RESEARCH HORIZONS

In this issue

ENERGY IN CITIES and AGEING IN THE 21st CENTURY

plus news and views from across the University

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Issue 4 | Autumn 2007

UNIVERSITY OF CAMBRIDGE

Foreword

A warm welcome to the Autumn issue of Research Horizons. We aim to reflect the excellence and breadth of research across the University, and I hope that you'll find much of interest in the impressive line-up of innovative projects featured this issue.

Our regular 'Spotlight' section complements the one-day Horizon Seminar events that bring together researchers to debate topical issues. This time we mirror not one but two Seminars – 'Energy in Cities' on 10 October and 'Ageing in the 21st Century' on 4 December. Both of these promise to be stimulating and thought-provoking events and I hope that you can join us.

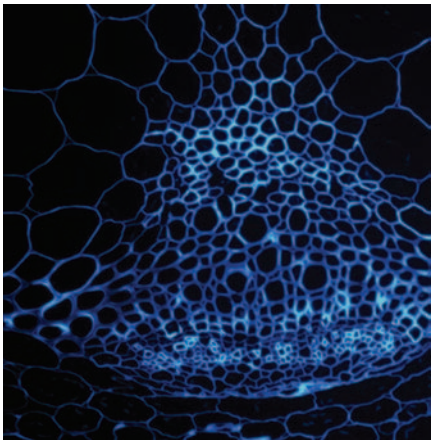
A new dimension to this issue is 'Preview' – an opportunity to discover an author's inspiration behind their newly published book. In 'Going feral', Dr Robert Macfarlane describes his journey in search of the last wild places in Britain and Ireland, reflecting on how his writings are influenced by his research interests in the Faculty of English. In future issues, we look forward to exploring the motivation that drives other authors.

Feature articles this month contemplate the massive to the miniscule: from discovering the elusive origins of stars in our galaxy to how parasites manipulate our immune system to their own ends. We describe how forensic linguists are dissecting the minute variations in speech patterns that might one day be used to identify criminals. Also how a research project in the Department of Architecture is exploring the capacity of buildings in embattled cities like Jerusalem to manifest and absorb conflict, and eventually be healed. And have you ever considered the importance of social dynamics when creating the Cambridge Boat Race team? Read on!

Special thanks go to all our authors and contributors. As always, I welcome your comments and suggestions for future issues. Please email me at Research.Horizons@rsd.cam.ac.uk

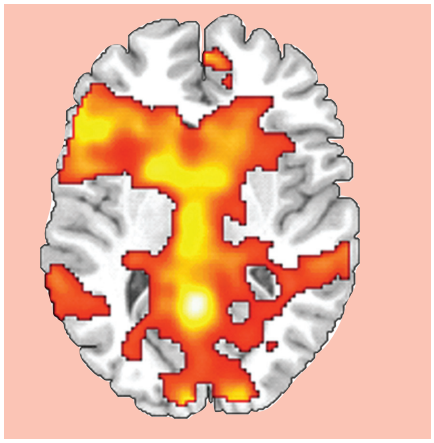
Louise Walsh

Dr Louise Walsh
Editor



DR PAUL DUPREE

Using plants to harvest the Sun's energy



DR M SHAFTO AND PROFESSOR LK TYLER

Can old brains learn new tricks?

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Cover photograph of Dr Luke Skinner by Mark Mniszko
Edited by Louise Walsh
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Centre for the Physics of Medicine

Construction of the £12.5 million Centre for the Physics of Medicine, adjacent to the Cavendish Laboratory, was started in May and signals the scale of Cambridge's commitment to such innovative collaboration.

UNIVERSITY OF CAMBRIDGE

Artist's impression of the building when completed (phases 1 and 2)

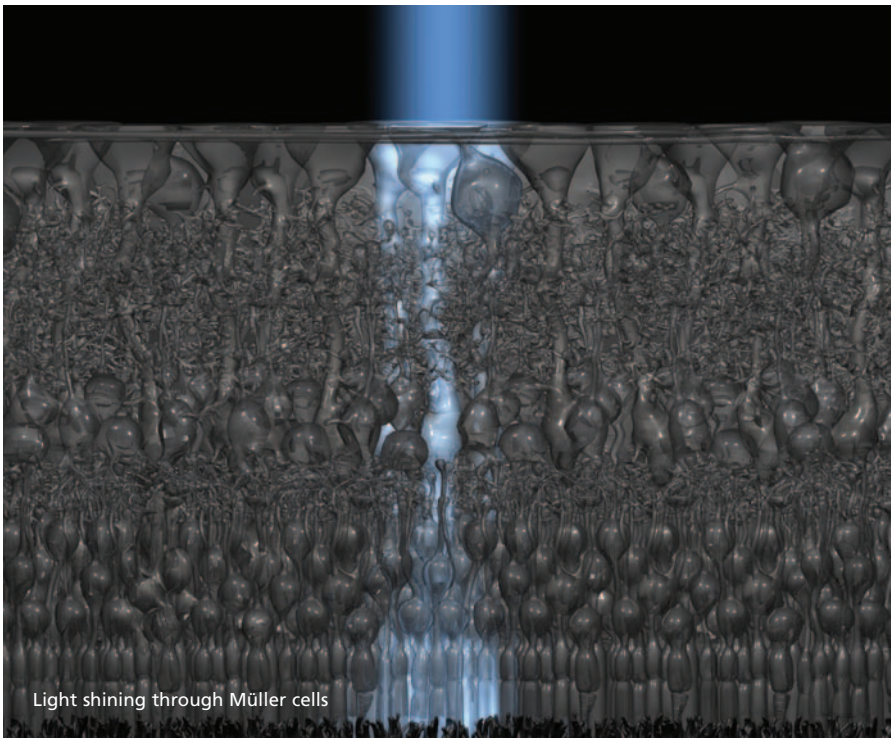
Due to be completed in summer 2008, the new building will bring together researchers across the University from multiple disciplines in the medical, biological and physical sciences. It forms the first part of the phased building, with this phase predominantly providing state-of-the-art research laboratories. The research centre will host projects in soft matter and biological physics, biology and medicine. Further funding is being sought to allow the second phase of the building to go ahead, in which the majority of offices and teaching space will be housed.

Professor Athene Donald, Director for the Physics of Medicine initiative, explains the significance of this move: 'The tools and techniques that physicists are developing offer enormous potential for solving problems in healthcare and cell biology, from diagnostics, through imaging to modelling. But real advances will only come when researchers can share ideas on a day-to-day basis, learning each other's language and with a common goal. The idea of the new building is to turn this philosophy into a practical reality, with students working together in the laboratory and at the whiteboard.'

For more information on the Centre for the Physics of Medicine, please contact Professor Athene Donald (amd3@cam.ac.uk).

Guiding the light

Pioneering research shines new light on our understanding of the way we see the world. Optical fibres have now been found to exist in vertebrate eyes, channelling light down their length and delivering it without distortion straight to the cells that 'see'.



DR JENS GROSCHE, UNIVERSITÄT LEIPZIG

Light shining through Müller cells

Incredibly sophisticated in structure and function, the construction of the retina has puzzled researchers ever since the finer structures of the eye were first resolved over 150 years ago: the retina is built the 'wrong' way around. The cells responsible for light sensing are sited at the back of the eye, furthest from the incoming light. An explanation for the 'inverted retina' has now been revealed by Dr Jochen Guck, newly arrived at the Cavendish Laboratory, while working with a team of scientists at the University of Leipzig, Germany.

Because of its inverted structure, light has to pass through several cells in the retina before it reaches the photoreceptor cells that capture the image and transmit it to the brain. How does this happen without the light being scattered and distorted? Dr Guck describes the problem: 'Nobody would put sandwich paper in their camera in front of the film and expect a crisp image – like the one we're used to seeing. And yet, this is how the retina is constructed.'

An understanding of this enigma has become possible with the invention of a special dual-beam laser trap or 'Optical Stretcher' by Dr Guck and colleagues, in which physical, light-transmitting properties can be visualised and measured at the level of a single cell. Using this tool, the researchers discovered that the answer to the mystery lies with specialised, elongated cells known as Müller cells, which span the retina and have an amazingly high refractive index compared with their surroundings. This difference in refractive index effectively means the light 'bounces' along the cell and barely leaks.

The ground-breaking studies, highlighted on the front cover of the *Proceedings of the National Academy of Sciences USA*, showed that the Müller cells essentially act as a field of miniature optic fibres – lined up in parallel in the direction of the light and traversing the whole retina. They trap the light, guide it down their length, and deliver it to the photoreceptors waiting to receive the stimulus. 'All these living optical fibres together work like a fibreoptic plate,' says Dr Guck.

With his move to the Cavendish Laboratory, Dr Guck has brought with him the new expertise of using light to investigate the mechanical and optical properties of living cells and tissues. His research adds to an ongoing initiative within the University to draw physics more deeply into the life sciences.

For more information, please contact Dr Jochen Guck (jg473@cam.ac.uk). This research was published in *PNAS* (2007) 104, 8287–8292.

The mathematics of avalanches

Each year more than a million avalanches fall worldwide, killing around a hundred people in the Alps alone. Can mathematical models be used to predict and prevent these disasters?

SLF, DAVOS, SWITZERLAND

Artificially released powder snow avalanche, approximately 50 m high and travelling at 150 mph in Vallée de la Sionne, Switzerland

Dr Jim McElwaine, in the Department of Applied Mathematics and Theoretical Physics, is interested in developing such models. He has recently returned from a three-month trip to the Swiss Federal Institute for Snow and Avalanche Research in Davos, where he has been validating his models using real avalanche situations.

Historically, the disciplines of forecasting and hazard zoning have been used in an effort to reduce the deaths and damage caused by avalanches. Both rely heavily on the historical record and the wealth of data collected over hundreds of years.

Forecasting estimates the chance of an avalanche occurring on a particular day in a particular region and is carried out by collecting weather data and information about the snowpack, and comparing it with the frequency of avalanches on similar days in the past. As avalanches tend to fall on the same track year on year but with different sizes, hazard zoning estimates how far an avalanche will travel and what damage it will cause. In the most dangerous 'red' zones, which are highly vulnerable to avalanches, no building is permitted.

Although these methods have proved very successful in the Alps, there have been rare but disastrous occasions where they have gone wrong. In 1999, the worst avalanche winter in the Alps for 20 years, an 'Alpine Tsunami' travelling at over 100 mph entered the safe 'green' zone of the Austrian village of Galtür, killing 31 people. 'These methods are becoming increasingly uncertain for the Alps as the climate changes and past statistics stop being useful,' explains Dr McElwaine, 'and, in countries like Turkey and Iran, where fewer data are available, bad accidents frequently devastate villages.'

Where data are scant, or where the past record can no longer be relied upon, predictive models are necessary. To do this, Dr McElwaine has designed and installed sensors in the Swiss test site Vallée de la Sionne. Powder snow avalanches are triggered by dropping explosive charges from a helicopter. The speed of the air in front of, and inside, the very largest avalanches are then measured and compared with mathematical models. 'The data from these experiments confirmed our model,' says Dr McElwaine, 'and showed how natural avalanches can indeed be related to laboratory experiments. The aim now is to use these models for designing defensive avalanche structures such as dams or snow sheds.'

This research was supported by the Royal Society. For more information, please contact Dr Jim McElwaine (jnm11@amtp.cam.ac.uk).

