institutional. The outcomes are three programme-specific computer simulation models linking over 300 different variables. The models can help implementing organisations to appreciate the complexity of project management, to understand the interactions and consequences of any policy strategy and, crucially, to make recommendations for increasing the success of an HWTS programme.

'Literally thousands of scenarios can be simulated in the model, whereas in the real

world you can only try one strategy at a time,' he says. 'Comprehensive analysis showed that no single strategy will always work in all situations, and that some measures that have long-term benefits may at first appear counter-intuitive.'

One of the models has also been designed as an easy-to-use simulation game that can be run on a PC, allowing agencies and government officials to explore the effects of different potential intervention strategies concerning programme expansion, promotion, training, pricing and capacity building, and to predict adoption and sustained use of HWTS.

In his next post, as Director of Research Learnings at the Centre for Affordable Water and Sanitation Technology in Canada ([www.cawst.org/](http://www.cawst.org/)), Ngai will be using his research to help NGOs and government policy makers to understand quickly how best to encourage sustained adoption of HWTS in their region.

<sup>1</sup> [www.unep.org/pdf/SickWater\\_screen.pdf](http://www.unep.org/pdf/SickWater_screen.pdf)

**For more information about these projects, please contact Dr David Aldridge (da113@cam.ac.uk) at the Department of Zoology; Dr Douglas Crawford-Brown (djc77@cam.ac.uk) at the Department of Land Economy; Tommy Ngai (tommyngai@yahoo.co) and Dr Dick Fenner (raf37@cam.ac.uk) at the Department of Engineering.**

At a time when more than 70 million children are not in school<sup>1</sup> – almost half of whom live in sub-Saharan Africa and a quarter in south-west Asia – research in Cambridge is aiming both to understand precisely what benefits education brings and to improve its provision where it is most needed. These are the combined goals of complementary research programmes ongoing in two research centres at the Faculty of Education.

It's the big picture of how and why education plays a central role in the development of nations that concerns the Centre for Education and International Development (CEID). Directed by Professor Christopher Colclough, CEID leads a research consortium on educational outcomes and poverty (RECOUP) that is focusing particularly on what difference education makes in India, Pakistan, Ghana and Kenya.

Meanwhile, research at the Centre for Commonwealth Education (CCE), directed by Mike Younger, is aimed at helping to improve both the quality of teaching in schools and the local leadership needed to continue this in the long term. Although CCE is working at some level with all countries in the Commonwealth, current projects are based in Ghana, Tanzania, South Africa, Uganda, Zambia, Kenya and the Caribbean.

# Lessons from learning studies

---

**Two research programmes in the Faculty of Education are bringing new insight to the impact and implementation of education in developing countries.**

---

At the heart of the multi-dimensional topic of education is a central guiding principle, as Professor Colclough explains: 'Put simply, education is tremendously affirming – once you are given even a basic education, those skills cannot be taken away. Education can potentially determine future behaviour, productivity, health, fertility, citizenship and equality of individuals.'

## Educational outcomes and poverty

RECOUP is investigating how education affects the lives and livelihoods of people living in poorer communities – focusing on sub-Saharan Africa and south Asia, regions that pose the greatest challenge to achieving the Millennium Development Goals (MDG) set 10 years ago by the United Nations to provide universal primary education by 2015.

Now midway through its five-year £2.5 million programme, funded by the UK Department for International Development, RECOUP involves academics from several disciplines across seven academic institutions in India, Pakistan, Ghana, Kenya and the UK (Universities of Edinburgh and Oxford, and coordinated by Cambridge).

To arrive at a sense of the impact that education has on individuals – socially, economically, behaviourally and politically – the research is based extensively on fieldwork that combines household surveys with qualitative interview-based enquiries. Importantly, the research is also investigating the policy interventions that might best support positive returns on investment in education, looking for instance at partnerships with the private sector and aid donors.

---

**'Put simply, education is tremendously affirming – once you are given even a basic education, those skills cannot be taken away.'**

---

Some of the latest findings relate to the relationships between education and earnings. 'Education is fundamental to people's identity and their sense of themselves. But as well as these non-market benefits it's also valued for its role in helping individuals to achieve higher earnings and avoid poverty,' says Colclough. 'While this is still the case, our data indicate that the pattern of the relationship between education and earnings may be changing.'

Until recently, the general pattern has been that every extra year of primary schooling in developing countries brings a greater proportionate increase in earnings than additional years of secondary and tertiary education. This means that the earnings benefits in return for very modest investments in education have been very high. The indications are, however, that this





**'I have become a new teacher'**

**Access to online learning materials, when used in conjunction with school-based professional development, could be one way by which schools that are otherwise poorly resourced might improve their teaching.**

A recent pilot project by CCE researchers investigated what difference it would make to teaching practices in three primary schools in Zambia if teachers were equipped with netbooks and internet access to appropriate open educational resources (OER) – learning materials that are freely available on the web – with a view to promoting more-

interactive teaching methods.

Working with researcher Godfrey Mwewa from the University of Zambia, Dr Sara Hennessy and Dr Björn Haßler developed and trialled new pedagogical approaches for primary school mathematics, which has been identified as a key subject in the socioeconomic development of Zambia. The project specifically sought digital resources that would encourage an active learning environment with increased group work and open-ended investigations.

They found that the teachers responded with unanimous enthusiasm ('I have become a new teacher,' said one) and there was a marked increase in the

use of interactive teaching and collaborative learning approaches after only four months. However, it was also clear that ongoing peer cooperation and researcher support would be needed to develop the process further.

The aim now is to collaborate with other organisations and institutions to develop teacher education methodologies that underpin lasting educational transformation in poorly resourced educational systems.

**For more information, please contact Dr Sara Hennessy (sch30@cam.ac.uk) and Dr Björn Haßler (bjoern@caret.cam.ac.uk).**

is no longer the case, and that education at higher levels has a much stronger relative impact on earnings than education at primary levels.

This has implications for education and labour market policy, as he explains: 'Although primary education is just as important as it ever was, it needs to be balanced with expansion at the post-primary level. Also, the rapid expansion in primary schooling has not been without risks – in some cases, stretched resourcing has jeopardised the quality of teaching to the point where basic numeracy and literacy skills have been reduced, lessening the very positive relationship between earnings and number of years spent in primary school.'

**Building sustainable quality**

Identifying how schools in developing countries might enhance the quality of their teaching, and maintain this for the future, is the primary purpose of CCE. Funded by £3 million from the Commonwealth Education Trust, the programme is now midway through its four-year span and ranges in scale from working with all of the teachers and children in a single school, to working nationwide with schools, government education ministries, local universities and NGOs.

The emphasis is on building the capacity for excellent education in a sustainable fashion – often through the professional development of teachers – which will continue after the lifetime of the research programme. One of the most ambitious of the projects, based in Ghana and working in collaboration with the University of Cape Coast, the Ghana Education Service and UNICEF, is aimed at equipping a cohort of 150 head teachers to implement school changes and transform educational leadership across the country.

Other projects focus on teaching resources and styles: whether it's the provision of AIDS education to primary



School in Punjab, Pakistan

school pupils in South Africa, or supporting learning through information and communications technologies in Zambia (see panel), or promoting poetry in schools in the Caribbean. Many projects have tangible outcomes, such as the development of a teaching tool kit for AIDS education, which will be available for education establishments throughout East and South Africa.

'The Education for All agenda means that there are now more children than ever before being taught to the age of 11. Their fortunes will be affected by their educational experiences,' comments CCE Director Mike Younger. 'There is an urgent need to examine the policies and practice that can help governments and schools respond effectively, particularly in regions where the challenge of achieving the MDG objective is greatest.'

<sup>1</sup> www.campaignforeducation.org/



**Professor Christopher Colclough (left) and Mike Younger**

**For more information, please contact Professor Christopher Colclough (c.colclough@educ.cam.ac.uk) and Mike Younger (mry20@cam.ac.uk) at the Faculty of Education (www.educ.cam.ac.uk/).**

**A new research collaboration will investigate the capacity of radio to facilitate citizen-led governance in developing countries.**



Community radio volunteers, Breeze-FM, Chipata, Zambia

## Democratising the airwaves

In Africa, an estimated 90% of households own a radio. But for all its muscle in connecting with the masses, radio communication remains mostly one-way. If radio was more interactive, listeners could share information, communicate grassroots reactions to current affairs and mobilise change.

Now, a pioneering research collaboration between Cambridge's Centre of Governance and Human Rights, in the Department of Politics and International Studies, and FrontlineSMS, a UK-based non-profit organisation, aims to help transform African radio into a two-way communications channel. In so doing, the project will assess the capacity of interactive radio for improved citizen awareness and greater citizen engagement.

### Developing tools, investigating outcomes

FrontlineSMS provides free software to enable users to send and receive text messages with large groups of people – a particular advantage in the developing world where the use of mobile phones and text messaging is rapidly increasing but internet access is limited. At the core of the project is the tailoring and deployment of the software to community and local radio networks, enabling radio stations of any size to use a laptop to gather information from listeners via mobile phone text messaging, helping them to shape programming and communicate with their audiences in real-time.

Other project partners include Developing Radio Partners, the International Center for Journalists and Internews, each of which has a long-standing track record in media development in Africa and will be essential to help pilot test the software in

Kenya, Zambia, Sierra Leone, South Africa, Tanzania and Malawi. A subsequent worldwide roll-out is planned for mid-2011.

Alongside this tangible goal of the project runs a sociopolitical investigation of how new communications technologies influence governance relations and practices, as the Centre's Director Sharath Srinivasan explains: 'Without question, 'hybrid media' that combine the interactive power of mobile SMS with the reach of radio have the potential to expand citizens' political capabilities and enrich public sphere interactions. But a major challenge has been to develop an empirical sense of how transformative this can be in relation to public debate, political participation, accountability and governance.'

Understanding this impact is precisely the type of question that interests the Centre, which was launched in 2009 as an interdisciplinary hub for research, teaching and engagement with policy and practice on issues of human rights and governance in Africa and the global South. The project is harnessing interdisciplinary expertise across the University, from the Computer Laboratory, Judge Business School, Engineering, Social Anthropology and Psychology.

### Social technology innovation meets academia

A collaboration between the University and FrontlineSMS makes sound sense, as Ken Banks, founder of FrontlineSMS, explains: 'The impact of tools in the mobile-for-development field tends to suffer from a lack of rigorous academic scrutiny, and most impact assessment is carried out after the event rather than being an intrinsic part of the deployment process. As a result of the

collaboration, from the outset and for the first time, this project will determine user behaviour, identify system design and monitor impact throughout the project life cycle.'

'Imagine thousands of radio stations being able to interact with citizens on issues from agriculture to politics, health to human rights, and how this can change the nature of public discussion,' adds Sharath Srinivasan. 'This study is our entry point for looking at such issues more broadly. Our long-term vision is to evolve the programme into evaluating not just the mobile phone and radio but also a whole range of communication technologies and how they are reconfiguring governance relations in Africa and beyond.'



### Sharath Srinivasan

For more information, please contact Sharath Srinivasan ([ss919@cam.ac.uk](mailto:ss919@cam.ac.uk)) at the Centre of Governance and Human Rights, or Karim Amijee ([karim@radio.frontlinesms.com](mailto:karim@radio.frontlinesms.com)). The Centre was established through the David and Elaine Potter Foundation; this project is funded by The Cairns Charitable Trust with matching support from the Isaac Newton Trust.

Work in resource-restricted healthcare settings in south-east Asia is defining the transmission of hospital 'superbugs' using low-tech diagnostics and high-tech tools.

## Stopping superbugs in their tracks

Hundreds of millions of patients around the world are affected by healthcare-associated infections each year, although the true scale of their global burden and impact on health remains unknown because of the difficulty in gathering reliable data. In developing countries, the problem of such infections is compounded by the fact that the pathogens involved are frequently resistant to the antibiotics available.

Reducing mortality and morbidity from healthcare-associated infections depends on effective prescribing policies based on information provided by diagnostic microbiology, as well as prevention through improved hygiene such as frequent hand washing. 'One of the major difficulties in resource-poor countries,' says Professor Sharon Peacock, from the Departments of Medicine and Pathology, 'is the lack of even simple diagnostic microbiology in many hospitals. As a result, many pathogens go unrecognised.'

Having spent most of the past decade working in resource-restricted areas of south-east Asia, Professor Peacock believes that researchers can help tackle this problem using technology at two ends of the spectrum. 'By supporting the development of low-cost, sustainable diagnostic microbiology laboratories to identify pathogens, information is generated to guide prescribing and highlight the need for infection control. This also provides bacterial strain collections that can then be examined using cutting-edge tools to define transmission pathways of important pathogens at local, national and global levels.'

### Detective work

The antibiotic-resistant MRSA 'superbug' has a deservedly high profile across the developed world but is barely on the radar in developing countries. For example, until recently, there had been no documented report of MRSA in Cambodia. This isn't because the country has remained completely free of the pathogen but simply because there were no facilities to detect its presence. Now, the Angkor Hospital for Children in Western Cambodia has such a laboratory, the development of which was supported by a team led by Professor Peacock while working at the Wellcome Trust-Mahidol University-Oxford Tropical Medicine Research Unit in Thailand, where she continues to support research following her move to Cambridge in 2009.

Within a month of opening, the first child with MRSA infection was identified. And, with continued support from Cambridge- and Thailand-based researchers, the laboratory has recently reported that MRSA causes infection in both the hospital and the community, and is being carried by a proportion of the population.

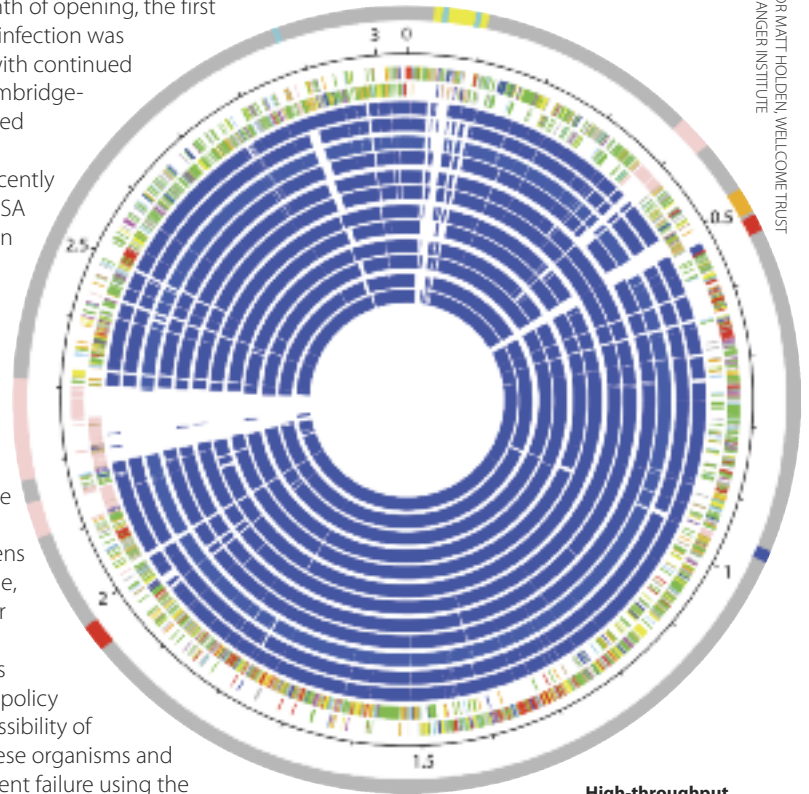
The impact of detecting these and other multi-resistant pathogens is potentially huge, explains Professor Peacock: 'Such information alerts healthcarers and policy makers of the possibility of infection with these organisms and the risk of treatment failure using the readily available antimicrobial drugs, as well as supporting the need for hand washing to reduce spread among hospital patients.'