Revitalising research in Africa

Following recent funding from the Leverhulme Trust, a new programme of academic exchange kicks off in October in the Centre of African Studies, as the first of five groups of Africa-based academics arrive in Cambridge to embark on a six-month period of research.

Following two decades of economic crisis and increased student enrolments, academics working in African Universities are suffering from overwhelming teaching and administrative workloads and poor resources. Compelled to work almost entirely within their national boundaries on topics that can be studied with minimal research funding, Africa-based academics are at risk of becoming geographically and intellectually isolated.

The recently inaugurated Cambridge/Africa Collaborative Research Programme, which will run over five years, seeks to address this need. As Dr Derek Peterson, Director of the Centre of African Studies, explains: 'The programme is intended to help African academics enlarge their networks, activate their research and give them precious time away from the heavy demands of work – time that they can use to read, write and give seminars.' Five Africa-based scholars will each year be invited to come to Cambridge to spend six months pursuing their research. After the scholars have returned to their home institutions, a Cambridge academic will travel to Africa to convene a conference and continue the collaboration.

The first group of academics will work together on the theme Religion and Public Culture in Africa. Their particular projects vary widely: one will pursue research on representations of Islam in East Africa's Swahili-language press; another will investigate the religious dispositions of undergraduates in Ghana's universities.

'We hope the visitors will return to their home institutions refreshed by Cambridge's intellectual hospitality, fortified by a broad range of contacts and energised by the freedom of six months of research,' explains Dr Peterson. 'By invigorating African academics' intellectual lives, we're also enriching the life of the African university.' At the same time, the programme generates cutting-edge interdisciplinary scholarship for researchers here in Cambridge.

For more information, please contact Dr Derek Peterson (drp31@cam.ac.uk) or visit www.african.cam.ac.uk

Cambridge Centre for Energy Studies

Mounting concerns about climate change, continued conflict in the Middle East, rapid economic growth in China and India, and tensions between Russia and its neighbours have put energy high on the global political agenda in recent years.

The newly established Cambridge Centre for Energy Studies, funded with an initial grant from BP, aims to examine some of the key issues that threaten international energy security and to give Cambridge a new voice in the policy debate.

Nick Butler, the founding Director of the Centre, believes that the University has an influential role to play, with its long tradition of energy research in the biological and physical sciences, engineering, mathematics, economics, politics and law. As he explains: 'Energy policy is inherently multidisciplinary and the University of Cambridge is uniquely able to bring these diverse resources together at the highest intellectual level.'

A suite of projects are planned that cover the spectrum of energy-related issues: from an examination of Russia's growing role in the world energy market, to the impact of climate change and carbon emissions, to an examination of the potential for alternative energy sources. The intention is that at least two projects should be up and running by the end of 2007.

One project will examine energy in cities (see page 10 for information on the 'Energy in Cities' Horizon Seminar). 'This theme is important because over 80% of energy consumption takes place in urban environments,' explains Nick Butler, 'and the continued migration from rural to urban areas in Asia and Latin America will increase this figure.' The project will focus on the use of energy in buildings and how this can be managed in the most efficient ways. Areas such as building construction, waste management and recycling, and transport systems are considerations that affect both developed and developing countries.

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Identifying heat loss in the built environment

Professor Martin Rees, Master of Trinity College and President of the Royal Society, is delighted that the Centre is being established: 'These are fundamental issues for the future of the world and it is right that Cambridge should make an informed contribution to the development of public policy.'

For more information, please contact Nick Butler (n.butler@jbs.cam.ac.uk) at the Cambridge Centre for Energy Studies.

New evidence for the origin of modern man

An exhaustive study of over 60,000 skulls has provided compelling evidence that modern humans originated from a single point of origin.

DR TSUNEHIKO HANIHARA SAGA MEDICAL SCHOOL, JAPAN

One of the skulls used in the study: African skulls have the highest levels of diversity

The origin of modern humans has always been a hotly debated issue: did *Homo sapiens* arise in Africa and migrate to other parts of the world to replace other hominid species, or did earlier hominids such as *Homo erectus* leave Africa at an earlier time, later evolving into *Homo sapiens* in their new locations? The first theory, for a single point of origin, has been called the 'Out of Africa' model and it is this argument that is supported by new evidence recently published in *Nature* magazine.

Dr Andrea Manica from the University's Department of Zoology and lead researcher on the project explains how the team studied diversity in populations both from a genetic perspective and by taking measurements of skulls kept in academic collections: 'We have combined our genetic data with new measurements of a large sample of skulls to show definitively that modern humans originated from a single area in sub-Saharan Africa.'

Their findings showed that the further away populations are from Africa, the more the diversity has been depleted by 'bottlenecks' – whereby only a few individuals leave an existing population to start a new population – phenomena that characterised the rapid migration out of the African cradle. As Dr Manica says: 'The major strength of our data is that it uses two independent datasets and yet both yield virtually identical results: that anatomically modern humans came out of Africa relatively recently, around 55,000 years ago, and eventually replaced older hominid species across the world.'

For more information, please contact Dr Andrea Manica (am315@cam.ac.uk). This research was published in *Nature* (2007) 448, 346–348.

cambridge cancer centre

The Cambridge Cancer Centre was successfully launched on 22 June with a highly motivating symposium.

The aim of this virtual organisation is to promote interdisciplinary collaboration between researchers in and around Cambridge whose work has current or potential applications to cancer research. The initiative will provide pump-priming funds for new collaborative projects and set up meetings to enhance the exchange of scientific ideas. If you are a researcher with an interest in the field, do visit the website to submit your research profile.

For more information, including how to submit a profile, please go to www.cancer.cam.ac.uk or email admin@cancer.cam.ac.uk

Diagnosing crime, dispensing justice

Finding the best routes to predicting, preventing and atoning for crime is a thorny issue. Experimental criminologists such as Lawrence Sherman, recently appointed as the fourth Wolfson Professor at the University of Cambridge Institute of Criminology, see randomised field trials as the shortest path to discovering the answers.

Professor Lawrence Sherman

Randomised trials have been a mainstay of testing drugs and surgery in medicine for decades. Remarkably, experimental criminologists have also been applying this gold standard to the testing of crime prevention theories. The results are providing police forces and probationary services worldwide with the means to improve their effectiveness.

For the past 30 years, Professor Sherman has been breaking new ground in crime prevention experiments. In the USA, his work identifying crime 'hot-spots' in cities, for example, discovered that a small fraction of street corners generated most of the crime in the city. Through randomised field trials, he found that directing increased police patrol time to these areas substantially reduced violence and disorder, as measured by independent observers working incognito in the hot spots. 'This was the first successful demonstration that police patrol prevents crime. It transformed policing in the US away from random patrol to hot-spot patrol,' says Professor Sherman, who moved here in April from the University of Pennsylvania.

His more recent randomised field experiments in Australia and the UK have tackled the issue of 'restorative justice' – in which the offender comes face to face with the victim to account for the crime. 'The discussion between victim and offender almost always included an apology, which crime victims say they desperately want and don't get in the criminal justice system,' says Professor Sherman. The randomised trials test whether the face-to-face meetings, led mostly by police officers, can help victims and reduce re-offending. The results on crime are currently being collated, but the results for victims show major reductions in post-traumatic stress symptoms. They also show more offenders accepting responsibility for their crimes.

'Including all experiments looking at the number of offences brought to justice,' says Professor Sherman, 'it turns out that one of the most powerful things restorative justice can do when it's an alternative to prosecution is to increase the number of cases successfully resolved. Given the high rate of case dismissal as a result of witnesses not turning up at court after long delays, restorative justice meetings yield two to three times better odds that an offender who's been arrested for an offence will admit the crime and accept some form of justice.'

His new post at Cambridge will allow Professor Sherman to intensify his research on crime prevention strategies and restorative justice in the UK. The Institute of Criminology already has a worldwide reputation in experimental methods, as well as in other ways of studying crime. Professor Sherman's appointment builds on its prestigious research strengths and the excellence of its academic staff. He succeeds Professor Sir Anthony Bottoms, who retired from the Wolfson Professorship in October 2006, and continues his work in building bridges to the police, prison and probation services.

For more information on the Institute of Criminology, please go to www.crim.cam.ac.uk

Letters of the 'acid-bath murderer'

Over 100 documents written by the notorious serial killer John Haigh, the 'acid-bath murderer', are now available to researchers in the Institute of Criminology.

Between 1944 and 1949, John Haigh's murderous spree earned him a place among the UK's most infamous killers. Killing six victims for financial gain, including his former friend and his friend's wealthy parents, he then disposed of their bodies by immersing them in 40-gallon drums of sulphuric acid. He mistakenly believed that he was committing the 'perfect murder'. But police suspicions were aroused when questioning Haigh over the murder of a wealthy widow. After their gruesome discovery of the unfortunate woman's gallstones, and later some bone and a set of false teeth, at Haigh's workshop, Haigh was tried and eventually hanged on 10 August 1949.

This unusual bequest to the Institute of Criminology was made by Vivian Robinson, an alumnus of Sidney Sussex College whose father had helped Haigh's parents to cope with their son's criminality.

Professor Friedrich Lösel, Director of the Institute of Criminology and an expert in forensic psychology, explains the significance of the bequest: 'Obviously the documents are of immense interest to us because we are involved in analysing the causes and background of serious crimes and for the first time we have the opportunity to analyse the Haigh archive from a scientific perspective.' The archive will provide a rare insight into criminal behaviour and possibly the roots of Haigh's predisposition to murder.

For more information, please contact the Institute of Criminology (www.crim.cam.ac.uk).

Police photograph of John George Haigh, taken at Horsham Police Station in 1949 (photo supplied by David Briffett, author of *The Acid Bath Murders*, Blake Publishing)

Defining words

Two very different projects in the University have at their heart the ancient craft of lexicography: the art of compiling and editing dictionaries. But one project is reviving glossaries created over a thousand years ago and the other is creating a new lexicon of an ancient language.

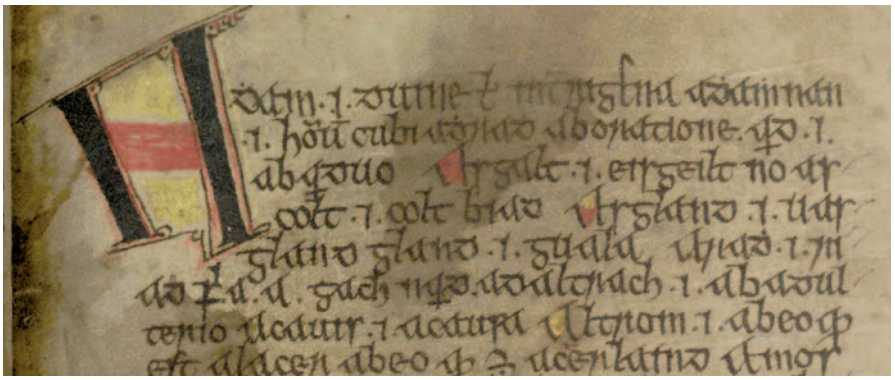


IMAGE COURTESY OF IRISH SCRIPT ON SCREEN

Cormac's Glossary in the Book of Uí Maine, fol. 177r, by permission of the Royal Irish Academy ©RIA

If you think of lexicography as a way of making sense of the world through words, the ancient scholarly glossaries can provide unique insight into the life and times of the people who wrote them. In the Department of Anglo-Saxon, Norse and Celtic (ASNC), a set of early medieval Irish glossaries written as long ago as the 8th century is being restored under the leadership of Dr Paul Russell. Meanwhile, modern-day lexicography is happening in the Faculty of Classics, where a team headed by Professor James Diggle is writing a new dictionary, or lexicon, of Ancient Greek to English. Both research projects are building fully searchable, web-based resources that will provide important academic tools for future research worldwide.