### Tracking the global spread of multi-resistant pathogens

As highlighted by a study published this year in *Science* magazine, cutting-edge technology also has an important role to play. In this study, Professor Peacock was part of a team led by the Wellcome Trust Sanger Institute at Hinxton, Cambridge, which developed high-throughput genome sequencing to study the transmission of a single clone of MRSA that has become disseminated across much of the world.

Existing techniques were unable to discriminate between individual strains, but genome sequencing showed that no two strains were genetically identical. The beauty of the technique is that it allows healthcare officials to see how MRSA, or any other pathogen, can evolve and spread – from person to person, from hospital to hospital, and from country to country.

Professor Peacock's research is continuing to use this sophisticated technology to inform better infection control of MRSA, and other pathogens, in hospital settings. 'Being able to feed this information back to hospitals,' she explains, 'is key for interventions to be targeted with precision and according to need.'



High-throughput sequencing of the genome of pathogens such as MRSA (shown here) is helping to track their worldwide transmission

DR MATT HOLDEN, WELLCOME TRUST SANGER INSTITUTE



### Professor Sharon Peacock

For more information, please contact Professor Sharon Peacock (sjp97@cam.ac.uk) at the Departments of Medicine and Pathology. Professor Peacock chairs the Cambridge Infectious Disease Initiative ([www.infectiousdisease.cam.ac.uk/](http://www.infectiousdisease.cam.ac.uk/)), one aim of which is the development and translation of research in developing countries.

---

Using satellite imagery, researchers have developed the first systematic approach for tracking the recovery of regions stricken by natural disaster.

---



A timeline of satellite images used to assess the recovery of Baan Nam Khem, a fishing village on the west coast of Thailand that was severely hit by the 2004 Indian Ocean tsunami; features such as the pier at the top of the images were used to infer the recovery of the fishing industry

## When disaster strikes

Earthquakes, tsunamis, hurricanes, floods and volcanic eruptions – natural hazards such as these are inevitable and at times disastrous, causing horrific loss of life and widespread damage. Although these events can affect regions all over the world, the likelihood of a devastating impact is far greater for developing countries, sometimes wiping out decades of development work in a few seconds. According to figures from the World Bank, developing countries experience not only a higher number of natural disasters (in some years, as many as six times more) but also 20 times greater direct and indirect losses compared with industrialised countries.

When disaster strikes, the relief phase in the immediate aftermath is focused on life-saving tasks, finding survivors and providing food, water and sanitation. And then begins the process of recovery – a long, costly and complex period in which amenities, schools and livelihoods need to be rebuilt and, for those affected by the disaster, some sense of a return to normality.

It is to this process of post-disaster recovery that researchers in Cambridge have been making a significant contribution – both by providing immediate engineering and architectural expertise at the sites of disaster (see panel) and by developing the first systematic approach to monitoring and evaluating how the recovery process is progressing.

### Need for knowledge

'Surprisingly, considering the billions that are spent in aid, there is currently no integrated approach for assessing long-term recovery,' explains Daniel Brown who, with Dr Torwong Chenvidyarn and Dr Keiko Saito in the Department of Architecture, has been responsible for spearheading a new approach to the complex problem of post-disaster monitoring and evaluation.

'The various stakeholders – government departments, NGOs, donors and executing agencies – currently use an assortment of data collection methods such as surveys, interviews and direct observations,' he continues. 'These methods can be time-consuming and prone to inconsistencies, and might be taking place in situations that are confusing and dangerous.' In some extreme cases, no monitoring and evaluation data can be collected at all, either because access to the country has been denied by its government or security is a critical issue.

Yet, evaluations are vitally important, says Dr Saito: 'Lessons can be learned from how quickly regions do or don't recover. Evaluations also assist in ongoing work on the ground, and provide long-term accountability to donors.'

### The recovery project

Thanks to recent technological advances, the Cambridge researchers have been able to look in a new way at assessing what is happening on the ground: in fact from high above the Earth, using very high-resolution optical satellite imagery.

Satellites are now in widespread use for capturing virtually instantaneous images from space of disaster areas. However, Daniel Brown and colleagues have taken the information these images provide a step further. Working in association with Cambridge Architectural Research (a spin-out from the Department of Architecture) and ImageCat (an R&D company providing advanced technologies for risk and disaster management), and with funding from the Engineering and Physical Sciences Research Council, the team has developed a means of extracting information from the images that is at once incredibly detailed and yet gives a region-wide evaluation of the situation.

At the heart of the approach is a set of 12 'performance indicators' that map aspects of the recovery process, including population

---

'Surprisingly, considering the billions that are spent in aid, there is currently no integrated approach for assessing long-term recovery.'

---



## Earthquake Engineering Field Investigation

For over 25 years, Cambridge researchers have been involved in reconnaissance missions following major earthquakes worldwide.

After the initial emergency relief operation is under way, one of the most important tasks is to assess the performance of structures and foundations under the ground where shaking occurred. This is the objective of the Earthquake Engineering Field Investigation Team (EEFIT) – a group of engineers and architects from British universities and industry who mobilise following disasters like the devastating Haiti earthquake of 12 January 2010.

Co-founded by Robin Spence, Cambridge's Emeritus Professor of Architectural Engineering, the EEFIT team currently includes Dr Keiko Saito and Dr Gopal Madabhushi from the Departments of Architecture and Engineering, respectively, both of whom took part in the reconnaissance mission to Haiti.

Dr Saito's focus is to examine damage using high-resolution satellite images and aerial images to assist in the process of post-disaster needs assessment: 'In Haiti, we used high-resolution oblique aerial photographs called pictometry, which was available for the first time following an earthquake. Unlike vertical aerial images, it captures aerial views of the façade of buildings. This proved ideal for assessing damage and the results contributed to the estimation of the cost of reconstruction by the World Bank.'

Dr Madabhushi leads the Earthquake Geotechnical Engineering group at the Department of Engineering's Schofield Centre, home to a centrifuge 10 metres in diameter that simulates the effects of earthquakes. Much of his research looks at how building foundations perform under seismic stress, particularly when degradation of the soil effectively causes it to act as a liquid. 'If this happens, buildings can sink into the ground, as in the harbour region of Port-au-Prince, Haiti,' he says. 'One way of reducing the problem is to super-compact the soil around buildings and bridges. We've been investigating how this can be achieved economically in earthquake-vulnerable regions that have few resources.'

For more information, please contact Dr Keiko Saito ([ks269@cam.ac.uk](mailto:ks269@cam.ac.uk)) and Dr Gopal Madabhushi ([mosp1@cam.ac.uk](mailto:mosp1@cam.ac.uk)).

movements and the construction of dwellings, transportation and road accessibility, livelihoods and crop damage, healthcare and schooling, and facilities such as power, water and sanitation. The indicators were designed following discussion with affected communities, members of the international aid community, national recovery agencies and local NGOs.

Features related to each of the performance indicators are tracked in satellite images taken before, immediately after the disaster and at months and years thereafter, using manual mapping methods and semi-automated techniques such as object-based image analysis. Not only does this provide an independent snapshot of recovery but, significantly, it also maps its speed and quality, providing valuable feedback to stakeholders.

### Monitoring real disasters

The team focused on two very different disasters: Baan Nam Khem, a fishing village on the west coast of Thailand that was severely hit by the 2004 tsunami, and Muzaffarabad, Pakistan, which was struck by the Kashmir earthquake of 2005.

With a remarkable level of resolution, capable of zooming in to see objects 60 cm in width, the researchers were able to infer the speed of recovery of the fishing industry in Thailand by analysing, for instance, pier length and the presence of trawlers in the satellite images. Agriculture in Pakistan was monitored through crop cycle patterns. Road rehabilitation, debris removal, the building and dismantling of emergency camps, the appearance of temples, even the distance between new dwellings and the market, all helped piece together elements of the recovery jigsaw. And in each case study, what was inferred from the satellite image was verified against narratives from the ground: the opinions of affected citizens, those directly involved in the recovery and the government ministries.

### Any disaster, anywhere

The technique is being updated as new technology becomes available – the most recent being the use of high-resolution oblique aerial photographs called pictometry (see panel). Significantly, the Recovery Project has been developed for use in any disaster in any region and can produce an enormous array of different types of data on the recovery process. 'The next stage of the project,' Dr Chenvidykarn explains, 'will be to work even closer with aid agencies and government departments to comprehend which particular aspects of the data they would find most useful to integrate into their usual working practices.'

Ultimately, the hope is that this approach will help to ease the enormous burden that disasters place on communities worldwide by helping to speed up decision making and coordinate best practice in the lengthy process of recovery.



(Left to right) Dr Torwong Chenvidykarn, Daniel Brown, Professor Robin Spence and Dr Keiko Saito

For more information, please contact Daniel Brown ([dmb56@cam.ac.uk](mailto:dmb56@cam.ac.uk)), Dr Torwong Chenvidykarn ([tc233@cam.ac.uk](mailto:tc233@cam.ac.uk)) and Dr Keiko Saito ([ks269@cam.ac.uk](mailto:ks269@cam.ac.uk)).

# Out of poverty

Cambridge researchers are contributing to projects in Bangladesh that aim to lift 1 million people out of poverty by 2015.

**Chars dwellers building plinths as part of the cash-for-work scheme**

Bangladesh is a country beset by seasonal cycles of poverty and hunger. Almost 20 million people in the country are extremely poor and are vulnerable to natural disasters such as flooding. The UK Department for International Development (DFID) has invested a combined £120 million in two projects aimed at overcoming the poverty cycle by providing people who have almost no assets with the resources to build and secure a sustainable livelihood.

Professor Nick Mascie-Taylor and Dr Rie Goto, together with other members of the Human Epidemiology, Nutrition, Growth and Ecology (HENGE) group in the Department of Biological Anthropology, are supporting the projects by conducting in-depth nutritional and health surveys, as well as looking for ways of improving the nutritional status of the very poor.

## Small steps to stability

Under the £65 million DFID-funded 'shiree' Economic Empowerment of the Poorest programme, which runs until 2015, a consortium of NGOs is helping 750,000 of the poorest individuals across Bangladesh to generate assets and improve their income. The idea is that, by stimulating economic improvements, individuals can take iterative steps (shiree is the Bengali word for steps) out of poverty.

The HENGE team will be carrying out annual surveys throughout the project, providing a measure of how nutrition and health changes as a result of the development programmes. The baseline assessment survey has just been completed and the results provide a stark illustration of why the intervention is needed: as many as 80% of individuals are undernourished,

compared with 40% across the Bangladesh population. For children, this rises to 85%, and one in seven children is stunted, wasted and underweight.

## Cash-for-work

The DFID-funded Chars Livelihoods Programme is focused on an area in north-western Bangladesh where people living on large flat islands (*chars*) in river channels live with the frequent risk of losing their homes and crops to flooding. The project is providing 55,000 of the poorest households with a raised earthen plinth to lift their homes above the flood plain, plus income-generating assets – livestock or a vegetable garden – to help them not slip back into poverty.

A cash-for-work plinth building programme during the *Monga* (hungry) season gave local people approximately 2.6 million person-days of paid work. Although cash-for-work schemes are a familiar feature of development programmes, no research has looked at their impact on nutritional status. A concern levelled at such schemes has been that the increased physical work might cause weight loss. Results of the first such investigation have just been published by the HENGE team. Working with *chars* dwellers engaged in cash-for-work during a particularly severe *Monga*, they found no evidence to back up the concerns. By contrast, the scheme led to greater food expenditure and consumption, and a significant increase in the nutritional status of families.

## Health package

The team is also investigating how they can translate their research into tangible health benefits. They have been looking at the

perennial problem among the extreme poor of gut parasites like hookworm (picked up through the soles of bare feet), which damages the lining of the gut, contributing to nutrient loss and anaemia.

Professor Mascie-Taylor has trialled a combination of deworming and dietary supplementation with vitamins, supplied in powdered form so that they can be sprinkled onto food. In only three months, the results were dramatic; the children, in particular, showed a 54% reduction in wasting.

With innovation funding from the *shiree* project, work has already begun on putting together a combined health package comprising regular deworming, micronutrients in sachets and flip-flops to prevent hookworm infection. 'Our aim,' he explains, 'is to provide a cost-effective means of helping people back to the health needed to sustain graduation out of poverty.'

PROFESSOR NICK MASCIE-TAYLOR



## Professor Nick Mascie-Taylor

For more information, please contact Professor Nick Mascie-Taylor (nmt1@cam.ac.uk) at the Department of Biological Anthropology or visit <http://henge.bioanth.cam.ac.uk/>

# Nature dialogues: whose ecosystem?

Finding the right balance between global and local demands on the natural world could help reduce poverty.

Researcher speaking to a forest villager about participatory forest management in Madhya Pradesh, central India

DR BHASKAR VIRA



The forests, lakes, oceans and other ecosystems of the world are sometimes referred to as the planet's life-support systems because of the global services they provide. They preserve biodiversity, soak up atmospheric carbon and are fundamental to the water cycle. These same resources are also used by people who live in their proximity for food, fuel and employment. Often, these local needs are not compatible with global needs.

'How do we balance the interests and rights of individuals living in some of the world's most vulnerable communities with the global demands for ecosystem services?' asks Dr Bhaskar Vira, in the Department of Geography. 'If the balance is tipped unfavourably away from consumers in the developing world, so that they can no longer use their local resources in the same way, the effects on their livelihoods can lead to, and exacerbate, poverty.'

Dr Vira's research examines these conflicting demands upon nature, and whether synergies can be found that achieve developmental aspirations for reducing poverty and yet keep the human impact on the natural environment within ecologically safe limits. To do this, his research group is looking closely at ecosystems around the world where trade-offs between different objectives are in evidence – such as in the case of the Indian village of Botezari.

## Tiger territory

Tadoba-Andhari Tiger Reserve in India's Maharashtra State is home to around 45 of India's dwindling population of tigers, as well as many other rare species. In 2007, to protect this globally important site of biodiversity, the village of Botezari, then

consisting of 76 households and situated within the reserve, was moved to a new location approximately 40 km southeast.

Conservation-induced displacement is a classic example of the complexities that underlie the juggling of ecosystem services. PhD student Kim Beazley has spent the past four years examining the intricacies of Botezari's displacement strategy – how it was formulated, instigated and justified, and the key players, institutions and external structures that drove the displacement process over time. Her work is interrogating the intricate politics that surround such operations, and is providing important new information on the impact of ecosystem management on the welfare and poverty of a community.

## Negotiating trade-offs

'Of course, the reality of ecosystem management involves making difficult choices and trade-offs between different types of ecosystem services and between the competing claims of different groups in society,' says Dr Vira, who has just commenced a new research project to understand how stakeholders negotiate over such trade-offs.

The new study is aimed at helping policy makers to develop better strategies for pro-poor ecosystem management and has been funded jointly by the Department for International Development, the Natural Environment Research Council and the Economic and Social Research Council. The project also involves colleague Professor Bill Adams plus two India-based NGOs (Winrock International and Ashoka Trust for Research in Ecology and Environment), who have first-hand knowledge of the case studies under investigation: forest–

hydrological–urban landscapes in the Himalayas and the Western Ghats.

A second new study has also commenced thanks to funding from the Cambridge Conservation Initiative. Working with Birdlife International, the RSPB and the UNEP World Conservation Monitoring Centre, Dr Vira leads a study that aims to identify trade-offs and synergy over ecosystem service flows across a range of landscapes. 'Ultimately, it's important not just to determine the economic values of ecosystem service flows, but also to see how these are captured by specific groups in society, and what this means for poverty, equity and justice.'



## Dr Bhaskar Vira

For more information, please contact Dr Bhaskar Vira (bv101@cam.ac.uk) at the Department of Geography. For Cambridge Conservation Initiative, whose goal is to transform the global understanding and conservation of biodiversity, please visit [www.conservation.cam.ac.uk/](http://www.conservation.cam.ac.uk/)

Cambridge academics are helping to strengthen research expertise in Uganda, Tanzania, Kenya and Rwanda.

## Helping African science to THRiVE

For over 25 years, Professor David Dunne from the Department of Pathology has collaborated with African scientists working on parasitic diseases in their region – infections such as those caused by the schistosome worm, which can live for up to 40 years in the human body.

On his many trips to east Africa, he has seen at close quarters the importance of equipping its researchers with the practical and fundamental knowledge they need to be centrally involved in health research endeavours in Africa: 'Even in the best African universities, shortages of PhD-level staff and internationally competitive research groups denies young research scientists sufficient mentorship and advanced training, causing a serious block to African scientific progress,' he explains. 'Africa has 11% of the world's population and a disproportional amount of the world's diseases but accounts for just 0.3% of the world's research output.'

Now, an initiative has commenced to help African researchers participate more effectively in the march of science. The Africa-led programme 'Training Health Researchers into Vocational Excellence in East Africa' (THRiVE) is harnessing research expertise at Cambridge, under the directorship of Professor Dunne, and at the London School of Hygiene and Tropical Medicine (LSHTM) to generate a critical mass of future research leaders in seven universities and research institutes on the African continent.

### Expertise into Africa

Funded with £5.2 million from the Wellcome Trust through its £30 million African Institutions Initiative, and directed by Professor Nelson Sewankambo at Uganda's Makerere University, the Programme's aim is to create a self-sustaining research infrastructure in Africa.

A core component of the Programme is to match the scientific interests of African scientists to relevant experts at Cambridge and at the LSHTM. The UK researchers provide scientific mentorship and co-supervision plus access to individually tailored research training in the UK. THRiVE also provides the opportunity for UK researchers to travel to Africa, to interact with the students and their African supervisors in their home institutions.

Only months after commencing, more than 80 Cambridge academics (including researchers from the Wellcome Trust Sanger Institute) have already come forward to offer their research experience in areas ranging from clinical medicine, biological sciences and veterinary medicine, to social sciences, mathematics and engineering.

'It has been astonishing,' says Professor Dunne. 'I found myself pushing against an open door. I'm delighted about the breadth of expertise we are offering and the willingness of people to get involved.' It's now the job of Programme Coordinator Dr Pauline Essah to match successful applicants from the seven African



Institutions to the health-related expert at Cambridge who can best support their research area.

A pilot scheme that preceded THRiVE is already showing the benefits of the principle of combining mentorship and training to stimulate and support researchers at the highest level. Launched in 2008, the Makerere University–Uganda Virus Research Institute Training Programme for Infection and Immunity currently supports two postdoctoral fellows, four PhD students (including Dr Annetee Nakimuli, see panel) and 20 MSc projects in Uganda. The partnership brings together these two African institutions with the University of Cambridge and the LSHTM, and is funded by £1 million from the Wellcome Trust.

### Two-way street

It's not only the scientists in Africa who will benefit, as Professor Dunne explains: 'Developing networked collaborations with African scientists will be of huge benefit to us too. Working in Africa provides a fantastic opportunity to conduct research under conditions that are only found in disease-endemic countries and is sure to provide a new impetus for research.'

He adds: 'I fully anticipate that we will see African science leapfrogging us in areas where domestic challenges have forced economies and efficiencies that we can learn from.'





MARK MNISZKO

Vincent A. Owino is a Kenyan PhD student currently working in Professor Mark Field's laboratory in the Pathology Department and is supported by the Cambridge Commonwealth Trust; through the THRiVE Programme, many more African researchers like Vincent will have the opportunity to receive research training in Cambridge labs from next year

**'The aspiration is to create a new way to build research capacity where needed – a new way for the University to interact globally.'**

## Great expectations of pregnancy research

**One African scientist to benefit from the pilot scheme on which THRiVE has been built is Dr Annetee Nakimuli.**

Working as an obstetrician at Uganda's Mulago Hospital and a lecturer at Makerere University, Dr Nakimuli's primary research interest is pre-eclampsia, a life-threatening condition that can develop suddenly during pregnancy. In the UK, about two in 100 births are affected by pre-eclampsia. But in Africa, this ratio escalates to about one in 10, affecting many of the patients Dr Nakimuli sees at Mulago Hospital.

Now midway through her PhD Fellowship, Dr Nakimuli is supervised by scientists at the University of Makerere and the Uganda Virus Research Institute. Through the scheme, she is also co-mentored by Cambridge's Professor Ashley Moffett, whose pioneering research at the Centre for Trophoblast Research is uncovering how an immunological imbalance at the placental interface can underlie pre-eclampsia.

'Ashley's immunological understanding has helped me enormously, and on visits to Cambridge I've learnt the practical techniques I need to extract and genotype DNA from blood and cord samples from affected patients,' explains Dr Nakimuli, who has already recruited 150 mother-baby pairs to a case-control study to investigate the causes of pre-eclampsia. One area she is focusing on is how genes normally thought to be important in immune responses to infections also contribute to how successfully the placenta implants to establish the maternal blood supply to the baby.

For Professor Moffett, the experience has been just as positive: 'It's been an enlightening experience to be able to work here and in Africa with impressive medical scientists like Annetee who see at first-hand the severity of the pre-eclampsia problem in Africa. The resource Annetee is building will provide the first collection of genetic information on African cases of pre-eclampsia. The links we now have together will go forward into the future, as Annetee builds her own research programme.'

**For more information, please contact Professor Ashley Moffett ([am485@cam.ac.uk](mailto:am485@cam.ac.uk)).**

By gathering together experts as part of the THRiVE Programme, a horizontal network of research scientists has developed, all linked by their common interests in Africa. A number already have their own collaborative activities with Africa, such as Professor James Wood in the Department of Veterinary Medicine.

Professor Wood's work with the University of Ghana on the dynamics of viral infections in bats has recently been awarded a Medical Research Council Emerging Infection Catalyst Award to develop his links with Africa and UK-based partner institutions. Using the THRiVE model, Professor Wood (with support from THRiVE in Cambridge) is also making arrangements for PhD students from the University of Ghana to visit Cambridge for training purposes, using funds provided by the Carnegie Foundation.

## A global university

THRiVE will support five postdoctoral fellows and 14 PhD students from seven African institutions, some in post-conflict areas of Africa. Crucially, however, the Programme has been modelled with a view to scalability. 'In some ways, we've over-engineered the Cambridge organisation because we wanted to create a structure that can easily be built on,' explains Professor Dunne. 'The goal is to be capable of expanding the model into teaching, extending it elsewhere in

Africa, and covering fields outside of health research. Essentially, the aspiration is to create a new way to build research capacity where needed – a new way for the University to interact globally.'



**Professor David Dunne and Dr Pauline Essah**

For more information, please contact Dr Pauline Essah ([pae21@cam.ac.uk](mailto:pae21@cam.ac.uk)), THRiVE (Cambridge) Programme Coordinator, at the Department of Pathology or visit [www.thrive.cam.ac.uk/](http://www.thrive.cam.ac.uk/)

## Flying high: levitation and energy storage



PROFESSOR DAVID CARDWELL

A bulk single-grain sample of superconducting material levitated by a permanent magnet (see page 35 for details of a video demonstration)

### Research by the Department of Engineering and Boeing is taking advantage of the remarkable properties of superconductors.

For almost a century, it's been known that at temperatures as low as  $-269^{\circ}\text{C}$  'superconductors' can carry a DC electric current without losing energy. In some cases, they can carry 100 times more current density (current per unit cross-sectional area) than the copper used in power lines, offering great promise for more-sustainable, energy-related applications.

But it's not just their conducting properties that make superconductors so attractive: associated with their ability to carry a large electric current is an ability to generate a magnetic field that is sufficiently large to support practical magnetic levitation, an attribute that could be utilised to develop frictionless bearings in devices such as mechanical flywheels.

Professor David Cardwell, who leads the study, explains: 'Flywheels have long been used to store rotational energy at times when the energy is not needed, in order to release it later – the obvious example being the powering of underground stations. Inevitably, some of this energy is lost through friction at the point of contact between the stationary and the rotating parts of the flywheel. By using bearings made from superconductors, it's possible for the flywheel to be suspended in space by a magnet, overcoming this energy loss.'

However, a major challenge in realising the potential of bulk superconductors has been the difficulty and cost of mass producing them. Now, Professor Cardwell's team have found a means to manufacture materials that are cheaper, better and more reliable.

Using high-temperature superconductors such as yttrium barium copper oxide, which requires cooling only

to  $-181^{\circ}\text{C}$  by relatively inexpensive liquid nitrogen, the Cambridge Bulk Processing Group has developed a means of growing single grains to the size of a hockey puck by partially melting them at around  $1,000^{\circ}\text{C}$  in air, without the need for a controlled processing atmosphere. Crucially, the properties of the resulting material have the required microscopic properties that are essential to maximise the flow of current.

Boeing Flywheel Program Manager Dr Mike Strasik explains the importance of these developments: 'Being able to make bulk superconductor materials in a practical and economical way that can be scaled up from the laboratory to industry, while maintaining the required superconducting properties, creates a significant market opportunity for a range of emerging engineering applications, such as flywheels.' The aim now is to improve the properties and production yet further and to work closely with Boeing on application-specific devices.



**Professor David Cardwell**

For more information, please contact  
Professor David Cardwell  
([dc135@cam.ac.uk](mailto:dc135@cam.ac.uk)).



With the future of aerospace being driven by developments in technology, Boeing is continually looking globally for new ideas and innovations. To help achieve this, the US-based company has established strategic relationships with universities around the world.

In the UK, Boeing is collaborating through multi-year agreements to conduct research and technology programmes with the University of Sheffield, Cranfield University and the University of Cambridge. Not only are these programmes helping to expand Boeing's technical reach and business concepts, but they also have long-lasting benefits in helping to stimulate British aerospace innovation.

Boeing's framework agreement with Cambridge to conduct collaborative research began in 2003 and has recently been extended to 2014. Currently, nine projects are running, involving research teams in the Department of Engineering, the Computer Laboratory and the Department of Social and Developmental Psychology.

The principal focus has been to conduct research and development in areas such as automated reasoning, intelligent systems, natural language and information processing, information manipulation and



Boeing is the world's largest aerospace company and leading manufacturer of commercial aeroplanes and defence, space and security systems. The company strives to work with the best technical talent in developing new aerospace-related technologies and has established multi-year collaborative research relationships with several UK universities, including Cambridge.

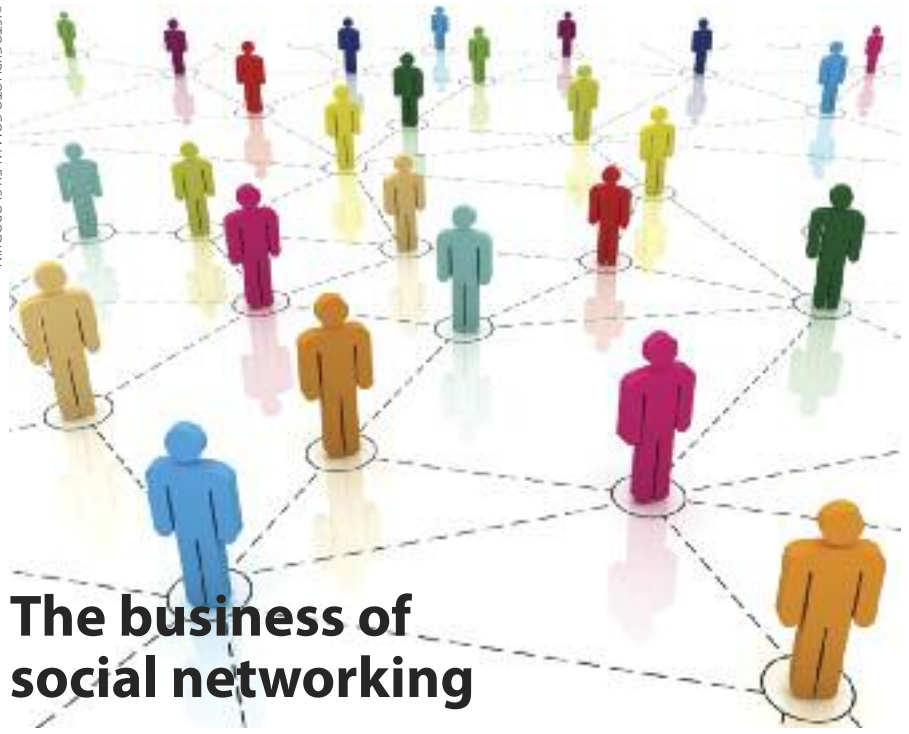
information security, new materials for high-end engineering, and the interface between humans and computers.

Professor Cardwell, from the Department of Engineering and the lead principal investigator in the collaboration, explains why the relationship with Boeing has proved such an extraordinarily healthy example of industrial collaboration with academia: 'Boeing facilitate – they make it easy for us to do the academic research that we think is relevant, while keeping in mind the best interests of the company. It's a very productive, very supportive way of doing research. Their open-minded attitude makes it possible for new objectives to be set as new discoveries are made.'

Applications of the research are as varied as developing new materials for energy-storage systems (see left), assessing the potential of social networking technologies to improve knowledge management and communication in businesses (see right), and improving the operation and security of airports.

For more information about Boeing, please visit [www.boeing.com/](http://www.boeing.com/)

©ISTOCKPHOTO.COM/ALEX SLOBODKIN



## The business of social networking

A new study is examining the value of social networking technologies to business collaboration.

Social networking (SN) sites such as Facebook, LinkedIn and Twitter have taken communication in the 21st century by storm. As businesses increasingly embrace the technology to connect individuals and share information, a new study funded by Boeing is developing methods to measure its value to organisations.

'SN technologies are seen by companies as a major opportunity for improving collaboration, managing knowledge, connecting with clients, and generally helping individuals to feel part of a business,' says project leader Dr David Good in the Department of Social and Developmental Psychology. 'But, there is little understanding of how SN technologies evolve, what impact they have in practice and therefore how one can best deploy them for business efficiency.'

In the past, SN structures were studied without much regard to the individuals that form them. However, Dr Good, PhD student Michal Kosinski, together with Dr Alan Blackwell from the Computer Laboratory and collaborators at Boeing believe that successful collaboration depends on the interaction of the SN structure and the individual characteristics of its members.