The Early Irish Glossaries Project is centred on three inter-related medieval glossaries known as *Sanas Cormaic* ('Cormac's Glossary'), O'Mulconry's Glossary and *Dúil Dromma Cetta* ('the Collection of Druim Cett'). These previously neglected works are semi-encyclopaedic listings of headwords and their definitions, ranging from single-word translations to explanations that include anecdotes and poems.

By carefully comparing and contrasting the different entries in each glossary, a picture is emerging of the literary and cultural environment of the scholars who wrote them. 'The glossaries have different preoccupations; for example, O'Mulconry's Glossary contains a great deal of Latin, Greek and Hebrew, while *Sanas Cormaic* seems very interested in the activities of poets and lawyers,' says Dr Russell.

Crucially, the nature of the glossaries lends itself to the creation of a fully searchable online database: 'The only way of making sense of these entries is not to treat them piecemeal,' explains Dr Russell, 'but to bring together from the different glossaries similar or related entries. Only then can you begin to say something sensible about them.' The project is one year into its three-year funding by the Arts and Humanities Research Council (AHRC) and, when complete, about 2600 entries will have been added to the database.

For the Ancient Greek Lexicon project, the drive to create a new dictionary stemmed from the inadequacies of earlier works, which are outdated in ways that cannot be solved by a superficial revision. Having secured a further three years' funding from the AHRC, a team of compilers in the Faculty of Classics are heading towards the completion of a project that has been nine years in the making, and uses an electronic database developed in collaboration with Perseus, an American digital library with a huge databank of classical texts. Modern technology allows rapid searches through hundreds of texts, so the writers can study the Greek words in their original context. As Professor Diggle explains: 'We are doing something that is radically new, not based on existing lexicons but going back to the original sources.'

The resulting entries are ground-breaking for their focus on providing contextual information, which is a vital part of a given word's meaning. The parallels between this modern-day lexicography and that of the early Irish scholars at work a millennium earlier are remarkable.

For more information on the Early Irish Glossaries project, please visit www.asnc.cam.ac.uk/irishglossaries, and on the Greek Lexicon Project, please visit www.classics.cam.ac.uk/glp/index.html

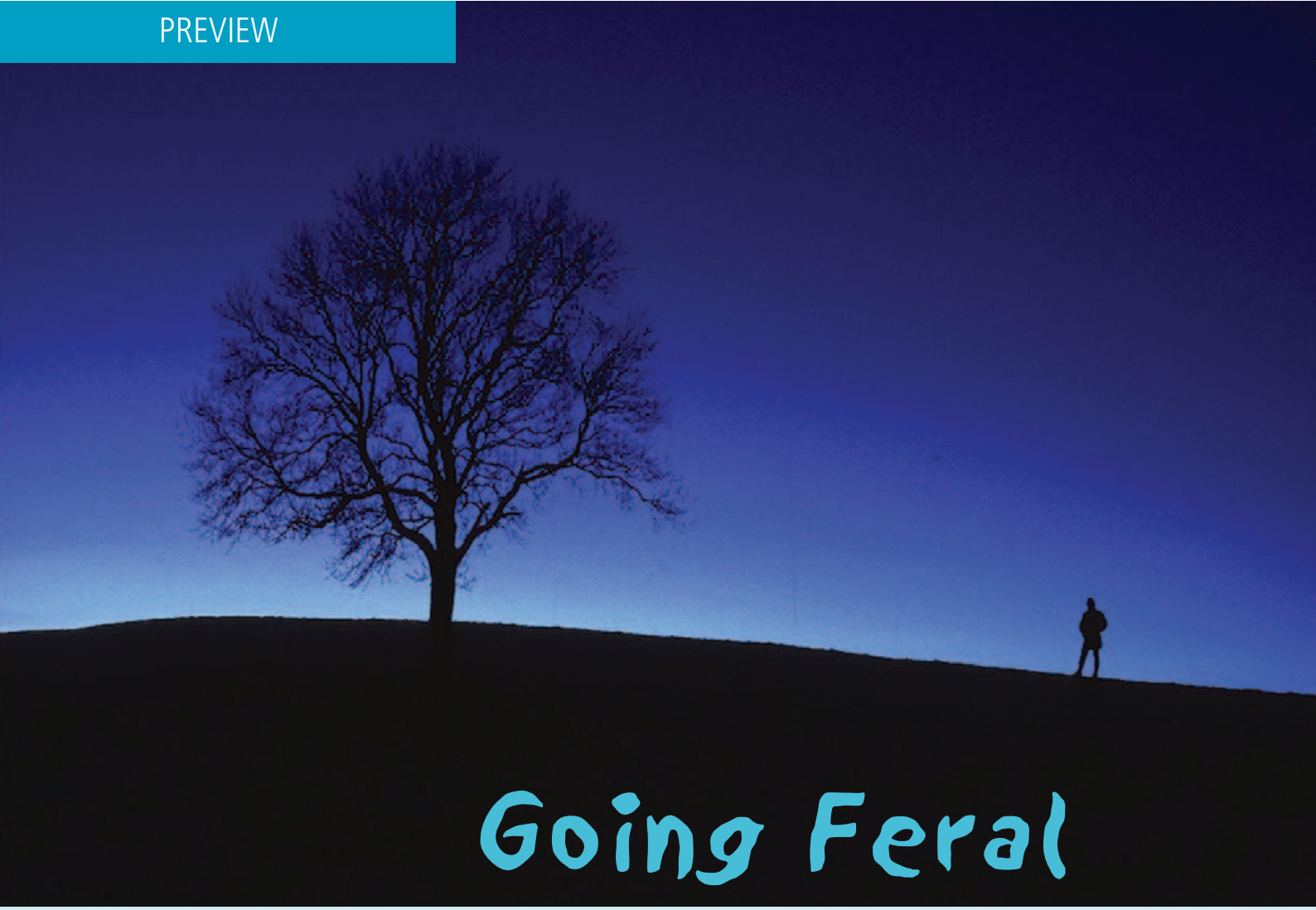
Arts, Humanities and Social Sciences Festival 22–31 October 2008

Following the success of the Cambridge Science Festival, which last year attracted an estimated 20,000 people and hosted over 100 events at 40 departments, an Arts, Humanities and Social Sciences Festival will take place in 2008.

PHOTOGRAPHER: NIGEL LUCKHURST

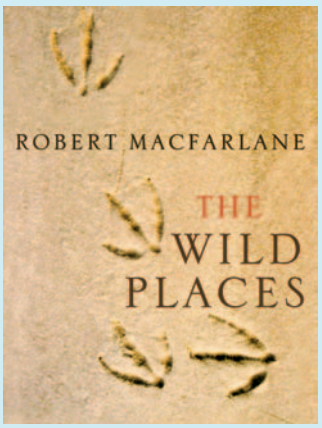
The Festival will celebrate the rich history of work in the Arts, Humanities and Social Sciences at the University by engaging the public in new dialogues and areas of interest, and promoting the University museums, collections and cutting-edge research. Events will stretch across the vast range of subjects – from music, theatre and the visual arts, to explorations within the fields of philosophy and geography. Planned activities include lectures by academics, department open days, visits from well-known alumni, art exhibitions, theatre and musical performances, and school visits. The Festival promises to be a stimulating and innovative experience for all ages.

Ideas for events in the Festival are being sought from academics, staff and students: please contact Nicola Buckley, Festivals and Outreach Co-ordinator (nicola.buckley@admin.cam.ac.uk; Tel: 01223 764069).



Going Feral

Are there any wild places left in Britain and Ireland? Robert Macfarlane has travelled in search of them, reflecting on the meaning of 'wildness' and the nature writing tradition.



Robert Macfarlane's *The Wild Places*, published by Granta in September 2007 and by Penguin USA in June 2008.

Time and again, I had read obituaries for the wild. To the American author William Least-Heat Moon, for instance, Britain had become 'a tidy garden of a toy realm where there's almost no real wilderness left and absolutely no memory of it.' I didn't want to believe these reports of the death of the wild, however. They did not square with my academic teaching on the subject of 'nature writing'. Nor did they square with my personal experiences of our archipelago: its ecologies, its natural histories, its geology and its weathers.

So I began a series of journeys around Britain and Ireland, to see what wild places still remained, and to explore the meanings and histories of 'wildness' in the context of different terrains and nations. I travelled widely – from the cliffs of Cape Wrath, to the holloways of Dorset, the storm beaches of Norfolk and Suffolk, the salt marshes of Essex, the moors and tors of Rannoch and the Pennines, the estuaries of Sutherland, and the sea caves of West Wales and Ireland.

At the beginning of my journeys, I decided – to come closer to whatever wildness was left – I would try to travel ferally. I would walk, swim and climb through the landscapes and seascapes I reached. I would sleep out wherever I could. I would travel in all four seasons, by night as well as by day, and in all weathers: high sunlight, rainstorm and blizzard. I would try to find new logics of motion – to follow the migratory paths of birds, the tracks of deer and the flight paths of bumblebees, and to see what came of these pursuits. And I would seek the company of native guides: people who had lived in those landscapes for many years, or come to know them intimately as scientists, artists, shepherds, or foresters.

I wanted, in short, to find new ways of approaching this much travelled-in, and much written-about, archipelago. Ways of 'coming at the landscape' – as the Georgian travel writer Stephen Graham once memorably put it – 'diagonally'.

Reader, I had a lot of fun. I spent nights on cliff tops and on distant beaches, and in snowy woods, on peaks and pilgrim islands. I climbed winter mountains in moonlight so bright I could read by it, I walked up frozen rivers, and I bathed at midnight in flaring phosphorescent seas – purple! gold!

JOHN BEATTY

silver! – off the Lleyn peninsula. I researched and wrote about the histories of Celtic monks, Wittgenstein's love of Connemara, and the Catholic recusancy in Dorset. I watched a red sun rise over an England that could have been Antarctica, and I slept in a shearwater colony (noisy), and in the flight path of thousands of migrating geese (exceptionally noisy). I got cold, high, lonely, hot, tired, low, wet – and most often of all, very happy.

Nature writing

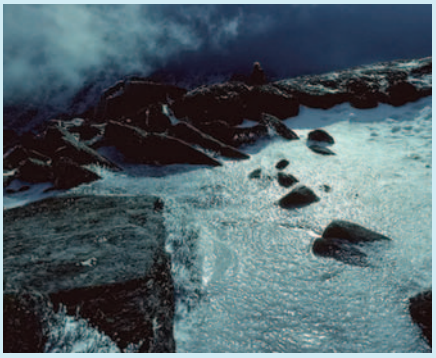
The book I have written – *The Wild Places* – is an account of these journeys into the wild, both as place and as concept. It isn't, as you will have gathered, an academic monograph. I'm not really sure what to call it: it mixes travel writing, natural history, geology, geography and memoir. 'Nature writing' is probably the easiest description: a great deal gummier is 'autobiopsychogeography', a recent academic coinage for such hybrid travelogues.

I have research interests in the relations between ecology, environmentalism and literature, and I lecture at undergraduate level on the theory of 'ecocriticism', as well as on the varieties of nature writing – the worshipful visions of Barry Lopez's *Arctic Dreams*, the pentecostal naturalism of Cormac McCarthy, and more recognisably lyric poets such as Robinson Jeffers and Alice Oswald. In short, the book both informs, and is informed by, my teaching within the Faculty of English.

The idea of the wild

What *is* wildness, though? When I began my research, I thought I knew what the word meant. To me, its obvious cognates were 'remoteness' and 'inhumanness', and geographically speaking, wildness was restricted to the high altitudes and high latitudes of the country. Places that were, to borrow a phrase from the controversial 1964 American Wilderness Act, 'untrammeled by man, where man himself is a visitor who does not remain.'

The more I travelled, however, the more it became clear that such a definition was inadequate. It took no account, for instance, of the dark historical events (the Irish Famine, the Scottish Clearances) that had left these northern and western landscapes 'remote' or 'depopulated'. It also propagated an unhelpful opposition between 'culture' and 'nature'. Everywhere I went, I found evidence of human life, past and present: fortifications, paths, dwellings, agricultural and industrial works. The wild and the human have braided together in these islands for millennia, and any attempt to separate them conceptually, I have come to think, is a category-error.



JOHN BEATTY

Dr Robert Macfarlane

The unofficial countryside

The greatest change in my understanding of wildness concerned scale. My first journeys were all to the big spaces of the north and west. It was with reluctance that I turned back south, into urbanised England.

What I came to understand, however, is that in England, wild places still exist – but on a small scale, and opportunistically. Wildness is there, if carefully looked for, in hedgerows, in river valleys, and in copses and spinneys. It is there, too, in the interzones and rough cusps of the country – quarry rims, abandoned railway sidings and motorway verges (places that the great natural historian Richard Mabey has described as 'the unofficial countryside'). This nearby nature is even there, I eventually discovered, in a tiny fragment of beechwood a mile from my city home in south Cambridge. It was in this beechwood that both my journeys and my book ended.

I finished my research uplifted and depressed. Depressed, because wherever I had been I had seen evidence of damage: pollution, marine debris and climate change. Natural England's recent report *Tracking Change in the Character of the English Landscape* assessed 40% of English landscapes to be degrading in terms of biodiversity and other ecological indices.

Uplifted, though, because wherever I went I also found evidence of a fierce human love for wildness and nature. I once gave a lecture on the idea of the wild at the Wesleyan Chapel on Christ's Pieces, Cambridge, and mentioned the beechwood near my home. Afterwards, an 86-year-old lady came up to me. She told me how, in the 1940s, she had taken cub scouts up into that beechwood, to camp overnight and boil tea in their billycans. 'For us,' she said, 'it was somewhere to have adventures, and see nature happening. A really wild place.'

For more information, please contact the author Dr Robert Macfarlane at the Faculty of English.

Would you like to contribute to the Preview section, describing the motivation behind your book and how it relates to your research within the University? Let us know about your forthcoming book by emailing us at Research.Horizons@rsd.cam.ac.uk

Energy in Cities: What does the future hold?

The Horizon Seminar 'Energy in Cities: What does the future hold?' will showcase the latest Cambridge research on the way we consume energy in built environments. The Seminar takes place on 10 October 2007 at Buckingham House, New Hall, Cambridge.

Energy is essential to every aspect of our economic and social well-being. The world today faces two big challenges: climate change and the security of energy supplies. Cities and regions have both a responsibility to reduce their carbon emissions and the opportunity to take advantage of new energy-efficient systems and renewable energy.

As we progress towards a sustainable energy future, consumption and efficiency are increasingly under scrutiny. Distributed networks with low-carbon technologies are emerging, providing new research and business opportunities. Interwoven with these challenges are those needed in urban mobility and clean transport: what economic and technological changes are needed to tackle congestion and decrease emissions?

At this Horizon Seminar, leading experts will describe their ground-breaking research in energy use in built environments, clean and efficient urban transport, and renewable energy generation in cities.

USE OF ENERGY IN THE BUILT ENVIRONMENT

The built environment faces rising energy demands and a requirement for more efficient energy. This session discusses the sustainable urban environment and how great an impact we can make to meet these challenges. Can we change our ways, and will economics drive our behaviour?

Professor Peter Guthrie
Dept of Engineering
Professor Koen Steemers
Dept of Architecture
Professor Andy Woods
BP Institute for Multiphase Flow
Professor Colin Humphreys
Dept of Materials Science and Metallurgy
Dr Andrew Rice
Computer Laboratory
Dr Jonathan Köhler
Dept of Land Economy

CLEAN AND EFFICIENT URBAN TRANSPORT

Transport and mobility are essential for all aspects of life in the city. How do we balance congestion and pollution with energy efficiency and economic impact?

Professor Marcial Echenique
Dept of Architecture
Professor Jean Bacon
Computer Laboratory
Professor Nick Collings
Dept of Engineering
Professor David Cebon
Dept of Engineering

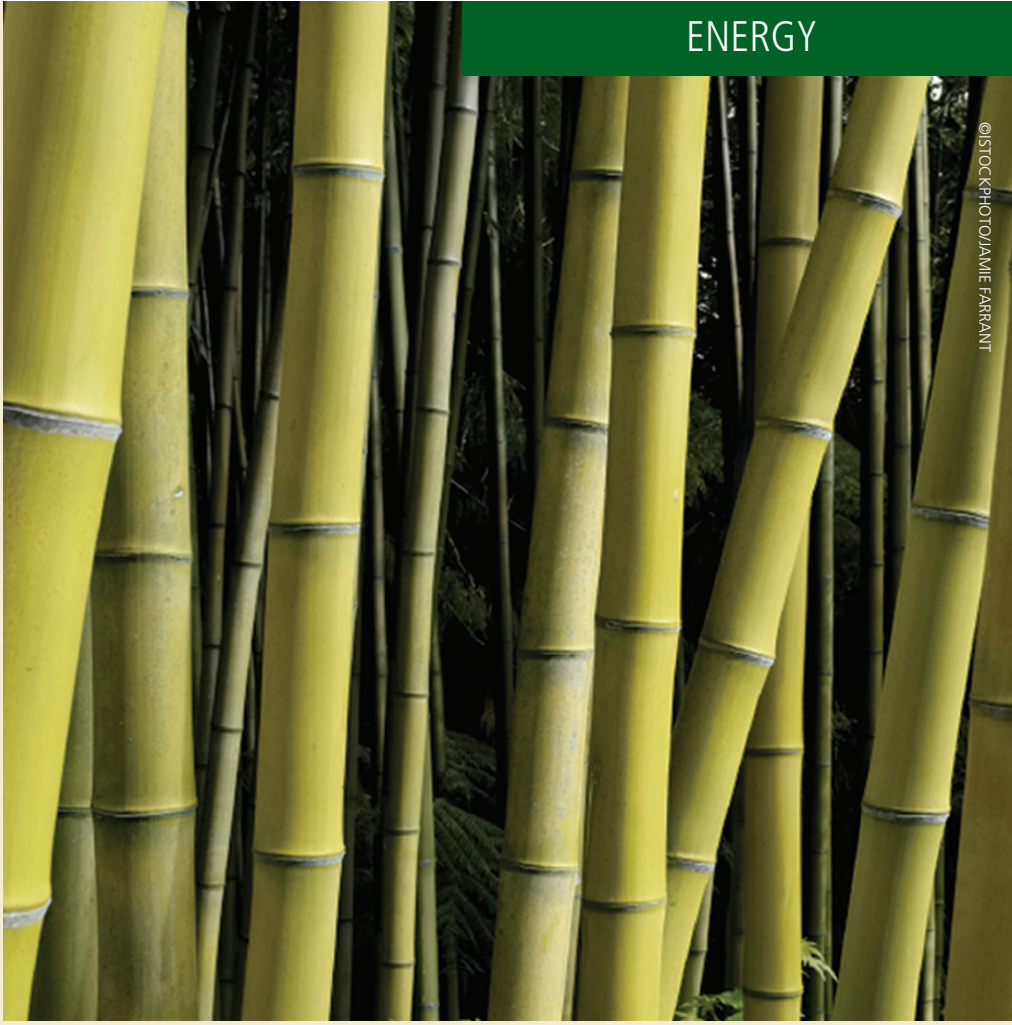
ENERGY GENERATION

As we move towards a low-carbon energy system, new possibilities are emerging for distributed networks and the use of renewables. In this session, we explore some low-carbon alternatives to the centralised national grid.

Professor Gehan Amaratunga
Dept of Engineering
Dr Holger Babinsky
Dept of Engineering
Professor John Young
Dept of Engineering
Dr John Dennis
Dept of Chemical Engineering

For more information about the Horizon Seminar series and to book online, please go to www.rsd.cam.ac.uk/events/horizon or email horizon@rsd.cam.ac.uk

Wind Turbines Turn to Bamboo



©ISTOCKPHOTO/JAMIE FARRANT

Bamboo – one of China's most precious commodities – is showing great promise as the material of choice for building wind turbines.

As increasing attention turns to how we might generate energy from sustainable and renewable sources – from the natural resources of wind, solar and tidal power, among others – research in the development of the best materials to harness this energy is imperative. Jim Platts from the Institute for Manufacturing has worked for over 20 years on wind turbine design and most recently on developing a new type of blade made from bamboo.

Blade technology

The large rotating blades that make up wind turbines must work at the limits of their tensile strength when facing into the wind and revolving the turbine shaft that generates electricity. From the beginning, the best blades have used wood – Nature's own fibre-reinforced composite material – as the primary structural material, comprising some 70% of the weight of the blade. Wood has excellent fatigue behaviour and an unbeatable strength-to-cost ratio, as well as being a low-energy input material. As Jim Platts explains: 'Most people don't think of wood as a technical material, but it has superb properties: wood uses more than an order of magnitude less energy input to provide the required stiffness compared with materials such as fibreglass, steel and aluminium. In energy technology terms, this ranks it as a technical material of the highest order.'

The bonus of bamboo

Early blades in the 1980s used African mahogany, moving on to poplar, and then more recently to Finnish birch. But there is one type of wood that is better than all of these in having the most ideal properties for blade construction: bamboo (particularly the variety known as Mao bamboo). For China, which has about 2.8 million hectares of Mao bamboo, much of which grows on mountainous areas unusable for farming, this is an exciting new use of a material that has been employed in many different ways for thousands of years.

Jim Platts has been working in China and Cambridge, analysing the tensile strength and stiffness properties of bamboo and identifying how best to select and prepare bamboo to provide maximum benefits in blade design. Meanwhile, in China, the manufacturing and supply routes are being forged, and it's anticipated that the first blades will be made by the end of this year.

'What's particularly attractive about this technology,' he comments, 'is that bamboo brings a new perspective to carbon trading because bamboo sequesters carbon from the atmosphere, building it into high-strength fibres. In constructing wind turbine blades from bamboo, the blades have captured enough wind energy to pay back the energy used in their construction after just two days – an impressive statistic for a turbine with an average life of 20 years.'