To investigate this problem requires the amassing of vast amounts of information on collaboration efficiency, SN structures and individual traits of network members, and then analysing the data using an interdisciplinary approach.

To understand individual traits, Michal Kosinski, working with David Stillwell from the University of Nottingham, has developed a Facebook application that allows its users to complete a psychometric test and receive feedback. More than four

million people have now taken the my Personality test, providing a huge dataset that links SN data with such traits as personality, life satisfaction, interests, education and demographic profile.

Results of the Facebook study will assist the team in evaluating the use of an in-house SN tool available to Boeing's 160,000 employees and its relation to collaboration efficiency and tactical decision making.

SN services are predicted<sup>1</sup> to replace email as the primary vehicle for interpersonal communication for 20% of business users by 2014. With such escalating use in mind, Boeing collaborator Dr Anthony Majoros comments on the widespread benefits of this new research: 'For businesses to develop an effective culture around SN that places the technology at the centre of collaborative and communication activities, it's important to develop the qualitative and quantitative measures that this project aims to do.'

<sup>1</sup> [www.gartner.com/](http://www.gartner.com/)



**Dr David Good**

For more information, please contact Dr David Good ([dg25@cam.ac.uk](mailto:dg25@cam.ac.uk)) or Dr Alan Blackwell ([afb21@cam.ac.uk](mailto:afb21@cam.ac.uk)).

JONATHAN LITTLE PHOTOGRAPHY

Art historian Professor Paul Binski describes his ventures into the gold-embellished world of illuminated manuscripts.

## Magical illuminations

Cambridge is a wonder-world for the study of medieval illuminated manuscripts. The Fitzwilliam Museum, the University Library and the Colleges possess treasures of international quality rivalling those in the British Library, or even the Vatican. In 2005, their sheer splendour hit the headlines when many of the best manuscripts were displayed at The Fitzwilliam Museum in *The Cambridge Illuminations* exhibition, one of the Museum's most successful ever held. The power of these often tiny, sometimes grand, but always intriguing objects to attract and fascinate the public remains undiminished. A manuscript is a magical little world into which we peer.

But behind every exhibition lies a great deal of expert academic work to unearth the truth of these often complex and sometimes downright obscure books. It is at this moment that experts in manuscript illumination, including art historians like myself, come in to help.

### In Monty's footsteps

Until quite recently, no-one was quite sure exactly how many illuminated manuscripts were owned by the University and kept in the University Library – nor was there any up-to-date catalogue of them. The only attempt to track all of the manuscripts down and catalogue them had been carried out by the brilliant Victorian scholar and writer of atmospheric ghost stories Dr M. R. James ('Monty'), Provost of King's College and one of my heroes.

Monty had his own distinct way of working. Librarians would send him manuscripts, which he catalogued while sitting up in bed at King's. Working with daunting speed, he made his way through most of the Cambridge collections and pencilled a nearly complete catalogue of the University Library manuscripts in the 1930s. However, it was never published and, since his time, the collection has continued to grow.

As a Cambridge research student working on medieval art in the 1980s, I had occasionally made forays into the collection following in Monty's footsteps, but it wasn't until 1995 when I joined the History of Art Department in Cambridge that I hatched a plan which Monty himself might have saluted, or so I hoped – to re-catalogue all the Cambridge collections to modern standards, and illustrate them comprehensively.



The Hours of Marie de St Pol: Marie praying to St Cecilia; Ms Dd 5.5



A 13th-century astrolabe from a French manuscript on astronomy; Ms li 3.3

REPRODUCED BY PERMISSION OF THE SYNDICS OF CAMBRIDGE UNIVERSITY LIBRARY

Monasteries in the 16th century, and had come from such great and wealthy monastery libraries as Canterbury, Bury and Norwich. These manuscripts, crafted by skilled illuminators over many months, were for devotional purposes.

Collectors engaged in salvaging the monastic libraries, such as Matthew Parker, Archbishop of Canterbury, began a tradition of benefaction which slowly built up the University collection in the post-medieval period: Richard Holdsworth, John Moore, Bishop of Norwich and Ely, and George I were among the great collectors or donors in the 17th and 18th centuries.

In fact, what the Library collection shows is how tastes and collecting opportunities changed. Salvaging monastic libraries meant gaining large and elegantly decorated Romanesque books; whereas, by the 19th century, collecting tastes were favouring the smaller, prettier, Books of Hours (containing prayers for different times of the day) which started to enter the Library.

planned to go with a manual on confession, science and religion.

A catalogue consists of thousands of sometimes tiny insights from which a bigger picture builds up. Such work can't be rushed – catalogues are never perfect, but they have to be as 'right' as possible in order to last. So each manuscript was combed over repeatedly until it yielded up its secrets, often after years of work. Every book was carefully measured, its text and decoration described, and its subsequent history worked out from minute clues about ownership and provenance.

The physical pleasure of handling books of this age is not to be underestimated. Manuscripts are indeed little worlds, and to enter them we need many different skills, huge reserves of patience and sharp eyesight. But our collaboration on this project has above all been immense fun, indeed a once-in-a-lifetime opportunity. We will miss it.

## A team effort

My plan of attack was to get the one man vital to this enterprise 'on side', my old friend Dr Patrick Zutshi, by then Keeper of Manuscripts in the University Library. Together we decided that the best starting point for such a project would be the University Library itself. With the aid of a grant from the Gladys Kriebel Delmas Foundation, we set to work with the assistance of Dr Stella Panayotova, who subsequently went on to extend the project to the Colleges and The Fitzwilliam as we had hoped.

Now – and after many summers during which I simply disappeared into the University Library, escaped College and University politics, and peacefully catalogued its collection – we have between us produced a comprehensive catalogue of the 472 manuscripts which we thought could usefully be described as illuminated or decorated.

## Collecting history

The University Library's collection turns out to be quite extraordinarily rich and extensive: it spans 700 years of illumination – from the oldest, the 9th-century *Book of Cerne*, to the youngest, the Italian Renaissance books of the 16th century. About 60% of the manuscripts are British, and many of the most important European 'schools' of illumination are represented.

We needed to explore more deeply how the collection itself had formed. When it was first created, the University Library was a working collection of textbooks which were seldom illuminated – they were basically practical working texts. The University collection certainly existed by 1400, and has an early catalogue dating to 1424, but most of the decorated books came into the collection much later.

The earliest great illuminated manuscripts found their way into the Library after the Dissolution of the

## The treasure trove unfolds

We found no shortage of world-class highlights. There is the beautiful early 13th-century Bestiary, a compendium of fabulous and real beasts; the only surviving copy of the Life of St Edward the Confessor by the great chronicler Matthew Paris; the tiny Breviary that belonged to Marie de St Pol illuminated on parchment so white and thin as to be like the finest kid glove; or the stunning 15th-century *Douze Dames de Rhétorique*, with tiny paintings of the canals of Flanders; the first complete illustrated Chaucer; as well as beautifully illustrated scientific manuscripts.

## Manuscripts are indeed little worlds, and to enter them we need many different skills, huge reserves of patience and sharp eyesight.

But the whole point of a catalogue is to cover the smaller, less glamorous, but just as important, items. For instance, we had no idea of the extent and beauty of the Romanesque manuscripts from Cistercian monasteries in northern England. Some manuscripts were virtually unknown, such as a little Breviary made in the area of Westminster towards 1400.

Even fragments were full of potential, like the Parisian polyphonic musical notation (combining, for the first time, distinct lines of music) on some leaves in a manuscript from Bury St Edmunds. This may be amongst the earliest examples of polyphony of that type known, to judge from the style of their illumination. By reconstructing the original contents of one of the compilations – a book drawn up in the early 14th century which contains an early diagram of the human brain and its ventricles following the theories of the Arab Avicenna – we now know that it was



*Western Illuminated Manuscripts; A Catalogue of the Collection in Cambridge University Library* by Professor Paul Binski and Dr Patrick Zutshi will be published by Cambridge University Press in spring 2011



## Dr Patrick Zutshi (left) and Professor Paul Binski

For more information, please contact Professor Paul Binski (pb214@cam.ac.uk) at the Department of the History of Art and Dr Patrick Zutshi (pnrz2@cam.ac.uk) at the University Library.

# Reading the world's oldest libraries

Examples of the world's oldest science and literature – 2,500-year-old clay writing tablets – hold clues as to how ancient scholars acquired and used knowledge, as Dr Eleanor Robson explains.



Many have heard of the Library of Alexandria, founded in the 4th century BC on the northern coast of Egypt by the Ptolemaic successors of Alexander the Great, but very little of it remains: no books, no buildings, nothing but a confusing mass of anecdotes and legends of its past glories. Likewise, the ancient Greek Library of Pergamon, which reputedly flourished in the 3rd century BC and is today a series of ruins, and the holdings of the famous Villa of the Papyri in Herculaneum, carbonised following the eruption of Vesuvius in 79 AD.

Yet, in nearby Assyria and Babylonia – roughly the north and south of modern-day Iraq – we encounter the opposite problem: such an overwhelming quantity and complexity of primary data about ancient libraries that, until recently, it has been virtually impossible to make sense of the tale they are telling. Uncovering this story has been the goal of 'The Geography of Knowledge in Assyria and Babylonia' research project I have been running since 2007, with funding from the Arts and Humanities Research Council.

## From jottings to compendia

In ancient Iraq and its neighbours, most writing 2,500 years ago was in cuneiform (or wedge-shaped) script on durable clay tablets, which have withstood the ravages of the millennia much more robustly than perishable media such as parchment, papyrus and wooden writing boards.

The tablets were first used to document the economic activities of organisations of the Sumerian civilisation in southern Iraq in the late 4th millennium BC, a few centuries before the development of hieroglyphs in

Egypt. Memorisation was a key part of scribal training, and much of these earliest scholarly writings survive only as ephemera – the jottings of students and apprentices using a reed stylus as they repeated and recalled passages by rote.

By the 1st millennium BC though, as the body of knowledge and speculation about the world accrued and was organised into systematic compendia, knowledge was increasingly transmitted in fixed, written formats as well as in the memories of the learned.

**Most temples and palaces, and many private households, made collections of tablets and writing boards containing what we would now call science and literature, magic and religion.**

Over 40 such assemblages or 'libraries' of scholarly tablets have been excavated from across Assyria and Babylonia. Most famous – and by far the largest – is the 20,000-tablet Assyrian royal library from 7th-century BC Nineveh in northern Iraq, found by happenstance in the early days of exploration in the 1840s and now housed in the British Museum.

But most of the libraries comprise a few dozen or a few hundred tablets, typically stored (or abandoned) in a single room or courtyard of a house or temple, filed in built-in pigeonholes, large terracotta jars, or long-perished baskets or shelves. The latest date from the last few centuries BC – some time after the founding of the Library of Alexandria – at the tail end of cuneiform culture.



Clay tablet with a learned commentary on divination from the entrails of sacrificed rams, from the Kalhu Library; British Museum ND 5497/17



The ancient Assyrian city of Kalhu (Nimrud), on the banks of the Tigris in northern Iraq, as imagined by its first excavator in the 1850s; behind the Royal Palace (centre) was the Temple to Nabû, god of wisdom, which housed a substantial scholarly library (A.H. Layard, *A Second Series of the Monuments of Nineveh*, London 1853, pl. 1, after a sketch by J. Fergusson).

monthly and yearly rituals for the care and feeding of the Babylonian gods. But they also calculated with mind-boggling accuracy the future timings of major celestial events such as lunar eclipses, the better to serve the gods through the accurate timing of ritual performance – and presumably the better to maintain the dwindling community of worshippers. Their family documents show them marrying, inheriting and trading with just six other like-minded families. Thus we see Babylonian mathematical astronomy in its original context: not as a fledgling ‘exact science’ but as a defensive (and ultimately doomed) response to rival traditions of knowledge and belief.

### A new library is born

We are now three years into the five-year project. The tool that has made this research possible is Oracc (<http://oracc.org/>), an open-source toolkit and workspace for the edition and linguistic annotation of all sorts of cuneiform texts. It was created by project co-director Professor Steve Tinney of the University of Pennsylvania, and is managed as a cooperative by the two of us and Professor Niek Veldhuis of University of California, Berkeley.

Oracc has enabled the Cambridge team to create the *Corpus of Ancient Mesopotamian Scholarship* (<http://oracc.org/cams/>), presenting our sources in alphabetic transliteration and English translation, with full glossaries and sophisticated search and analysis facilities. Oracc now hosts about a dozen other projects too, bringing together a scattered worldwide community of researchers to develop a rich resource on three millennia of cuneiform culture that can be used in a multitude of ways by specialists, students and newcomers alike.



### Dr Eleanor Robson

For more information, please contact Dr Eleanor Robson ([er264@cam.ac.uk](mailto:er264@cam.ac.uk)) at the Department of History and Philosophy of Science or visit <http://oracc.org/gkab/>

### Libraries of knowledge

The project, based in the Department of History and Philosophy of Science and staffed by Dr Marie-Françoise Besnier, Dr Graham Cunningham and Dr Greta Van Buylaere, is currently creating online editions of the tablets from four of the 40 libraries, spanning the period 700–200 BC, to better understand the knowledge cultures of ancient Assyria and Babylonia on their own terms.

Where previous endeavours have focused on editing works such as *The Epic of Gilgamesh* or the great celestial omen compendium *Enūma Anu Ellil*, based on writings from a whole range of different periods and contexts, our aim is to restore context and coherence to cuneiform scholarship by studying it holistically, library by library.

We are as interested in the materiality of the tablets, and the buildings they were found in, as in the texts themselves. And the text often comprises not just the composition itself but also a so-called colophon, which typically recorded who wrote the tablet, why and when, and for whom. Colophons enable us to construct networks of ownership, apprenticeship and patronage of knowledge in cuneiform culture, revealing some of the mechanisms by which it was created, communicated, transformed, used and eventually abandoned.

Why, for instance, was a collection of about 400 scholarly writings abandoned outside a well-to-do house in Huzirina, a small town in provincial Assyria, hundreds of miles from the political and intellectual centre of the empire? Their colophons tell us that the collection was built up gradually over the 7th century BC, copied or composed by four generations of priests of the god Zababa but

also by about 30 other men, typically sons of local officials. However, they often produced low-quality texts. These and other clues lead us to hypothesise that the Huzirina collection was the output of a small provincial school for the middle-ability sons of middle-ranking imperial bureaucrats. Carefully buried for safeguarding in 610 BC, as the Medes and Persians overran the nearby Assyrian city of Harran in their final phase of conquest, the library was never returned for.

### Anu-belšunu’s horoscope

Remarkably, the piecing together of individual stories discovered in the tablets is providing insight into how indigenous knowledge adapted to the end of local rule, and with it royal patronage, and how it managed to survive for nearly half a millennium after the Persian conquest of Babylonia in 539 BC.

One such story concerns a man named Anu-belšunu who, some time in the late 3rd century BC in the Babylonian city of Uruk, commissioned a horoscope giving his date of birth as 28 December 248 BC. The horoscope was itself a new form of predicting the future, formerly a royal preserve through celestial divination, but since the 5th century increasingly available to a private clientele.

As it turns out, Anu-belšunu was no random punter. He too was a scholar and priest, who lived and worked in an increasingly small community of traditionalists in and around the main temple of Uruk, as the rest of the city became increasingly Grecophone and Hellenophile.

The remains of a library and archive found in the temple, and elsewhere in Uruk, show that Anu-belšunu, his sons and grandsons, performed and documented the daily,

# Neural transplantation in Parkinson's disease: moving forward




---

**Scientists and clinicians across Europe have joined forces to improve the efficacy and safety of neural transplantation in Parkinson's disease.**

---

**A** new multicentre, international research programme – TRANSEURO – aims to refine cell transplantation techniques for replacing the lost cells that lie at the heart of Parkinson's disease (PD). This progressive and ultimately fatal neurodegenerative disorder affects approximately 1% of people over 65 years of age.

Repairing the neural circuits has long been an aim of clinical neuroscientists like Dr Roger Barker, who leads the new programme and is based at Cambridge's Centre for Brain Repair. But neural transplantation in PD has had something of a roller coaster history, as he explains: 'Close to 100 patients have received cell transplants as part of well-conducted clinical trials worldwide in the past two decades. In some, the transplanted cells survive, grow and significant clinical improvements can be seen for as many as 15 years post-transplant. Yet, in others, the therapy not only fails, but the patient develops side effects.'

This variability has hampered progress in the field. TRANSEURO's goal is to coordinate research efforts to develop a best practice for any type of cell transplantation in PD and to move forward to a new phase of cell therapy trials.

## **A complex disease**

A key feature of PD is the progressive loss of cells that produce a chemical called dopamine. Located deep in the substantia nigra of the brain, the dopaminergic cells send their connections to the striatum in the forebrain. Here, the dopamine they release mediates a vast range of activities, including voluntary movement, cognition, motivation and reward – behaviours that are disturbed

when the cells, for reasons not yet understood, begin to die in PD. The first symptoms of tremors, stiffness and slowness of movement appear when half of the total number (about a million) of cells has already died.

In the 1960s, it was discovered that L-DOPA, a precursor to dopamine, reduces the intensity of Parkinsonian symptoms. Fifty years on, it is still the most effective drug to alleviate symptoms, although it has the inevitable side effect over time of generating involuntary movements (L-DOPA-induced dyskinesia). In the 1990s, the development of deep brain stimulation with high-frequency electrical impulses delivered to the damaged circuits was used successfully to manage this aspect of PD.

---

**'We regard TRANSEURO as a stepping stone that will refine the clinical methods needed for any kind of cell-based therapy, whatever the source of cells.'**

---

In fact it's now known that the loss of dopamine cells is part of a much wider pathological process throughout the brain. This additional complexity has meant that it has become increasingly important to characterise subtypes of PD in terms of symptoms, signs and underlying pathology – an area that scientists at the Centre for Brain Repair have made a major contribution to in the past decade.

Such complexity raises an important point about treating PD, as Barker explains: 'The starting point for therapeutic strategies has been to replace or restore the loss of the



dopamine-producing cells. This clearly won't cure the disease, not just because the additional pathology is so diffuse and widespread, but also because whatever causes PD has not been removed simply by placing in a graft. Nevertheless, reparative strategies used early in the disease course have the potential to give patients many drug-free years, which would be a major therapeutic step forward.'

### Rebuilding the dopamine circuit

Brain repair for PD has taken several forms in recent years, including approaches that transfer genes coding for dopamine-producing enzymes into the patient's own brain cells, and approaches that deliver growth factors into the brain to enhance the effects of the remaining dopamine-producing cells.

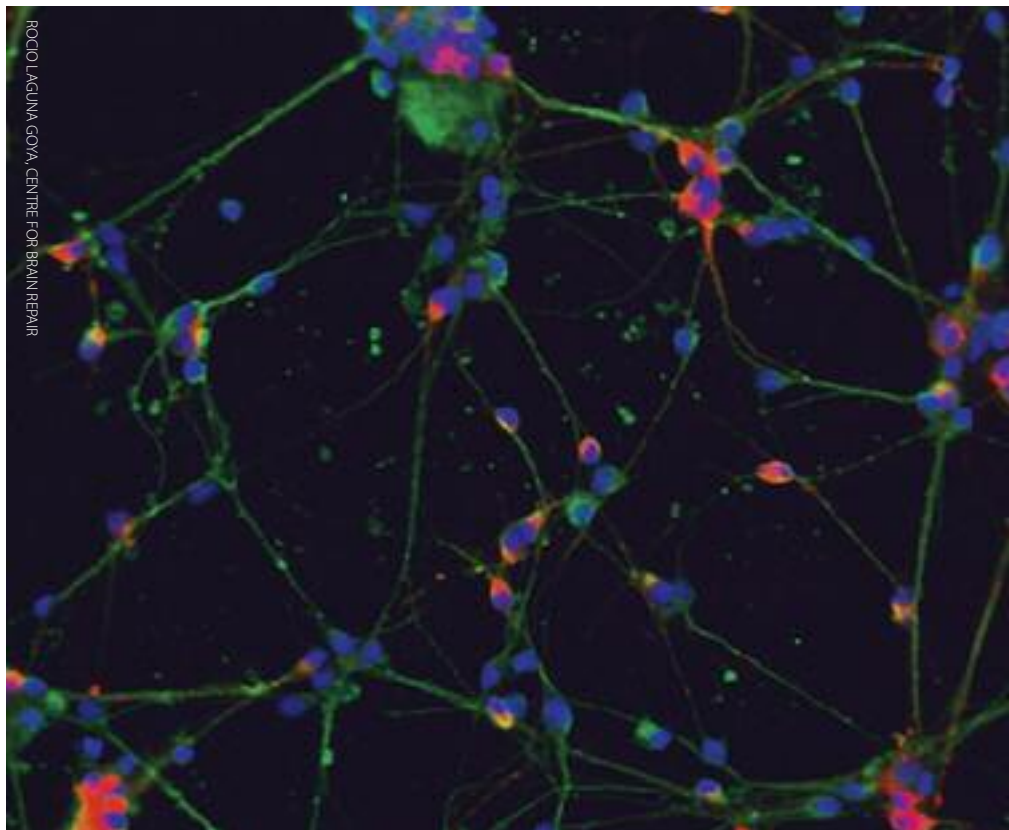
However, ever since pioneering experiments by Professor Anders Björklund in Lund University Hospital, Sweden, in the 1970s and 1980s, the most effective and well-advanced treatment has been the transplantation of new, undamaged cells to replenish those that are lost or dying. In this procedure, cells from the developing midbrain from aborted fetuses are transplanted into the striatum of the patient, to a site where dopamine normally functions. The original Swedish trials showed that these fetal dopaminergic cells survived and grew, and patients improved.

But, when two larger, placebo-controlled, clinical trials in the USA in the 1990s showed no major benefits, combined with some side effects, further trials were halted.

Most alarming of the side effects was the development in some patients of graft-induced dyskinesia (GID). Unlike L-DOPA-induced dyskinesia, where the abnormal movements can be reduced by stopping the drug, this is not possible in GID. In some cases, further surgery (albeit that used normally in PD deep brain stimulation) was needed to 'undo' the side effect the graft had induced.

As a consequence, the field was faced with a paradox: fetal cell therapy appeared to have no future in PD because the US trials had failed, yet some patients had done phenomenally well. In the meantime, the stem cell field was advancing and it was clear that dopamine neurons derived from stem cells might one day be an alternative approach to repair the brain in PD.

Barker and colleagues believed that hidden in the data from the clinical trials would be clear evidence for the factors that determine the success rate. 'With the benefit of hindsight, early trials might now be regarded as only ever being powered to fail,' he says. 'There has been huge variability in patients' stage of disease and medication history; the clinical techniques used for cell delivery; the viability and durability of the cells being transplanted; and even in how outcomes were measured. It's easy to see how differences in average improvement could be obscured within the data.'



In cell transplantation procedures for PD, undamaged dopaminergic neurons (shown here in red, with other neurons in green) are used to replenish those that are lost or dying

### TRANSEURO

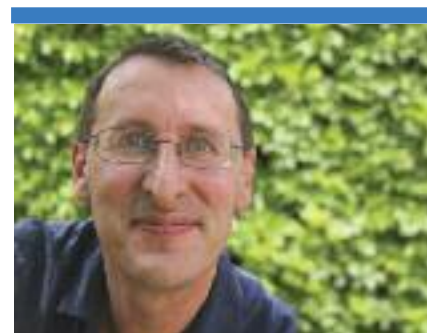
In 2006, Barker and Björklund set up an international working group to look at these issues. Over the course of the next three years, they contacted and worked with groups worldwide who had used cell therapy in PD. Out of these discussions has come TRANSEURO, a five-year, €12 million programme funded by the European Union. It brings together 14 institutions spread across five European countries, as well as close collaboration with research groups in the USA.

As well as a reassessment of the early trials data, the programme will investigate GIDs, optimal patient subgroups for grafting, the complex logistics of tissue procurement, and other critical factors. The goal is to arrive at a 'best guess' for the protocol most likely to provide safe, more consistent and clinically effective benefits for patients. It's anticipated that the programme will recruit at least 80 patients across the TRANSEURO network, of which the first 20 will be entered into an open-label Phase I transplantation trial in 2011/12.

Alongside the scientific and clinical arms of the programme, a project will consider the types of ethical issues that work of this nature throws up; this will touch upon the use of fetal tissue and the choice of patients (who are likely to be at an early stage of their disease), and issues such as what society will accept as ethical in emerging cell-based therapies.

### From fetal to stem

'We regard TRANSEURO as a stepping stone that will refine the clinical methods needed for any kind of cell-based therapy, whatever the source of cells,' says Barker. The expectation is that the study will pave the way for larger trials using dopaminergic neurons derived from stem cells, a purer and more plentiful source, and already a research strength in Cambridge. 'Our goal is to provide the impetus to push the field ahead to a new phase of cell therapy trials in PD.'



#### Dr Roger Barker

For more information, please contact Dr Roger Barker ([rab46@cam.ac.uk](mailto:rab46@cam.ac.uk)) or Danielle Jackson ([dmj34@cam.ac.uk](mailto:dmj34@cam.ac.uk)) at the Centre for Brain Repair in the Department of Clinical Neurosciences or visit [www.transeuro.org.uk/](http://www.transeuro.org.uk/) TRANSEURO is not currently recruiting patients for the trial as ethical approval is not yet in place.

# Against all odds: archaic Greek in a modern world

©DR IOANNA SITARIDOU 2009

Mountain village inland from the Black Sea coast of Turkey, home to one of the isolated enclaves of speakers of an endangered Greek dialect

**An endangered Greek dialect spoken in Turkey has been identified by Dr Ioanna Sitaridou as a 'linguistic goldmine' because of its closeness to a language spoken 2,000 years ago.**

Until Medieval times, the area of Trabzon, in Pontus on the Black Sea coast of Turkey, lay at the heart of the Greek-speaking world. The land of the legendary Amazon kingdom was colonised by the Greeks in the 8th and 7th centuries BC and was immortalised in Greek mythology as the area from which Jason and his crew of 50 Argonauts began their journey across the Black Sea on his quest for the Golden Fleece.

Remarkably, despite millennia of change in the cultural and sociopolitical history of the surrounding area, in this mountainous and isolated north-east corner of Asia Minor its people still speak Greek. The uniqueness of the dialect – known as Romeyka – is providing a fascinating window on language past and present, as Dr Ioanna Sitaridou, University Lecturer in Romance Philology at the Faculty of Modern and Medieval Languages and Fellow and Director of Studies in Linguistics at Queens' College, is discovering.

## On the verge of extinction

Romeyka is proving a linguistic goldmine for research because of the startling number of archaic features it shares with the Koiné (common) Greek of Hellenistic and Roman times, spoken at the height of Greek influence across Asia Minor from the 4th century BC to the 4th century AD.

'Although Romeyka can hardly be described as anything but a Modern Greek dialect,' explains Dr Sitaridou, 'it preserves an impressive number of grammatical traits that add an Ancient Greek flavour to the dialect's structure – traits that have been completely lost from other Modern Greek varieties.'

As devout Muslims, Romeyka speakers in the Trabzon area were exempt from the large-scale population exchange between Greece and Turkey following the Treaty of Lausanne in 1923. Using religion as the defining criterion to resettle Christians in Greece and Muslims in Turkey, the Treaty resulted in the exchange of some two million people between the two countries. For Pontus, the result was an exodus of Greek-speaking Christians, leaving small enclaves of Greek-speaking Muslims in Turkey.

Repeated waves of emigration from Trabzon, coupled with the influence of the dominant Turkish-speaking majority, have left the dialect vulnerable to extinction (UNESCO have designated Pontic Greek as 'definitely endangered'). 'With as few as 5,000 speakers left in the area, before long Romeyka could be more of a heritage language than a living vernacular,' says Dr Sitaridou. 'With its demise would go an unparalleled opportunity to unlock how the Greek language has evolved.'



Ioanna and a speaker of Romeyka

©DR IOANNA SITARIDOU 2009

## Language cartography

Dr Sitaridou's research project is uncovering the secrets of this little-studied dialect. Her expertise is both in syntax, which is the study of a language's grammatical rules and sentence structure, and in how and why language changes. 'With Romeyka, I have the most wonderful opportunity to study these two things in tandem. Not only does the dialect demonstrate elements that are proving problematic for the current linguistic theory but it also presents us with a living example of an evolving language.'

In collaboration with Professor Peter Mackridge (University of Oxford), who has carried out pioneering research on Pontic dialects since the 1980s, Dr Sitaridou is also working with Dr Hakan Özkan (University of Münster), Professor Stavroula Tsiplakou (Open University of Cyprus), the European Dialect Syntax network (Meertens Institute) and three postgraduate students: Stergios Chatzikiyiakidis, Petros Karatsareas and Dimitrios Michelioudakis.

---

**'With as few as 5,000 speakers left in the area, before long Romeyka could be more of a heritage language than a living vernacular.'**

---

At the core of her work are field trips to villages in Pontus to map the cartography of the language – how it works, how much micro-variation there exists (known as synchrony) and how the morpho-syntactic structure has changed through time (diachrony). Information is gathered through video and audio recordings of the villagers telling stories, as well as through specially structured questionnaires that Dr Sitaridou has designed to collect the complex data needed for unpicking the structure of a language.

## Window on the past

Studying language change is, in general, notoriously difficult because of the lack of living speakers who can positively tell us what they think is ungrammatical or not (in contrast to texts, from which we can recover only what is grammatical). Investigating the history of Greek is no different despite the plethora of old texts.

'Imagine if we could speak to individuals whose grammar is closer to the language of the past; not only could we map out a new grammar of a contemporary dialect but we could also understand some forms of the language of the past. This is the opportunity that Romeyka presents us with,' says Dr Sitaridou, who is also a member of the Cambridge Group for Endangered Languages and Cultures (CELC).

## Last of the infinitives

The first results of the study are already providing remarkable insights, as Dr Sitaridou announced during the first ever linguistics

conference on Romeyka last March at Queens' College, Cambridge: 'Unlike ancient forms of Greek, use of the infinitive has been lost in all other Greek dialects known today – so speakers of Modern Greek would say *I want that I go* instead of *I want to go*. But, in Romeyka, not only is the infinitive preserved, making this essentially the last Greek infinitive of the Greek-speaking world, but we also find quirky infinitival constructions that have never been observed before – only perhaps in the Romance languages are there parallel constructions.'