As China readies itself to develop its own wind turbine industry, Jim Platts and his Chinese partners have shown that bamboo can be used as an alternative to energy-intensive fibres and polymers for this high technology application. The use of bamboo in this way makes wind energy an attractive proposition for future sustainable electricity generation.

Jim Platts

For further information, please contact Jim Platts (mjp@eng.cam.ac.uk) at the Institute for Manufacturing in the Department of Engineering.

Taking the long view on climate change

Cambridge Earth Scientists are contributing to our understanding of the climate system by studying the history of climate change recorded in sediments deposited on the sea floor.

The Earth's climate has always changed and no doubt always will. However, this alone does not tell us very much about the climate system: we need to be able to say exactly *how* and *why* climate can change. Today this requirement has been brought to the fore by the prospect of human-induced global climate change resulting largely from greenhouse gas emissions that arise from our massive and growing appetite for fossil fuels. Thousands of scientists are now striving to predict how a sharp rise in greenhouse gas concentrations will affect the entire climate system, including the ecosystems and societies that it supports. But how can we be sure about our theories of climate change, let alone our theories of ecosystem or market response? Just how important are greenhouse gases in controlling global climate? And what are the timescales and thresholds of climate adjustment? These are just some of the urgent questions that have been raised by the prospect of anthropogenic climate change.

To help answer such questions we can look to the past, at how the Earth's climate evolved prior to the relative stability that human society has so far enjoyed. Researchers in the Department of Earth Sciences are taking up this challenge, using marine sediments as their lens into the past, and as a guide to the future.

Palaeoclimatology

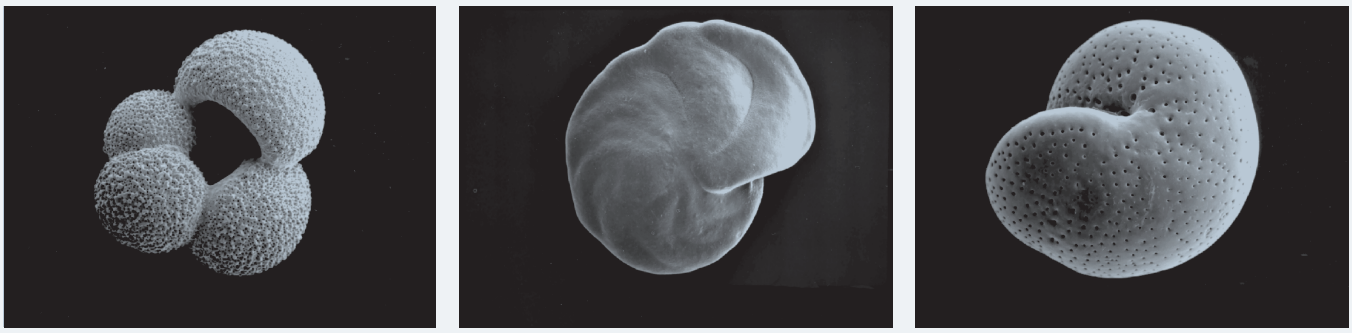
The study of past climate change – palaeoclimatology – aims to reconstruct what has happened in the past, in the oceans, on the land, in the atmosphere and in ecosystems, and to infer how the global climate system works 'as a whole'. In the last 20 years of palaeoclimate research, three major questions have emerged that are particularly relevant to modern climate change. First, how did changes in solar radiation (insolation) and atmospheric carbon dioxide (CO_2) conspire to trigger massive global climate upheavals such as the glacial–interglacial ('ice-age') climate cycles? Second, what regulates atmospheric CO_2 concentrations under changing climatic conditions, and what roles can we ascribe to marine biological productivity or ocean circulation changes in particular? And third, how abruptly can regional climate change and with what repercussions for the rest of the world?

All of these questions are interconnected of course, although each bears on a different aspect of the climate system's ability to pace and amplify climate perturbations through sensitive 'feedback' processes.

Past climate by proxy

A central aspect of palaeoclimate reconstructions is the 'proxy' character of our observations. Because scientists cannot measure past ocean temperatures directly, they must measure the impacts of past temperature changes instead, usually based on temperature-sensitive organisms or temperature-sensitive chemical constituents in their shells or skeletons.

As a palaeoceanographer, Dr Luke Skinner specifically makes use of marine sediments as a window into the past.



DR LUKE SKINNER

Geochemical measurements using foraminifer shells permit the reconstruction of a variety of environmental parameters (left to right: magnifications of planktonic foraminifer *Globigerinoides bulloides*; benthic foraminifer *Planulina wuellerstorfi*; benthic foraminifer *Melonis pompiloides*)

Among the many advantages of using marine sediments are that they can be obtained from nearly two thirds of the Earth's surface, they generally provide unbroken and often very high-resolution records of past conditions, and they contain a diversity of constituents that can be analysed, from tiny fossil shells to grains of sand dropped by passing icebergs.

To reconstruct past climate change, Dr Skinner collects and studies the fossil calcite shells of foraminifera – single-celled blobs of protoplasm – that have accumulated on the sea floor. Using the shells of these tiny creatures, Dr Skinner has been able to generate detailed records of temperature change, both at the sea surface and in the ocean interior. In combination with ice-rafted debris and oxygen- and carbon-isotope records, these reconstructions have helped to demonstrate that the North Atlantic region experienced very intense and abrupt climate swings in the past, involving massive glacier surges as well as drastic changes in the deep ocean circulation system and the Gulf Stream. It has also been possible to show that these same changes in the Atlantic Ocean's circulation were accompanied by a 'see-saw' in temperatures across the hemispheres, with heat pooling in the South to the extent that it was not efficiently delivered to the North. Based on records such as these it is now clear that global change can be heterogeneous and can occur too suddenly to be presaged by obvious warnings.

Perspectives on the future

Although it is clear that no previous climate period can really serve as a blueprint for the future, important lessons can still be learned from the study of the past. One important example is the use of palaeoclimate data to guide the improvement of our climate simulation models. Because numerical and statistical models provide our only means for predicting future climate, it is imperative that they be as general as possible. Studies like those described here are helping to achieve this, by revealing the feedbacks, thresholds and characteristic timescales for climate adjustment, across a wide range of climatic contexts.

In the future, global CO_2 levels will only be stabilised if we either drastically cut our emissions or identify, trigger or create a process that 'mops up' exactly as much CO_2 as millions of consumers are able to produce each day (the basis of carbon capture). The history of climate change tells us that we are going to need as many one-way fluxes out of the atmosphere as we can muster if are going to compete with the 'leak' we have created in the Earth's largest standing carbon reservoir, the solid Earth. We have much to learn about the climate system, both for our own sake and for the sake of knowledge itself.

Dr Luke Skinner

For more information, please contact the author Dr Luke Skinner (luke00@esc.cam.ac.uk) at the Department of Earth Sciences.

Carbon capture

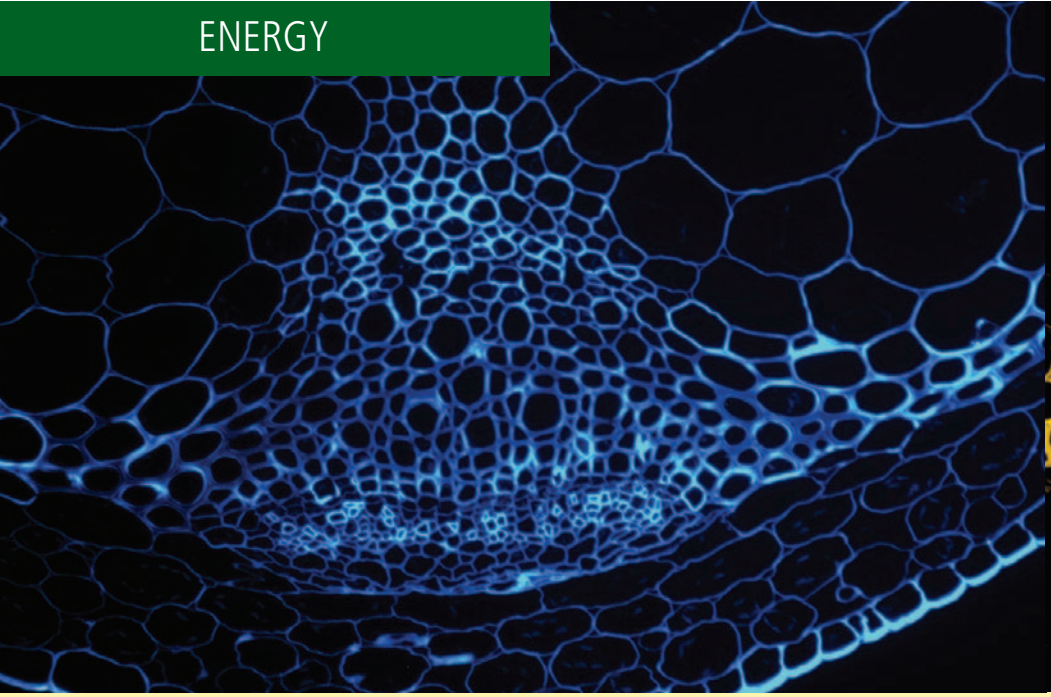
Whenever fossil fuel (coal, oil or gas) is burnt, carbon is released as CO_2 into the atmosphere, where it traps the Sun's heat. Can we counteract this build-up by capturing and storing CO_2? Any solution would require storage of many millions of tonnes reliably and possibly for up to 10,000 years.

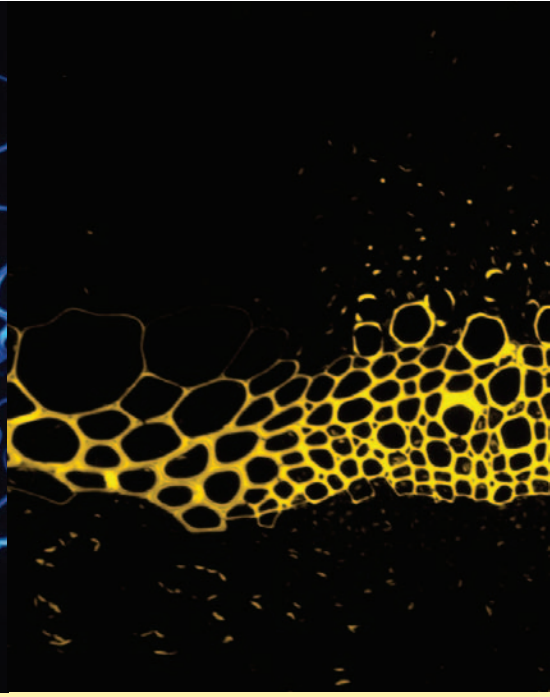
Compressing and injecting CO_2 into deep geological formations could provide the answer. The presence of oil, gas and natural CO_2 trapped in reservoirs underground for millions of years demonstrates that storage of CO_2 is feasible. At the Sleipner Oil Field in the Norwegian sector of the North Sea, CO_2 is already being separated from natural gas and re-injected at about 1 km depth below the sea surface. The CO_2 rises through the sandy earth before spreading out below a series of thin mudstones beneath the thick overlying mudstone.

A collaborative research project between Professor Mike Bickle in the Department of Earth Sciences and Professor Herbert Huppert in the Institute of Theoretical Geophysics has been modelling the spread of these accumulations to work out how much CO_2 is trapped and to understand the flow of CO_2 in the reservoir. A particular challenge is to predict the behaviour of the stored CO_2 over time to determine the safety of long-term CO_2 storage in this way.