All the more astonishing, the results so far seem to be indicating that Romeyka is closer to Hellenistic Koiné than all other Modern Greek dialects, which are generally considered to have emerged from the later Medieval Greek spoken in the 7th to the 13th century AD.

## Change 'in real time'

Dr Sitaridou's research is ultimately trying to pinpoint how Pontic Greek evolved. 'We know that Greek has been continuously spoken in Pontus since ancient times and can surmise that its geographic isolation from the rest of the Greek-speaking world is an important factor in why the language is as it is today,' says Dr Sitaridou. 'What we don't yet know is whether Romeyka emerged in exactly the same way as other Greek dialects but later developed its own unique characteristics which just happen to resemble archaic Greek. Or whether it developed from an earlier version of Greek in contrast to the rest of the Greek dialects and as a result of this more direct lineage, as well as its isolation from other dialects for centuries, it maintains archaic features.'

Nevertheless, Romeyka also demonstrates considerable innovation especially as a result of contact with Turkish. In this respect, Dr Sitaridou is interested in modelling what influence the contact with Turkish and Caucasian languages has had on the evolution of the dialect. Given the linguistic and sociohistoric context of Romeyka, she notes that 'in Pontus, we have near-perfect experimental conditions to assess what may be gained and what may be lost as a result of language contact.' It is precisely these questions that she will pursue further as the recipient of the prestigious Stanley J. Seeger Visiting Research Fellowship in Hellenic Studies at Princeton University in spring term 2011.

The implications of such research are, however, far more pervasive, since understanding how language functions could provide some insight into cultural identity and people's sense of themselves, as well as what happens when cultures connect.

Dr Sitaridou, whose own great-grandparents were from the region, believes that the linguistic evidence will help to unravel the thread of language evolution; we have yet to see whether the thread takes us all the way back to the time of Jason and the Argonauts and whether more surprises await us.

## Cambridge Group for Endangered Languages and Cultures (CELC)

Linguists and anthropologists from across Cambridge have created CELC as a forum for researchers with common interests not just in seeking to document languages that are under threat, but also the literatures and ideas about cultural identity that they help to maintain.

For more information, please visit <http://groups.pwf.cam.ac.uk/celc/>



## Dr Ioanna Sitaridou

For more information, please contact Dr Ioanna Sitaridou at the Faculty of Modern and Medieval Languages ([is269@cam.ac.uk](mailto:is269@cam.ac.uk)) or visit <http://people.pwf.cam.ac.uk/is269/>

# Synthesis made simpler

Research is bringing closer the conversion of simple organic molecules into drugs, plastics or potential new fuels in a single step.

The hydrocarbons found in crude oil and plants are the raw materials from which we synthesise vitally important products such as drugs and plastics. But the steps needed to convert the starting materials into functional commodities for further processing can be complicated and costly. The reason: the carbon–hydrogen chemical bond that needs to be broken during the synthetic process is one of the strongest bonds known. Chemists led by Dr Matthew Gaunt are devising new techniques to achieve the same synthetic results in a single step.

## Catalytic converters

At the cornerstone of synthetic chemistry is the need for molecules to have reactive ‘handles’ to stick them together. To break the carbon–hydrogen bond and enable it to bind to another molecule, the conventional route has been to convert the starting material into a series of reactive intermediates.

‘We want to get away from having to synthesise molecules in this way, which can be time-consuming and creates waste products,’ says Dr Gaunt. ‘Instead, we’ve focused on a new way of catalysing reactions that can theoretically work on any starting material, transiently making it reactive enough to bind to any other starting material in a single step.’

The technique – called metal-catalysed carbon–hydrogen bond functionalisation – is based on the ability of certain metals to ‘muscle in’ between the carbon and hydrogen and become the reactive handle needed to join the starting materials together. Importantly, the metal is released after it has linked two molecules, so that it can go and find more molecules to join together. This means that only a small amount of metal catalyst is needed to generate a large quantity of high-value product.

The work has focused on joining a range of simple hydrocarbons together and identifying the best metal catalyst for the

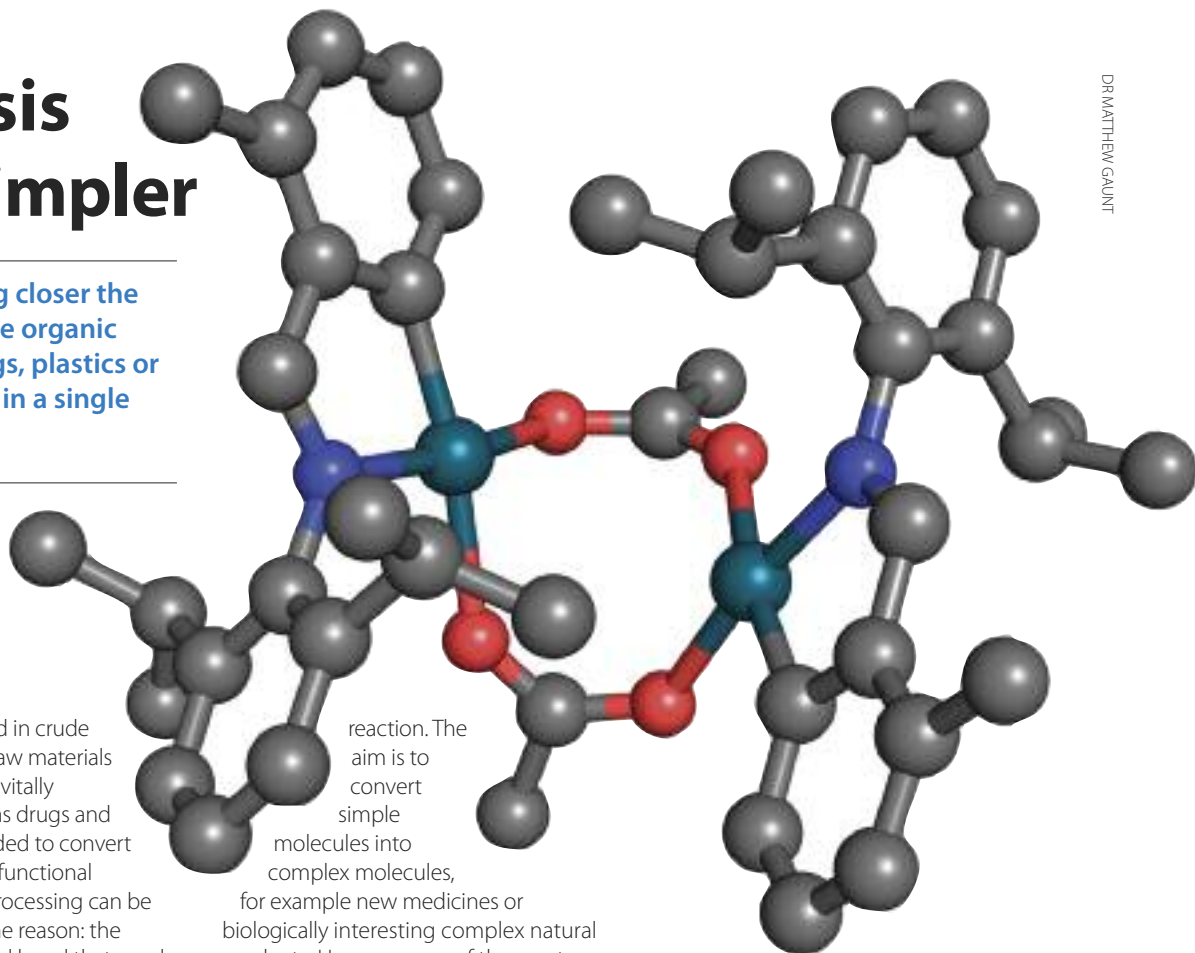
reaction. The aim is to convert simple molecules into complex molecules, for example new medicines or biologically interesting complex natural products. However, one of the most ambitious reactions would be to convert methane into methanol. ‘Nature and expensive chemical reactions can do this; imagine what a breakthrough it would be if we could perform this cheaply in a few minutes at room temperature,’ says Dr Gaunt. ‘It might even be possible to convert methane into octane as an alternative source of petrol.’

## Rule breakers

The research is putting a new perspective on the rules that govern how organic molecules are synthesised from simple components. Last year, Dr Gaunt’s group discovered a technique, published in *Science* magazine, which causes aromatic hydrocarbon rings to react in a way that was not deemed theoretically possible.

Using a copper catalyst, they showed that a new and unexpected bond was targeted in the reaction process. Importantly, the bond is part of a structure that is common in synthetic drugs. By finding a simple means to make this bond reactive, Dr Gaunt’s team has opened up a new landscape of synthetic drugs that chemists can potentially make.

The group is now looking beyond the test tube to living cells. ‘If we could find a way to target a chemical reaction on a protein that we know causes a certain disease, we could switch it off chemically.’ A core principle has been to carry out the reactions as close to ambient temperatures as possible, to increase the reaction’s energy efficiency and its adaptability to physiological scenarios.



**A palladium catalyst in action: the palladium (turquoise) can insert into an unreactive C–H bond to make an activated complex that can be transformed into a useful product**

## A synthetic revolution

Dr Gaunt recently won a Leadership Fellowship from the Engineering and Physical Sciences Research Council and, with additional funding from the European Union, Leverhulme Trust and industry, his group is now developing and streamlining the techniques. ‘We hope that not only will approaches like these be used increasingly alongside the conventional methods for organic synthesis but also that our research might encourage a step change in how chemists think about making molecules and unlocking latent reactivity.’



**Dr Matthew Gaunt**

For more information, please contact Dr Matthew Gaunt (mjg32@cam.ac.uk) at the Department of Chemistry.

# Gender's many faces

**New funding and a generous bequest are helping researchers in Cambridge to explore the complexities of how gender works in the world.**

Over the past two years, Cambridge's Centre for Gender Studies (UCCGS) has brought together scholars from across the University into a vibrant teaching and research community focused on the understanding of gender. Today, academics from 23 different departments – from the social sciences, humanities and arts, right through to the physical sciences, technology and biomedical sciences – are actively engaged with the Centre, as are an impressive series of visiting international scholars.

Although the Centre has existed for over a decade as a successful public events and postgraduate training resource, an endowment two years ago from Jessica and Peter Frankopan of the Staples Trust enabled it to begin a new and exciting process of development, launching an MPhil course and its own research programme.

Now, with academics from such a broad range of fields contributing to its intellectual landscape, the Centre demonstrates a remarkable and in many ways unique multidisciplinary approach to research and teaching, as Dr Jude Browne, the Centre's Frankopan Director of Gender Studies, attests: 'The study of gender at the Centre benefits immensely from having evolved from an engagement with diverse front-line research topics rather than from any one particular discipline, political view or methodology... Gender at the Centre is about *all* humans whatever their identities, condition or experiences.'

Issues tackled at the Centre encompass this holistic approach and range from what the latest advances in biomedical sciences tell us about gender, to how gender is used in conflict, to what we can learn about gender from antiquity, to how we could combat sexed-based inequalities in the labour markets. The result, as Dr Browne describes, is a 'different, and sometimes clashing, research perspective that gives us a wonderfully encompassing view of the implications of gender.'



©ALAMY.COM

## From head-hunting to HIV transmission

The two most recently funded research projects at UCCGS exemplify the extraordinary breadth of gender research.

Dr Browne, whose research was featured at the Hay Festival this year, is a specialist on sex segregation and inequality in the modern labour market. A three-year project she is directing will evaluate gender bias in the assessment and selection of top executives for recruitment (with Monica Wirz, PhD candidate in the Centre). Egon Zehnder International, the largest privately owned executive search firm, has funded the project following their recent finding that the proportion of women on the boards of UK FTSE companies is only 12.6%. 'It's dismal how little diversity there is in chief national and international posts,' comments Dr Browne. 'We need to link up the thinking behind selection processes at the very highest recruitment levels with that of the latest critical thinking in gender studies.'

Dr Andrew Tucker, Assistant Director of UCCGS, leads a Centre project focusing on HIV transmission in South Africa, which continues to exhibit one of the worst epidemics of HIV. The United States Agency for International Development is funding this groundbreaking two-year project through the US President's Emergency Plan for AIDS Relief. The study is aimed at reducing transmission in marginalised at-risk communities in South Africa – specifically men who have sex with men (MSM). What little work has been done on addressing this group's health needs has focused overwhelmingly on measures such as condom distribution; this project instead plans to examine the benefits of reducing social and economic discrimination, and an endemic sense of fatalism, which affect MSM in township environments.

## Bequest to 'spark young minds'

Thanks to a recent substantial bequest from Professor Carl Djerassi (inventor of the first oral contraceptive pill) in memory of his late wife Diane Middlebrook, the community of Cambridge researchers working on gender is being extended by the launch of the Diane Middlebrook and Carl Djerassi Visiting Professorship in Gender Studies, bringing internationally renowned scholars to the Centre. The first to visit is Professor Marcia Inhorn, a leading medical anthropologist from Yale University whose research focuses on 'reproductive tourism' – the search for assisted reproductive technologies and human eggs, sperm and embryos across national and international borders.

During their research period at UCCGS, each Visiting Professor will explore opportunities for continuing collaborative research with the Centre and offer guidance and intellectual leadership to junior researchers and students. As Professor Djerassi remarks: 'What better way of honoring the memory of my wife than bringing great teachers from all over the world to spark younger minds.'



### Dr Jude Browne

For more information, please contact Dr Jude Browne ([jmb63@cam.ac.uk](mailto:jmb63@cam.ac.uk)) at the University of Cambridge Centre for Gender Studies ([www.gender.cam.ac.uk/](http://www.gender.cam.ac.uk/)) in the Department of Geography.

## Just press print

---

**An academic-industrial consortium is developing the scientific know-how to underpin a printing revolution.**

---

Inkjet printing is fast becoming a major cross-sector enabling technology. Familiar to many as the process we rely on whenever we press 'print', the technology is now demonstrating an increasing capacity to influence a host of other industries.

Indeed, the power of inkjet printing is such that this high-precision, IT-driven technology is not only complementing conventional printing and manufacturing processes but also becoming relevant to completely unexpected areas, as diverse as drug manufacturing, crop spraying and electronic circuitry.

But with this comes a need to improve knowledge of the science underlying the technology. 'In many ways the development of inkjet technologies for industrial applications has moved ahead of our understanding of the basic science,' explains Professor Ian Hutchings from the Inkjet Research Centre (IRC) in Cambridge's Institute for Manufacturing (IfM), part of the Department of Engineering. 'To help realise the full potential of inkjet printing as a robust, fast, flexible and efficient technology, we need to enhance understanding in fundamental areas.'