The benefits are clear, as Professor Bickle explains: 'CO_2 storage is a feasible, politically achievable and relatively inexpensive way for dealing with the problem of increasing atmospheric CO_2 levels.'

For more information, please contact Professor Mike Bickle (mb72@esc.cam.ac.uk) at the Department of Earth Sciences.





Using plants to harvest the Sun's energy

How can we efficiently unlock the bioenergy stored within plants? Research carried out in the Department of Biochemistry is breaking down the cellular barriers.

In the search for fuels of the future, one of the most promising areas for the production of sustainable energy is the plant world. So-called 'biofuels' are renewable and home-grown, key advantages in the face of rising oil prices and instability in oil-producing countries. And, as important, biofuels are potentially 'carbon neutral' – carbon absorbed by the plant as it grows is balanced by the carbon released when used for energy – and so using biofuels can contribute to environmental goals to reduce greenhouse gas emissions.

Of course, in practice it's not that simple – from the moment the seed is planted, energy is required to farm and process the crops, reducing the potential carbon savings that could be made. However, if the energy balance could be tipped further into favour, the environmental and energy security advantages are clear. As a step towards this, researchers in the Department of Biochemistry are studying the way plant cell walls are built, in an effort to unlock their energy stores with greater efficiency. Despite these cell wall constituents being some of the most abundant on Earth, and having enormous nutritional, agricultural and industrial importance, until now surprisingly little has been known about the genes and enzymes that make them.

First- and second-generation fuels

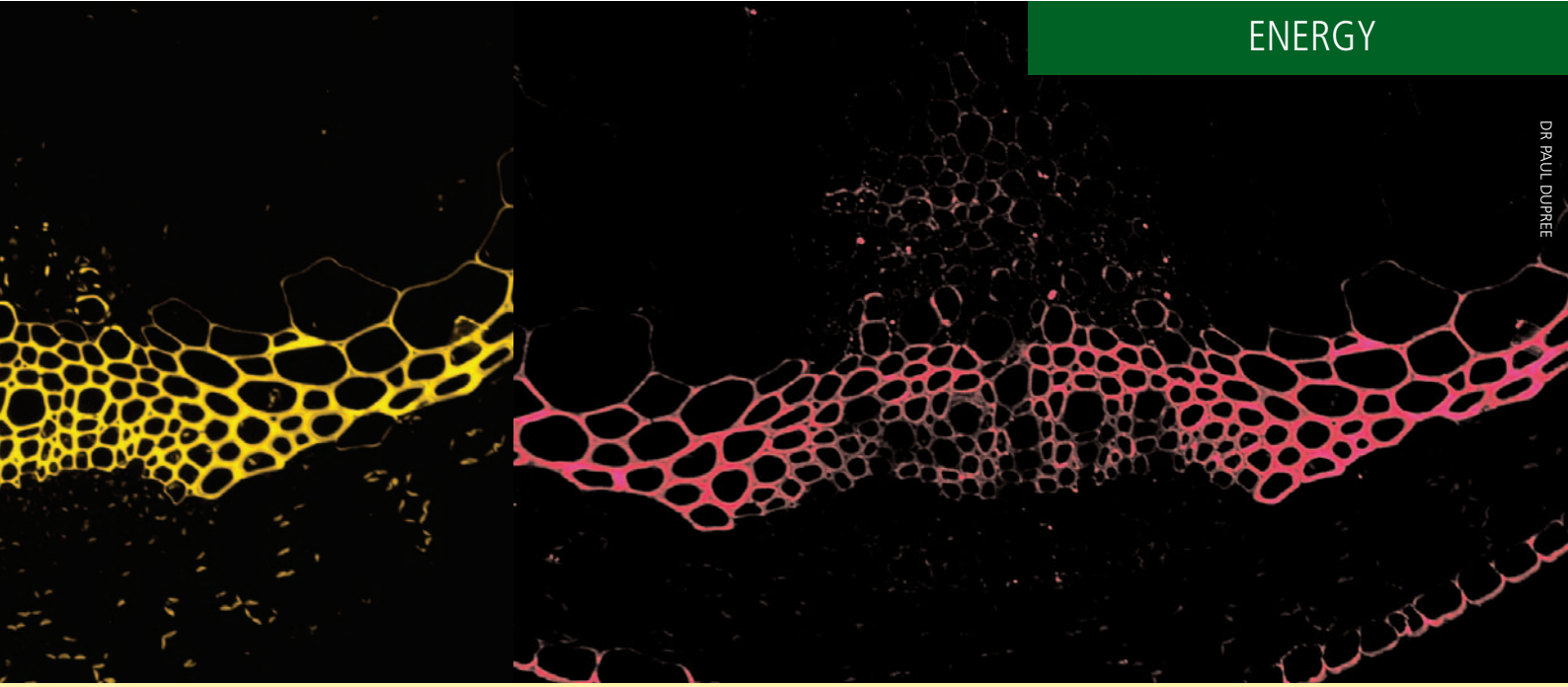
So-called 'first-generation' biofuels are made from food crops. In Europe and the USA, first-generation fuel is often made either from rapeseed oil, which is converted to biodiesel, or from maize, which is converted to glucose syrup and fermented to ethanol. We now know that there are substantial problems with the longer term use of maize or rapeseed oil to make biofuels: because of the energy required to farm and process these crops, the reduction in carbon emission through their use is relatively low, or may even be non-existent. Moreover, as the world population continues to rise, there are justifiable concerns that the use of food for energy will lead to increases in food prices and food shortages.

Much effort has therefore focused on 'second-generation' biofuels, made from any source of woody plant material, which could include straw, wood and food waste. In the UK, miscanthus grass and short rotation coppice willow, both of which will grow on marginal land that cannot be used to farm food crops, are now being bred for increased biomass yield and other improved sustainability qualities. Not only do these perennial species require lower agricultural input of fertilisers, pesticides and herbicides, but they are also much more productive, with a longer growing season than the conventional annual crops.

Breaking down barriers

So why aren't second-generation biofuels being used already for transport fuels? One of the main reasons is that unlike maize starch, which is easily digested, the tough woody tissues are resistant to enzyme attack. One solution is to use the microbes in the guts of termites and cows that slowly break down wood or grass into sugars, but current industrial techniques for this conversion are inefficient, expensive and not commercially well developed. Another solution is to look at how the sugars are locked up in the plant and develop a way of releasing them more easily: this is the route taken by Dr Paul Dupree's research group.

Plant sugars make the rigid cell walls that give the plant its strength and shape. Long chains of linked sugars



DR PAUL DUPREE

The main plant stem cell wall polysaccharides are cellulose, xylan and mannan (shown left to right in different colours)

known as polysaccharides are tightly interwoven into a structure that is physically flexible, yet strong and resistant to digestive enzymes. The main cell wall polysaccharide, cellulose, is made of pure glucose just like maize starch, but because the sugars are linked into chains in a different way, the plant cell walls are resistant to enzyme attack.

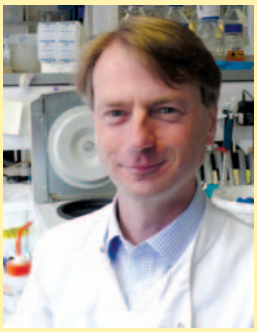
Plants vary enormously in the types and amounts of sugars used to build their walls, as well as in the way the sugars are linked together. These factors influence how easily the plants can be digested and how much of the wall can be fermented to ethanol. As this variability is under genetic control, Dr Dupree and his colleagues are searching for the plant's genes that control this variation. It is likely that several hundred genes in plants are involved in making their walls and, until recently, this genetic complexity has hindered investigations of the process.

Each plant cell has hundreds of cell wall polysaccharide factories, known as Golgi bodies, which weave the sugars into the polysaccharides. To find the genes that direct the formation of the cell wall polysaccharides, Dr Dupree's group has examined the enzyme machinery in these factories, with the help of Dr Kathryn Lilley's group in the Cambridge Centre for Proteomics in the Cambridge Systems Biology Centre. Now, the function of more than 10 individual components of this machinery has been discovered, and more than 100 further possible enzymes have been identified.

Unlocking the potential

Having found the genes involved in making the cell wall polysaccharides, the question could then be asked: is it possible to find plants that have defective components that are broken down more easily? Biofuel generation from such plants would be faster, more efficient and closer to carbon neutrality. The answer is yes – Dr Dupree's group has now found plants in which some of the polysaccharides are not linked together in the normal way. Remarkably, the plants seem to grow normally. By applying enzymes from wood-rotting microbes to the plant walls, more of the sugars could be released from the cell walls than usual. And even more encouragingly, a further study has shown that the activity of some genes can be increased, with the effect of increasing the amount of fermentable sugars in the plant cell walls. The expectation is that these studies will allow future bioenergy crops to be bred to provide greater quantities of biomass that can be converted more simply and cheaply to biofuels: a step towards bringing fuels of the future closer to fruition.

For more information, please contact the author Dr Paul Dupree (p.dupree@bioc.cam.ac.uk) at the Department of Biochemistry.



Dr Paul Dupree

Driving ambitions

Using plants to provide renewable transport fuels has grown quickly in the past few years and is set to continue:

- The UK Government and EU legislation obliges transport fuel suppliers to increase biofuel components to about 5% of fuel by 2010. The EU aims to increase this to 10% of fuel by 2020.
- In the USA, in an effort to reduce dependence on foreign oil imports, Congress aims to produce 25% of all energy by 2025 from renewable sources. By then, 80 billion litres of US transport fuel will be made with 'advanced' biofuels such as cellulosic ethanol – five times the current levels from maize.
- Following the energy crisis in the 1970s, Brazil now leads the world in biofuel use, having developed the production of ethanol from its huge supplies of sugar cane. This now provides an amazing 40% of transport fuel in Brazil and is achieved by farming as little as 1% of the agricultural land for fuel.

Live Long and Prosper? Ageing in the 21st century

The Horizon Seminar 'Live Long and Prosper? Ageing in the 21st century' will bring together academics and leading thinkers across the University and beyond to discuss ageing-related issues. The Seminar takes place on 4 December 2007 at the Centre for Mathematical Sciences, Cambridge.

Improvements in health care, sanitation and diet over the past 200 years have led many societies in developed economies to experience dramatic increases in longevity. It is a matter of some debate as to whether the trend can continue. Some argue that an economic or biological limit will be reached; others believe that the trend will continue. Advances in our understanding of cellular and genetic processes may offer further possibilities for extending lifespans. What effect will an ageing population have on the individual, on society and on economies worldwide? Does it represent a 'demographic time bomb' or are there opportunities to be explored? Where are the answers to be found?

THE AGE BOOM

In some developed economies today, life expectancy at birth is more than double what it was two centuries ago. How have we arrived at this situation, and what effects are we already experiencing?

LIVE LONG...

All of us are keen to live long and healthy lives, but a myriad of different advice exists on strategies we can adopt today to improve the length and quality of life in the future. Will our bodies and minds rise to the challenge of increasing longevity?

...AND PROSPER?

The impact of older populations is already being felt in developed economies. Is economic crisis the unavoidable consequence, or can we adapt in time to exploit the opportunities of a population that remains productive for longer?

AGEING IN THE 21st CENTURY

As the 'baby boom' generation reaches retirement age, how might our experience of ageing, and our attitudes to older people, change in the next century?

Hear the opinion of leading academics at this Horizon Seminar, including:
Professor Felicia Huppert (Director, Well-being Institute; Dept of Psychiatry)
Professor Richard Smith (Dept of Geography)
Professor Kay Tee Khaw (Dept of Clinical Gerontology)
Professor Carol Brayne (Dept of Public Health and Primary Care)
Professor John Clarkson (Engineering Design Centre)

A full programme for the day will soon be available: for more information and to book online, please go to www.rsd.cam.ac.uk/events/horizon or email horizon@rsd.cam.ac.uk

Getting to grips with inclusive design

The so-called 'demographic time bomb' is ticking. But is product design good enough to keep up with the ageing population?

By 2020, nearly half the adult population in the UK will be over 50 years old. Many will face everyday challenges as a result of failing mobility, vision, hearing and dexterity. And yet products are often designed with only the able-bodied user in mind. Researchers at the Cambridge Engineering Design Centre (EDC) in the Department of Engineering have a vision – to re-educate designers to design mainstream products that are usable by as many people as possible. This ethos is described simply as 'inclusive design'.

'A good inclusive design not only excludes fewer people but also reduces the level of frustration that many able-bodied people find when they're using the same products. That's the clear message we take out into industry. Tackle the problems that lead to exclusion and you tackle the problems that lead to frustration – in that sense inclusive design is just better design,' explains Professor John Clarkson, Director of the EDC. 'Everybody has used products that frustrate them and also products that delight – which would you buy?', says Dr Terry Dickerson, Industrial Liaison Manager at the EDC.

A fruitful collaboration

The third consecutive four-year programme in inclusive design, funded by the Engineering and Physical Sciences Research Council (EPSRC), has just begun at the EDC, with the aim of defining a national dataset for describing people's capabilities, aspirations and desires in their interactions with products. From the outset, Professor Roger Coleman at the Royal College of Art (RCA; www.rca.ac.uk) has been a crucial partner. As Professor Clarkson says: 'We have a unique project in the UK – we are an engineering design group working directly alongside a product design group. It's this alliance that has proved so valuable.' One of the outcomes of this extraordinarily fruitful collaboration is the development of a toolkit to promote and inform on the benefits of inclusive design.

Tools for change

The increasingly aged population makes a compelling case for designing inclusively, both in the home and in the workplace. And from a business viewpoint, the economic advantages of designing products that more people can use are clear. But where do designers and key decision makers in business begin?

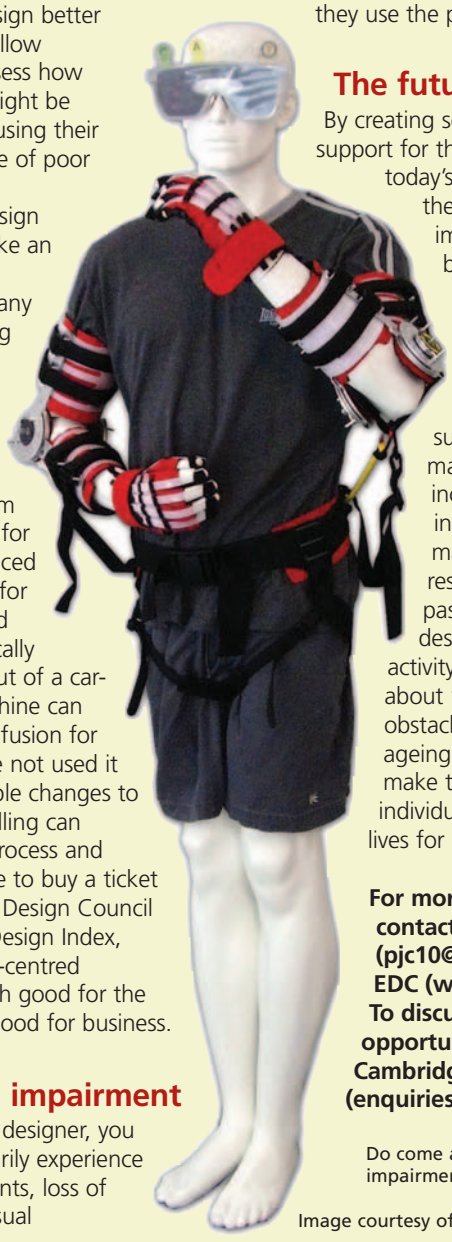
The research-based collaboration between the EDC and the RCA, together with input from the product development company Sagentia, has had multi-dimensional and creative results. A principle component is their online Inclusive Design Toolkit (www.inclusivedesigntoolkit.com), sponsored by BT, which was launched in July 2007 at the Business Design Centre in London. The website and accompanying book raise awareness of the range of potential product users, give guidance to design better products, and allow designers to assess how many people might be excluded from using their product because of poor design.

A simple design change can make an enormous difference to many users: enhancing the colour contrast on the controls of a kitchen appliance not only makes them easier to locate for those with reduced vision, but also for those with good vision. The typically haphazard layout of a car-park ticket machine can cause great confusion for those who have not used it before, yet simple changes to layout and labelling can demystify the process and enable everyone to buy a ticket with ease. As a Design Council report shows (Design Index, 2005), this user-centred approach is both good for the customer and good for business.

Simulating impairment

Imagine if, as a designer, you could momentarily experience the stiffened joints, loss of strength and visual impairments that the people you wish to include encounter every day. A fascinating move towards this by the EDC has been the building of physical simulators for a range of disabilities. 'We can't mimic the underlying causes of disabilities, or how people adapt to them,' says Professor Clarkson, 'but we can give an indication of some of the challenges faced.'

Ten complete physical impairment simulator kits have now been built and early studies looking at the response of designers to 'fast-forwarding' age-related disabilities have been hugely encouraging as to their usefulness. Eventually, the aim is to calibrate the simulator kits so that they directly relate to specific levels of impairment. Simulation kits like these can help overcome potential disconnection between the designer and the end-user. However, as Professor Clarkson cautions: 'This is just one part of the process to enable designers to gain more insight into diversity in the population. We strongly encourage designers to talk to actual users, engage with the people they are designing for and see at first-hand how they use the products.'



The future is inclusive

By creating software and hardware support for the challenges faced by today's and tomorrow's designers, the EDC is providing important engineering benefits in the UK. As we move rapidly towards a demographic shift in age, with dramatic lifestyle implications, promoting inclusive design and supporting those who will manage it is becoming increasingly important for individuals and manufacturers alike. The researchers at EDC are passionate that inclusive design needs to be a core activity – that inclusive design is about 'removing unnecessary obstacles in everyday life'. For the ageing population, this could make the difference in helping individuals to lead independent lives for as long as possible.

For more information, please contact Professor John Clarkson (pjc10@eng.cam.ac.uk) at the EDC (www-edc.eng.cam.ac.uk). To discuss commercialisation opportunities, please contact Cambridge Enterprise Ltd (enquiries@enterprise.cam.ac.uk).

Do come along and try out EDC's physical impairment simulator kits on 4 December at the Horizon Seminar
Image courtesy of the Engineering Design Centre

A brief history of ageing

As life expectancy increases, what can historical analysis of longevity tell us about limits to the human lifespan?

Over the past 200 years, life expectancy at birth has doubled from around 40 years to over 80 years in countries like the UK. In some countries such as France, where 250 years ago life expectancy at birth was slightly over 25 years, life expectancy has increased by almost 55 years. Although these trends have been well documented, there remains much disagreement between biological scientists and demographers (who study the structure and dynamics of populations) about their meaning. The question is: can we use these trends to predict future developments in life expectancy?

A biological ceiling?

On one side of the debate are those who believe that under favourable conditions the typical human has a characteristic maximal lifespan and that we are now approaching the uppermost limits to life expectancy. The main argument in favour of this stance is the notion that increasing life expectancy is beyond the reach of Darwinian forces of natural selection because almost all mortality now occurs after the age of reproduction. A further argument for having reached an upper limit rests on the fact that the reduction in infant mortality rates over the centuries in many societies has already brought a huge increase to lifespan, and further improvements in medical care won't now make such a significant impact on this age group.

However, each time a natural limit has been suggested, it has been exceeded. In the 1920s, eminent demographers thought that the maximal lifespan was a little under 65 years of age (life expectancy in the USA at the time was around 57 years). Distinguished analysts as late as 1990 declared that life expectancy would not exceed 85 years unless major breakthroughs were to occur in controlling the fundamental rate of ageing. This cap was surpassed by Japanese women in 1996, and a number of other countries have now joined Japan in passing this upper limit.

The historical perspective

Demographers who look at life expectancy trends over time, and give considerable weight to the findings from historical study, expect there to be continued improvements to life expectancy. Historical analysis undertaken collaboratively in the Department of Geography in Cambridge and at the Max Planck Institute for Demographic Research in Rostock, Germany, has focused on life expectancy by looking at records dating back to the 1840s in a large number of countries for which estimates can be made. These data have been used to chart trends over a period from 1840 to the present day.

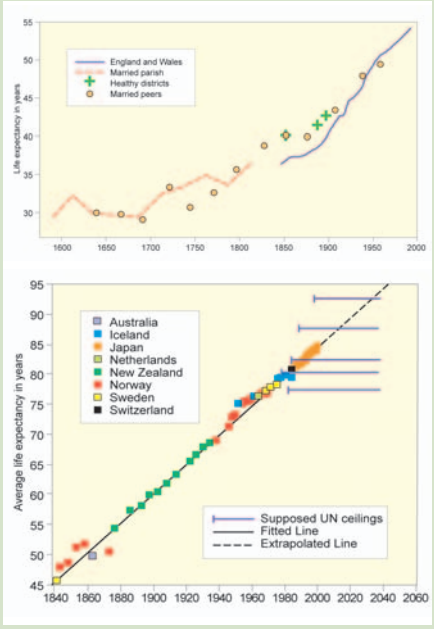
In 1840, life expectancy was highest among Swedish women, who lived on average 45 years. Today, as mentioned earlier, the longest life expectancy is to be found among Japanese women, whose lives on average exceed 85 years. This improvement appears to have been steady, with an average increase in life expectancy of three months every year until the present day. Record male longevity has risen rather more slowly yet still shows the same linear rise, with Japanese men now holding the record for the longest male survivors at an average age of just over 78 years.

In England, female adult mortality has been estimated from Anglican parish registers and genealogies relating to the Peerage, which reveal an increase in adult survivorship that began as early as 1700. Interestingly, this rise was experienced by both high- and low-income members of society, suggesting that at least initially the process derived from health-related changes rather than from a rise in economic well-being.

Future longevity

Historical demographic analysis has exposed a line of challenging enquiry: will life expectancy continue to rise, as predicted from the previous trends, or are we reaching a biologically determined ceiling? It would be rash on the basis of the historical trends to promote the idea of the attainment of eternity among humans or even an untrammelled route to a life expectancy at birth of 100 years by 2060, as some enthusiasts have done. Nonetheless, it is certain that centenarians will soon become commonplace individuals in our midst.