To this end, a consortium of academics and industrial collaborators led by Professor Hutchings has begun a five-year programme of research. The project has been funded with £5 million from the Engineering and Physical Sciences Research Council (EPSRC),

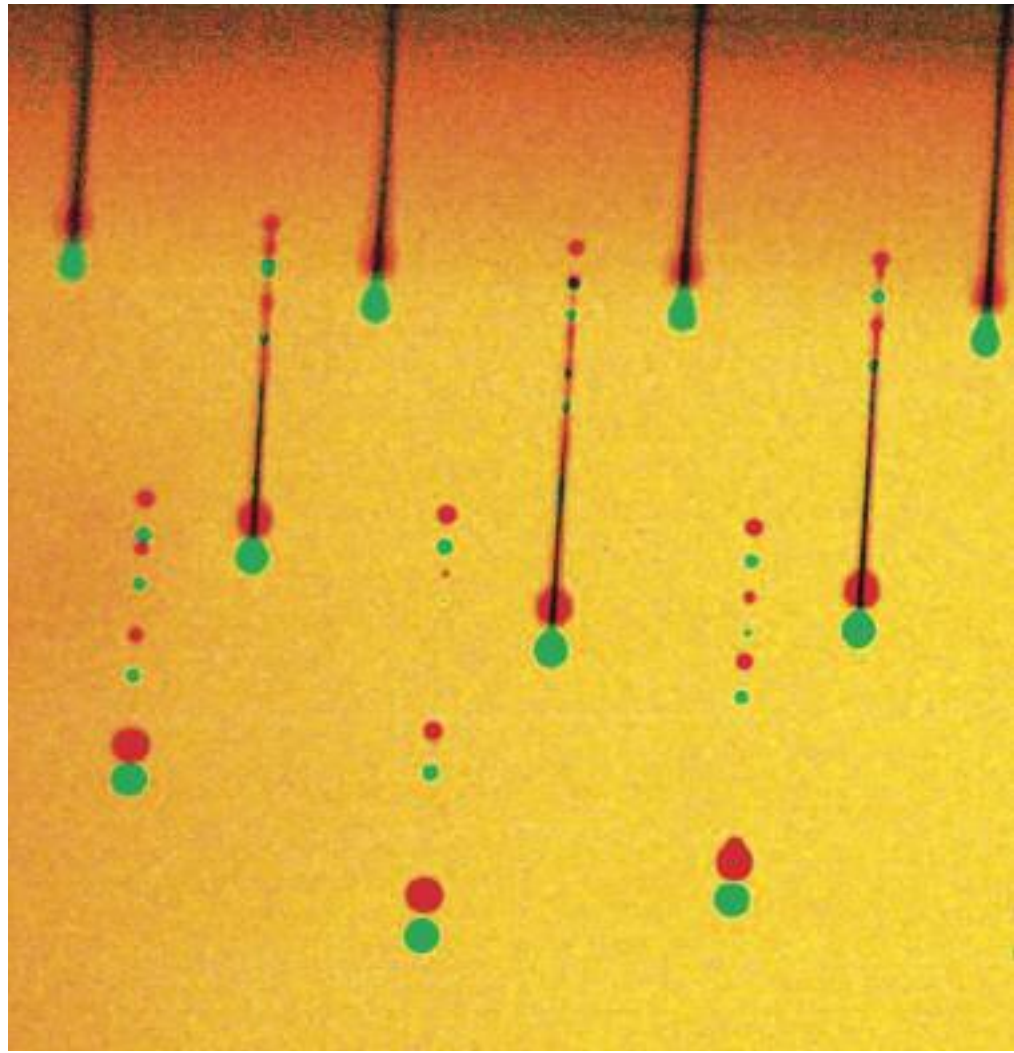
with additional substantial support from industry.

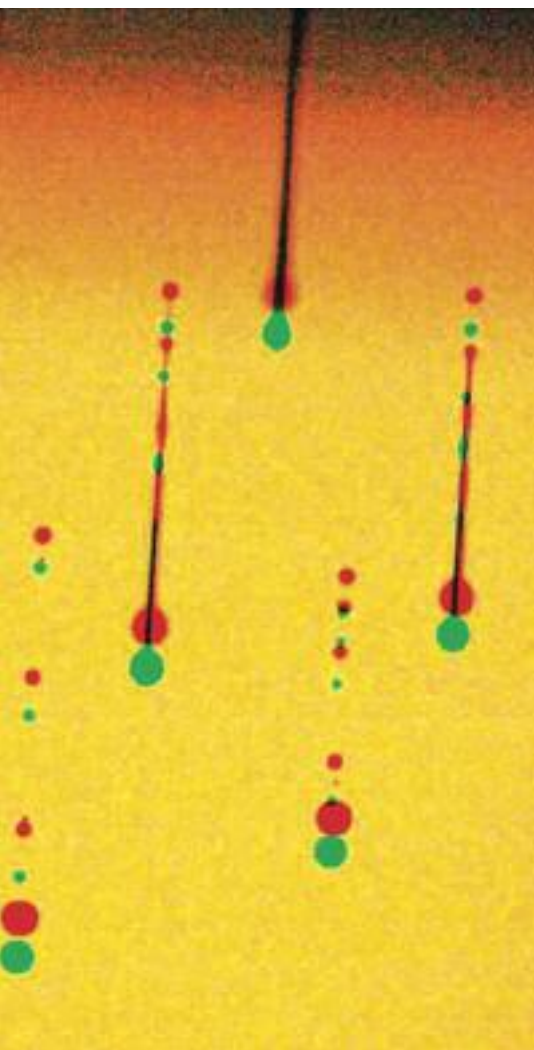
### Niche to mainstream

What makes inkjet technology so versatile is the ability to control digitally, at the level of individual droplets, precisely where the fluid appears on a surface and to change this dynamically.

The technology dominates the desktop home and office printing market and is now edging into the commercial print market. 'The flexibility is staggering,' says Professor Hutchings, 'instead of printing the pages of a single newspaper over and over again to produce many thousands of copies, an inkjet press can print all of the pages of one newspaper and then many others, completely different, one after the other. The technology is ideal for moving towards printing on demand.'

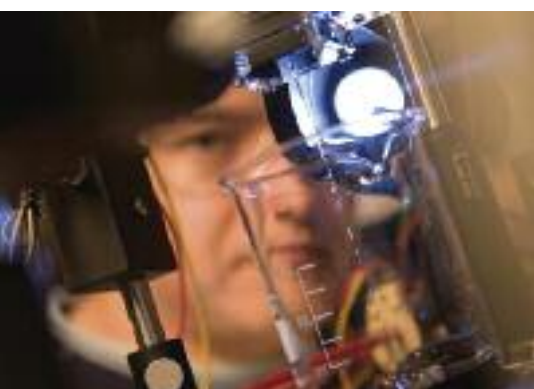
But this is only the beginning, as Dr Graham Martin, Director of the IRC, explains: 'Just as exciting is the emerging ability to print using a growing number of different liquids, such as plastic semiconductors, light-emitting polymers, electrical conductors and drugs, onto a multitude of different substrates with an incredible level of control.' As a result, the process has applications in industries as diverse as pharmaceutical, agrochemical, packaging, displays and electronics.





INKJET RESEARCH CENTRE

**Drop velocity measurement; two flashes delayed by a few microseconds captured on the same frame in different colours enable the velocity of drops to be measured**



INKJET RESEARCH CENTRE

Experimental drop generator

'We can help this transformation from a niche to a mainstream process,' adds Professor Hutchings, 'but we need a better theoretical and practical understanding of how small liquid drops are formed, behave, spread and dry, especially those that have a high solids content, as well as how to speed up the whole process.'

### Collaborative expertise

On the academic side, the interdisciplinary programme brings together researchers from three Cambridge University departments (Department of Engineering, Department of Chemical Engineering and Biotechnology, and Department of Applied Mathematics and Theoretical Physics) and chemists, mathematicians and engineers from the Universities of Leeds and Durham.

**'To help realise the full potential of inkjet printing as a robust, fast, flexible and efficient technology, we need to enhance understanding in fundamental areas.'**

The nine industrial collaborators – Domino Printing Sciences, FFEI, Fujifilm Specialist Ink Systems, GlaxoSmithKline, Inca Digital, Linx Printing Technologies, Printed Electronics Ltd, Sun Chemical and Xaar – are all UK-based global players with major interests in the inkjet printing and digital manufacturing sector. Several of the companies were spun out of early research and development at Cambridge Consultants in the 1970s and 1980s, and now form a recognised East of England cluster of industry-leading inkjet companies.

The academic investigators, well experienced with working with industrial partners, understand the benefits of knowledge exchange with their colleagues from industry, as Dr Martin explains: 'Our feet are kept firmly on industrial ground by having such an active and enthusiastic industrial partnership. In return, the companies, several of whom are direct competitors with each other, value the fact that the research programme provides both a common ground between them and a reservoir of expertise that didn't previously exist.'

'The intention is for research outputs to be taken up into product and application development programmes by the industrial partners, extending them well beyond the life of the project,' adds Professor Hutchings.

### Research themes

Inkjet printing is far from a new area of research at the IfM. The new funding follows on the back of a previous five-year EPSRC-supported research project that effectively set up the IRC and began the academic and industrial collaborations that are the backbone of the new programme.

Focusing on generic issues in industrial inkjet printing, the IRC and its partners have provided new understanding of fluid flow, including the interaction of fluid with both the printhead and the substrate. Recent research has focused on developing techniques to study inkjets and drops during the printing process at very high temporal and spatial resolutions. Using these techniques, inks with various flow characteristics have been studied, leading through development of theory and simulation to a better understanding of their behaviour. In several cases, the industrial partners have adopted the same techniques for their own R&D.

Under the new programme, three main research themes are being tackled. The investigators will explore the challenge of increasing the solids content of printing liquids – this might be drug particles in suspension or even metals or glass – as well as continue their studies of what happens to drops in the microseconds and milliseconds after they impact, as they spread and dry on surfaces. And they aim to develop and validate a practical industrial process model, or 'toolbox', that will enable industries using inkjet technology to control all aspects of the formation and ultimate fate of drops.

### Catching the wave

The UK printing industry plays a major role in the economy, with annual sales by companies in the printing industry of £14.5 billion, and some 140,000 employees in 10,500 companies<sup>1</sup>.

'Added to this is the wave of potential applications coming along,' says Professor Hutchings. 'One can imagine the day when inkjet technology is used to load tablets with drugs, spray crops, print books on demand at point of sale in bookshops, build circuit boards and even electronic devices, and manufacture low-cost diagnostic devices for medical use. Our hope is that scientific outputs from the programme will help UK industry catch this wave and make the most of these prospects.'

<sup>1</sup> Source: British Printing Industries Federation (2007 data from Office for National Statistics).



### Professor Ian Hutchings

**For more information, please contact Professor Ian Hutchings (imh2@cam.ac.uk) at the Inkjet Research Centre (www.ifm.eng.cam.ac.uk/pp/inkjet/) in the Institute for Manufacturing.**

**Consultancy is an effective way for academics to share their knowledge and expertise, bridging the gap between research and industry.**



**A brick and mortar dome structure designed by consultant Michael Ramage for the Yerba Buena Center for the Arts, San Francisco**

## Bridging research and industry

As well as helping Cambridge University academics enter into commercialisation arrangements for their discoveries, Cambridge Enterprise also provides a managed service to help them apply their knowledge to real-life situations by undertaking consultancy work.

Dr Paul Seabright heads the Cambridge University Technical Services Limited (CUTS) at Cambridge Enterprise, which now manages 200 consultancy projects per annum in subject areas that range from engineering to economics, physics to philosophy and computer sciences to clinical medicine.

'In consultancy, as opposed to collaborative research,' he explains, 'academics apply their personal expertise to help a client organisation solve problems that are specific to the client's business. It's one of the principal mechanisms by which knowledge that has practical applications can be disseminated to the public and private sector, and the University can make its earliest direct impact on society.'

The number of consultancy projects undertaken through Cambridge Enterprise continues to grow rapidly; in fact, a third of projects handled over the past year were from first-time consultants. The type of projects vary widely between expert witness appearances and tendered public contracts, while the broad scope of projects reflects the wide range of University research that is in demand by both industry and government.

### Expert knowledge

Consultancy can involve a problem-solving activity that has tangible results. Dr Minna Sunikka-Blank of the Department of Architecture, for instance, conducted a social and technical performance monitoring analysis for PRP Architects Ltd, aiming to discover how and why tenants alter their energy-use habits. The information contributed to 'Retrofit for the Future', an initiative of the Technology Strategy Board which aims to retrofit the existing housing to meet future emissions targets. Also from the Department of Architecture, Michael Ramage designed and supervised the installation of a brick and mortar dome structure for 'The Bowls Project', part of the annual New Frequencies Music Festival presented by the Yerba Buena Center for the Arts, San Francisco.

In many cases, consultancy takes the form of the delivery of expert opinion. Professor David Newbery of the Faculty of Economics wrote an analysis of policy options for the funding of a Carbon Capture and Storage demonstration plant in the UK. And Professor David Farrington, from the Institute of Criminology, completed a feasibility study for the National Policing Improvement Agency on the impact of closed-circuit television upon criminal justice outcomes.

### CUTS

The managed service provided by CUTS helps academics to concentrate on the project and the relationship with the client

without any distraction about contractual matters or the management of the administrative issues associated with the project. Meanwhile, client organisations are able to commission work from individual staff who have cutting-edge expertise, under contract with a professionally managed limited liability company backed by the University and utilising the University's insurance cover. 'The contractual terms ensure that both the client and the member of staff gain mutual benefit from the relationship,' explains Dr Seabright, 'and the University frequently benefits from the longer term substantial relationships, including research collaborations that develop from consultancy activity.'

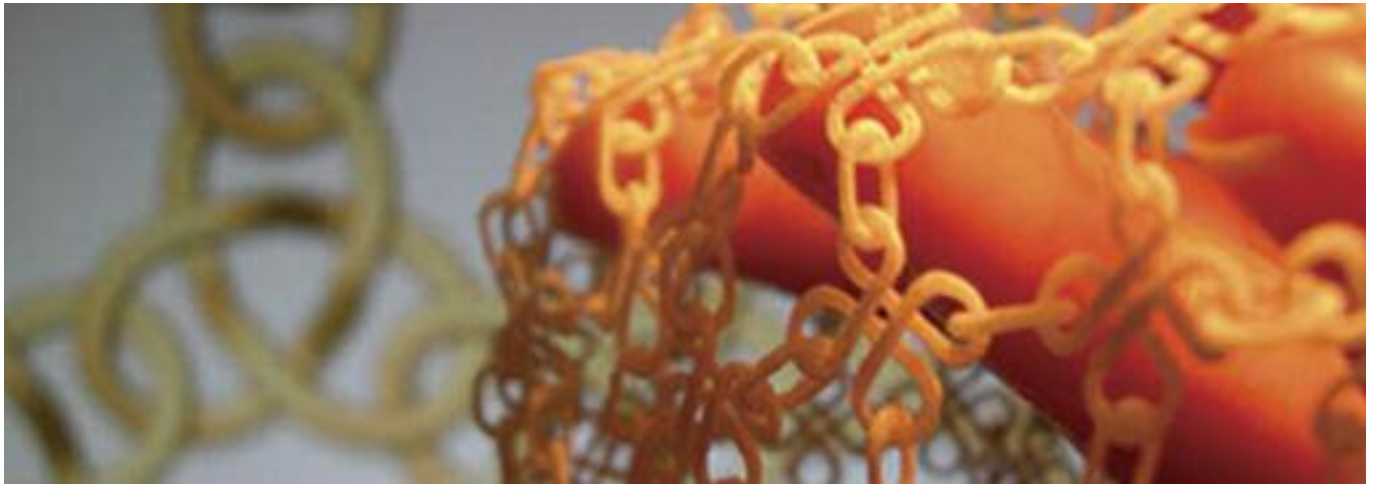


### Dr Paul Seabright

For more information, please contact Dr Paul Seabright ([cuts@enterprise.cam.ac.uk](mailto:cuts@enterprise.cam.ac.uk)) at Cambridge Enterprise Limited ([www.enterprise.cam.ac.uk/](http://www.enterprise.cam.ac.uk/)).



**Dr Chris Tyler, Executive Director of Cambridge's Centre for Science and Policy, explains how and why the Centre is helping the best scientific thinking to inform public policy.**



## Connecting science and policy

**D**ecisions that affect everyday lives and the course of human history are not always made on the best evidence. Factors that influence public policy decisions include economic climate, political context and morally derived priorities. Yet, arguably the most important factor – evidence – is often treated as an afterthought.

A large amount of research is pertinent to public policy. But a seemingly tiny amount of that knowledge makes it through to the policy world. This is a frustration not only for the research community but also for the policy community. Even with the best intentions, it is not always easy to ensure that the right research finds the right policy makers at the right time.

The Centre for Science and Policy (CSaP), launched in July 2009, is playing its part to fix the problem. Its mission is to help build productive and lasting relationships between researchers and policy makers wherever research is relevant to policy. Its approach is to build an energetic network of policy-conscious researchers and research-conscious policy makers.

### Policy Fellows

The Policy Fellows Programme brings policy makers from Whitehall and Westminster, and members of industry, to Cambridge to meet with academics in one-to-one meetings in a range of subjects. The Programme is valuable to the policy professionals, giving them a refresh in their policy area and helping them to develop a network of experts on whom they can call for advice. And it is also valuable to the

participating academics who gain contacts in the policy world and a viable mechanism for helping their research to find a policy home.

Recent Policy Fellow Lucia Costanzo, Head of European Union (EU) Research Policy at the Department for Business, Innovation and Skills (BIS), found that the experience gave her in-depth exposure to the University and its engagement with the wider science community: 'It also allowed me to gain a clearer picture of how the EU research agenda impacts on researchers at Cambridge – providing real insights that will inform my ongoing policy work.'

### Policy workshops

The wider network of CSaP Associates coalesces into Centre Interest Groups, which every few months bring together policy makers, science experts and industry representatives to generate new ideas within a specific interest area. A core mission is to scan the horizon for research topics of potential interest before they become major issues of policy.

Policy workshops take several forms. Some start with an initial show-and-tell, others with a brainstorm; all take the form of engaging and often vigorous discussion. Recent and upcoming workshops have been convened in response to topics of relevance to those attending from the Department of Energy and Climate Change and the Department for Environment, Food and Rural Affairs (DEFRA).

In addition to all of these activities, CSaP also runs seminars for Associates and early

career researchers. One of the goals of these events, other than promoting engagement and knowledge transfer, is to offer researchers the chance to learn about the policy process: to gain a better understanding of the constraints within which policy makers operate and to learn about the opportunities to influence public policy.

The Centre is already making an impact on influencing the use of research in the development of policy. As one example, DEFRA's Chief Economist recognised how CSaP's inaugural workshop on ecosystems demonstrated improved methods of valuation, saying: 'We will be looking again at how we use this research in developing policy.'



**Dr Christopher Tyler**

For more information, please contact  
**Dr Christopher Tyler**  
([cptyler@csap.cam.ac.uk](mailto:cptyler@csap.cam.ac.uk)) at the  
Centre for Science and Policy  
([www.csap.org.uk/](http://www.csap.org.uk/)).

## Professor Jane Clarke

**Professor Jane Clarke's laboratory was one of the first in the world to combine atomic force microscopy with protein engineering to 'visualise' the mechanical unfolding of a single protein at the molecular level. For her successes in this challenging area, she was awarded the 2010 U.S. Genomics Award for Outstanding Investigator in the Field of Single Molecule Biology.**



'Proteins are remarkable – although they start life as linear strings of amino acids, encoded by the information within our genes, they have an in-built ability to fold into a precise shape,' explains Jane Clarke, who has just been elected the Department of Chemistry's new Professor of Molecular Biophysics. 'It's this three-dimensional structure that gives proteins their biological function.'

Her work focuses on the fundamental forces of physics and chemistry that determine why a protein folds in a certain way, and how one region of a protein interacts with another. Having a better understanding of this behaviour is of biomedical importance for understanding not only how proteins work but also how they lose function in certain diseases.

'One of the things I am most excited about is investigating what's happening at the level of individual molecules,' says Professor Clarke, whose research is funded by the Wellcome Trust. 'With atomic force microscopy, we use a tiny cantilever to pick up a single molecule of protein and stretch it until it unfolds, one domain at a time. By combining experiments with simulations we can predict the unfolding pathway and even design proteins with new mechanical properties.'

One protein the Clarke lab has been investigating is spectrin, which maintains the elasticity of red blood cell membranes. Her team's latest discovery shows how mutations that cause an hereditary anaemia destroy cooperativity between the individual subunits of the spectrin protein, providing molecular understanding of precisely how mutation results in disease.

### What might others be surprised to learn about you?

*I was a school teacher for almost 20 years before I even thought about doing a PhD. I liked teaching very much and was head of science in a big comprehensive school in Tottenham. My aim was to be a head teacher. The change of plan came when my husband went to work in America, where I was unqualified to teach, and I decided to go back to school and study for a Masters in Applied Biology at Georgia Institute of Technology.*

### Who or what inspires you?

*An inspiring lecturer at Georgia Tech called Bud Suddath taught a course on protein structure – it was so fantastic that I realised this is what I wanted to work on. However, back in the UK, finding someone willing to take the chance on a 40-year-old mother-of-two wanting to do a PhD was far from easy. But Bud had given me a letter recommending me to Professor Alan Fersht here in Chemistry and Alan gave me the amazing opportunity to do a PhD in his group. As well as Bud, someone else who is a constant inspiration is my brand-new grandson – he's both an absolute joy and a complete distraction!*

### Have you ever had a Eureka moment?

*Science is at its most exciting and fun when the unexpected happens – when you get odd answers that you hadn't predicted. I had a moment of inspiration when a student in my group, Sarah Batey, had some very clear results that we just couldn't understand. We were completely stuck for nine months. One night I woke up and had the answer – I had to get up and write it down. In the morning, the mechanism still made sense, so I rushed in early and paced the lab waiting for Sarah to*

*arrive. I still remember how excited I was! Luckily, it came at just the right minute – Sarah was able to finish her PhD and we were able to publish.*

### What's the best piece of advice you've ever been given?

*The best advice was probably Bud's encouragement to do a PhD. Too often the perception is that the conventional career path into research is the only one. Not only should people have the courage to try but they deserve the opportunity to succeed. Another piece of advice I've also always liked is Alan Fersht's: 'don't waste clean thoughts on dirty data.' If the results aren't good enough, stop wasting time trying to understand them and go and get better data!*

### What motivates you to go to work each day?

*I love being able to work with fantastic young researchers who always bring you something new, something exciting. I have a small lab and I like it that way. It means that I can be intimately involved in the research as it's happening. I no longer do any hands-on wet work – my group get rather distressed if I put a lab coat on – but we plan the experiments together and I see the data come out. Every day is completely different. You just don't know what's going to happen.*

### What is your favourite research tool?

*My favourite research tool has to be my group – they are a wonderful mix of chemists, biochemists and physicists, all of whom bring and share their skills to tackle a challenging intellectual problem. That's why I think research is such an inspiring career.*

# Find us on YouTube EDU

Research at the University of Cambridge is accessible through YouTube EDU. The University's channel includes the flagship **Cambridge Ideas** series, which covers research as diverse as how ants have such incredibly sticky feet, to using statistics to face up to life's major risks. Together with a wide selection of other research videos, such as those listed below, these offer a unique opportunity to meet the scholars and gain insight into how knowledge emerging today has the power to transform lives tomorrow.



## Cambridge Ideas: Vanishing Voices

Of the world's 6,500 living languages, half will cease to be spoken by the end of this century. Dr Mark Turin, Director of the World Oral Literature Project, has spent much of his life travelling to remote corners of the Himalayas to study and document languages and cultures that are at risk. <http://bit.ly/a70cV7>



## Preventing HIV Transmission in Breastfeeding

Novel research is being conducted in the Department of Chemical Engineering and Biotechnology on developing a low-cost, modified nipple shield that dispenses antiviral compounds to reduce the transmission of HIV from mother to baby during breastfeeding. <http://bit.ly/d3lxbh>



## Meet the Algae

Cambridge scientists take a closer look at algae and examine their potential as a renewable source of energy. In the near future, algae could be used as a sustainable, carbon-neutral biofuel. <http://bit.ly/9Z3CRv>



## The Elephant Man

The story of Gyles Mackrell's courageous rescue of 200 refugees by elephant in Burma during the Second World War, told for the first time thanks to the donation to the University of Cambridge of diaries, papers and, remarkably, first-hand film footage he made during his expedition. <http://bit.ly/9AOJb6>



## Superconnected

Professor David Cardwell explains what superconductors are, why we need them, and how he and his team have devised techniques to make them more powerful than ever before. <http://bit.ly/d2APjn>

To view videos, please visit [www.youtube.com/cambridgeuniversity](http://www.youtube.com/cambridgeuniversity) or [www.youtube.com/edu](http://www.youtube.com/edu) and select the University of Cambridge.

All materials in Research Horizons, including but not limited to text, data, designs, logos, illustrations, still images, are protected by copyright, design rights, database rights, trademarks and other intellectual property and proprietary rights.

The materials in Research Horizons are either owned by the University of Cambridge or have been licensed by the owners to the University of Cambridge for inclusion in the publication.

Contributors to this publication have asserted their moral right under the Copyright, Designs and Patents Act 1988 to be identified as authors of their respective works. Except for the purposes of private study and noncommercial research or 'fair dealing for the purposes of criticism or review' as permitted under the Copyright, Designs and Patents Act 1988, this publication or any part thereof may not be reproduced, stored or transmitted in any form or by any means without the prior permission in writing of the University of Cambridge and the authors of contributions as identified.

Requests for further reproduction or reposting or reproduction for commercial purposes should be addressed to the Editor, Research Horizons, Office of External Affairs and Communications, The Pitt Building, Trumpington Street, Cambridge, CB2 1RP, UK; email [research.horizons@admin.cam.ac.uk](mailto:research.horizons@admin.cam.ac.uk)

Research Horizons has made all reasonable efforts to ensure that the reproduction of all content in this publication is done with the full consent of copyright owners. Research Horizons would be grateful to hear from intellectual property rights owners who are not properly identified in the publication so that Research Horizons may make the necessary corrections.

©2010 University of Cambridge and Contributors as identified. All rights reserved.

## Your way into Cambridge

Research Horizons is produced by the University of Cambridge's Office of External Affairs and Communications, The Pitt Building, Trumpington Street, Cambridge, CB2 1RP.

**If you would like information on research funding or working with the University, please contact:**

Cambridge Research office  
Tel: +44 (0)1223 333543; email: [cro.enquiries@admin.cam.ac.uk](mailto:cro.enquiries@admin.cam.ac.uk)  
[www.admin.cam.ac.uk/offices/research/](http://www.admin.cam.ac.uk/offices/research/)

**If you would like information on commercialisation of University intellectual property, please contact:**

Cambridge Enterprise Limited  
Tel: +44 (0)1223 760339; email: [enquiries@enterprise.cam.ac.uk](mailto:enquiries@enterprise.cam.ac.uk)  
[www.enterprise.cam.ac.uk/](http://www.enterprise.cam.ac.uk/)

**If you have an enquiry relating to the magazine, please contact:**

Dr Louise Walsh, Research Horizons Editor  
Tel: +44 (0)1223 765443; email: [research.horizons@admin.cam.ac.uk](mailto:research.horizons@admin.cam.ac.uk)  
[www.research-horizons.cam.ac.uk/](http://www.research-horizons.cam.ac.uk/)

**If you have a more general media enquiry, please contact:**

The Office of External Affairs and Communications  
Tel: +44 (0)1223 332300; email: [communications@admin.cam.ac.uk](mailto:communications@admin.cam.ac.uk)  
[www.admin.cam.ac.uk/offices/communications/](http://www.admin.cam.ac.uk/offices/communications/)

**University of Cambridge:**

[www.cam.ac.uk/](http://www.cam.ac.uk/)

We welcome suggestions, feedback and comments: please contact the Editor at [research.horizons@admin.cam.ac.uk](mailto:research.horizons@admin.cam.ac.uk)

CAMBRIDGE

# International Development books from a global publisher

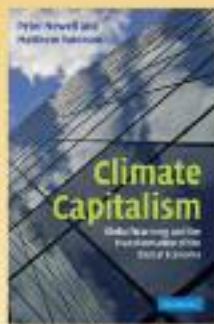
## Climate Capitalism

Global Warming and the Transformation of the Global Economy

Peter Newell *University of East Anglia*  
Matthew Paterson *University of Ottawa*

What are the best economic policies to reduce greenhouse gas emissions and combat climate change? *Climate Capitalism* assesses the politics and economics of market-led solutions to climate change. It is important reading for anyone wanting to better understand the challenge, including students on courses in environmental studies and business programmes.

2010 | 228 x 152 mm | 222pp | 4 line illus. | 3 tables  
HB £50.00 9783527194853  
PB £17.00 9783527112728



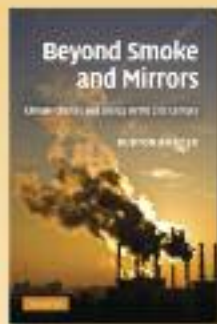
## Beyond Smoke and Mirrors

Climate Change and Energy in the 21st Century

Burton Richter *Stanford University, California*

This book assesses the sensible, senseless and biased proposals for averting the potentially disastrous consequences of global warming, allowing the reader to draw their own conclusions on switching to more sustainable energy provision. Burton Richter is a Nobel Prize-winning scientist who has served on many US and international review committees on climate change and energy issues.

2010 | 228 x 152 mm | 242pp | 38 line illus. | 22 tables  
HB £90.00 9780521753394  
PB £19.99 9780521717815



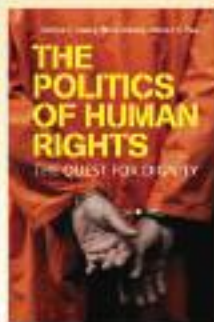
## The Politics of Human Rights

The Quest for Dignity

Sabine C. Carey *Universität Mannheim, Germany*  
Mark Gibney *University of North Carolina, Asheville*  
Steven C. Poe *University of North Texas*

A cutting-edge textbook analysing where and why human rights are violated. Adopting a unique empirical approach, *The Politics of Human Rights* provides a different slant to the theoretical approaches of other texts and directly challenges many of the previously unquestioned assumptions concerning human rights.

2010 | 228 x 152 mm | 240pp | 13 line illus. | 2 maps | 3 tables  
HB £45.00 9780521789572  
PB £17.00 9780521761454



## The United Nations Global Compact

Achievements, Trends and Challenges

Edited by Andreas Raschle *University of Warwick*  
Georg Kell *United Nations Global Compact Office*

Foreword by Ban Ki-moon

*The United Nations Global Compact* encourages businesses to support ten universal principles in the areas of human rights, labor standards, the environment, and anti-corruption. This book reviews the first ten years of the Compact's existence by presenting exclusively commissioned chapters from scholars, practitioners, and Global Compact staff.

2010 | 228 x 152 mm | 412pp | 23 line illus. | 5 tables  
HB £90.00 9780521789417  
PB £28.95 9780521745024