A significant part of the improvement in average life expectancy, certainly before 1950, was achieved by improvements in survivorship among the youngest age group; behavioural changes associated with health enhancement, such as a reduction in smoking, will also have contributed in recent decades. However, looking to the future, a fundamental finding of the historical analysis is that there is no sign of a levelling off of rates of improvement at the oldest ages. In fact, these rates of improvement would appear to be rising rather than levelling. It is perhaps noteworthy that, following a sequence of years when they had to raise their maximum life expectancy repeatedly, the United Nations has at last abandoned the practice of imposing such limits in their population projections.



Top graph: Female life expectancy at age 25 for the British Peerage and the population of England and Wales 1550–1900

Bottom graph: The best female life expectancy at birth 1840–2002, showing the natural limits predicted by the United Nations (UN)

PROFESSOR RICHARD SMITH

Implications

Forecasts of life expectancy are used in public and private decision-making to determine future pension benefits, healthcare and social services. Increases in life expectancy of just a few years can produce very large changes in the numbers of the old and particularly the very old. And a continued reduction in mortality among the oldest old suggests that longevity increases will be larger and population ageing will be more rapid than many high-income countries expect, which could have major implications for social security and medical care systems.

Perhaps one of the most significant implications of historical demographic analysis is that it has exposed the danger of believing that the expectation of life cannot rise much above its current uppermost level. As the so-called 'baby boomer' generation ages, longevity is becoming a highly significant debate. Whichever school of thought – those who believe the ceiling has been reached and those who do not – proves to be correct, the result will have enormous implications for how societies evolve, and manage their health and welfare issues, in the future.

For more information, please contact the author Professor Richard Smith (rms20@cam.ac.uk), who is Director of the Cambridge Group for the History of Population and Social Structure within the Department of Geography.

Life expectancy today

The average life expectancy from birth for men and women in the UK is currently 76.6 and 81.1 years, respectively.

The world's highest life expectancies can be found in Andorra, San Marino, Monaco and Japan; Japanese men and women live an average of 78.7 and 85.5 years, respectively.

Africa has some of the world's lowest life expectancies: Swaziland (37.6 years), Botswana (41.5 years) and Lesotho (41.5 years).

Source: World Health Organization statistical information (www.who.int/whosis/en)

Professor Richard Smith

Although our brains deteriorate as we get older, Cambridge researchers are finding that some abilities are preserved through 'flexible' use of neural networks.

Can old brains

The brain – the most complex organ in the human body – comprises billions of nerve cells, each forming the myriad of connections needed for cognitive functions. Inevitably, as our body ages, so does our brain, placing a burden on these abilities. But, compared with the dramatic effects of grey matter damage caused by accident and stroke, age-related neural degeneration, or atrophy, does not have uniform effects on older adults' cognition. Instead, current research shows that although old age is associated with deficits in some functions, other abilities are not affected.

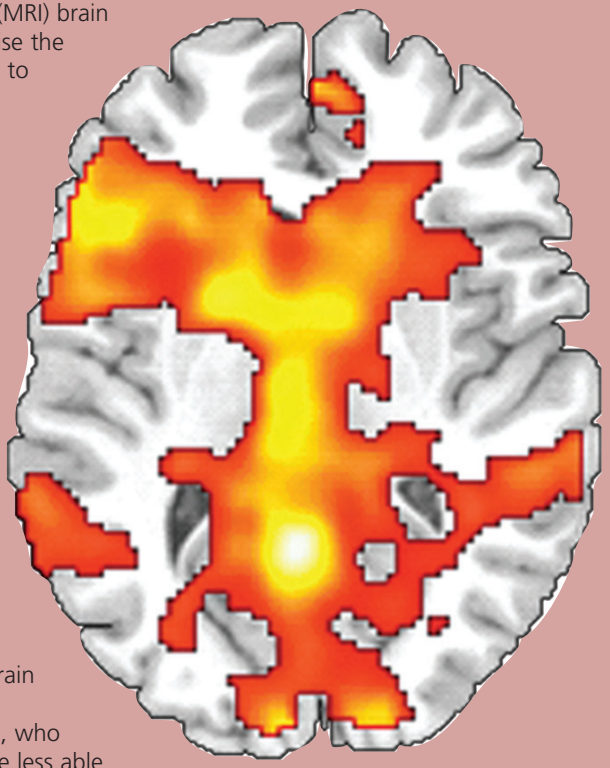
In the Centre for Speech, Language and the Brain (CSLB) in the Department of Experimental Psychology, researchers are working to understand the relationship between neural ageing and cognitive ageing. They focus on one aspect of brain function – language – and use behavioural testing and neuroimaging to monitor the different patterns of change that occur with age. Some language abilities show dramatic declines, like word finding, yet others are maintained across the lifespan, like sentence comprehension. Research from the CSLB indicates that, although decline may be due to neural atrophy, in some cases older adults can maintain performance by effectively and flexibly using the neural resources they still have.

It's on the tip of my...?

One of the most irritating and troubling difficulties reported by older adults is an increase in word-finding problems, known as tip-of-the-tongue states (TOTs). Although people of all ages occasionally experience the frustration of being temporarily unable to produce a well-known word or a person's name, TOTs become more common with advancing age. This is a source of concern for many older adults, who worry that this type of forgetfulness is a sign of serious memory problems or even encroaching dementia. But, despite the feeling during a TOT that your mind has gone completely blank, research indicates that a great deal of information is available about the word you are searching for; all that is missing is the actual sound.

Neuroimaging can be used to understand why TOTs are more common in old age. In the CSLB, a recent research project recruited volunteers aged 19 to 88 years to perform a task in which they named pictures of celebrities whose names had been selected as being vulnerable to TOTs. In the same study, a magnetic resonance imaging (MRI) brain scan was carried out to visualise the extent of age-related changes to grey and white matter. As expected, the rate of TOTs increased with age, but what was interesting was that this increase was related to decreased grey matter in regions of the brain that are important for retrieving the sounds of words.

Delving deeper into the source of the problem, functional MRI was used to examine neural activity while the participants actually performed a TOT task. Younger adults, who typically have fewer TOTs, generated a 'boost' of activity during a TOT compared with during successful naming, again in brain regions important for sound retrieval. Tellingly, older adults, who typically have more TOTs, were less able to generate this boost of activity, showing a clear link between increased TOTs and reduced neural activity in critical regions.



Functional MRI showing brain activity during retrieval (left) and extra activity when retrieval fails (right)

It's not all downhill

Although the link between increasing atrophy and declining performance seems straightforward, it is important to remember that cognitive deficits in old age are not simple, uniform, or even absolute. Although older adults have problems producing words, they are generally as good as younger adults at tasks involving comprehending language.

By testing young, older (aged 49–68 years) and 'very' old (over 70 years) volunteers for their ability to listen to and comprehend sentences, some interesting findings came to light in the CSLB. Older and very old adults showed significant grey matter atrophy compared with younger adults, but only the very old were slowed down – the older adults under 70 years old were just as fast as younger adults, despite deterioration in brain

learn new tricks?

DR M SHAFTO AND PROFESSOR LK TYLER

regions important for language comprehension.

How did older adults maintain their performance, and why did the very old adults not? This was examined by recording neural activity during a more difficult sentence comprehension task, where the sentence contained an ambiguous phrase that is more difficult to comprehend (e.g. 'private coaches', which might refer to tour buses or personal trainers). This is true even when the sentence context tells you which meaning is appropriate, as in: 'Although they are expensive, private coaches teach children effectively.'

Compared with hearing sentences that did not contain ambiguous phrases, hearing sentences with ambiguous phrases leads younger adults to activate regions in the left hemisphere of the brain that are known to be important for understanding language. Older adults also activated these regions, plus additional regions in the right hemisphere, raising the interesting possibility that the recruitment of the right hemisphere regions is what enables older adults to maintain their performance. However, very old adults, who respond more slowly, activated only the same left hemisphere regions as the younger adults. Why didn't the oldest adults recruit their right hemispheres? This is an ongoing area of study but one possibility is that continued deterioration in grey matter in very old age limits the ability of individuals to flexibly recruit neural regions when they are needed.

Preserving performance

These findings imply that although you can't prevent increasing brain deterioration with age, performance may be preserved when neural flexibility is possible. This may be true even for TOTs: despite the fact that TOTs are frustrating and potentially embarrassing, they are temporary problems, and often resolve themselves spontaneously. In the laboratory, TOTs can be overcome by cueing participants with key sounds in the target word. This intervention is limited to a laboratory environment but it makes the important point that TOTs are not permanent or static, and may even be avoidable under some circumstances. Finally, although older adults as a group suffer more TOTs, some individual older adults generate as few TOTs as their younger counterparts, raising the possibility that some older adults may be able to avoid even the most common cognitive changes in old age.

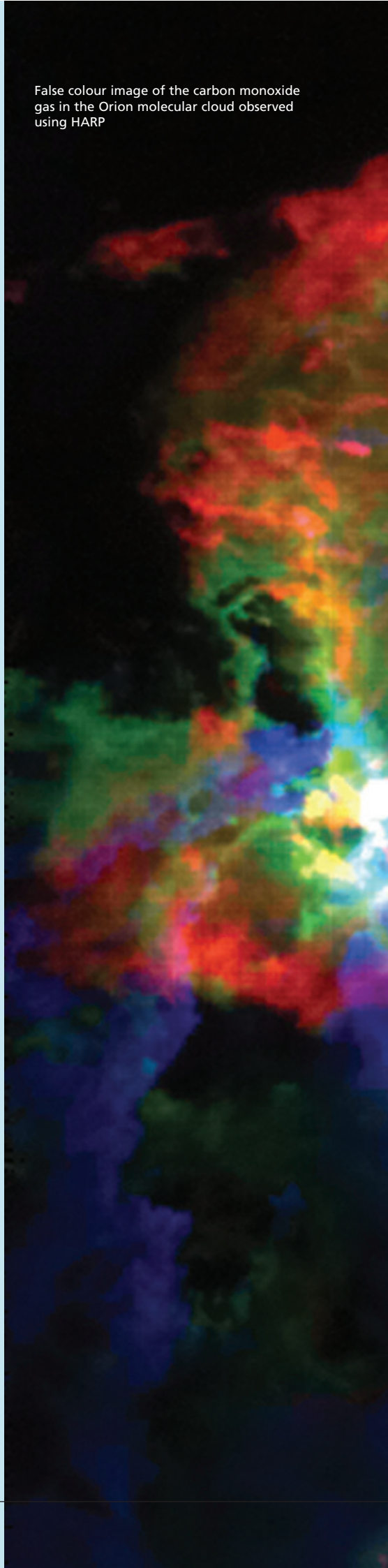
How can we best maintain our cognitive health in old age? Can we encourage neural flexibility? This research does not yet point to any clear interventions, but adds to growing evidence that old age doesn't lead to universal or inevitable cognitive decline. Understanding the conditions in which older adults can make the best use of the neural flexibility they still have will be an important step forward.

For more information, please contact the authors Dr Meredith Shafto (mshafto@csl.psychol.cam.ac.uk) and Professor Lorraine K Tyler (lktyler@csl.psychol.cam.ac.uk) in the Centre for Speech, Language and the Brain at the Department of Experimental Psychology.

Professor Lorraine Tyler and Dr Meredith Shafto

Hunting for protostars

Looking deep inside the swirling dust clouds that make up stellar nurseries – the birth place of stars – can help unravel mysteries of the birth and evolution of galaxies like our own.



False colour image of the carbon monoxide gas in the Orion molecular cloud observed using HARP

After seven years of design, construction and testing, the first images of deep space are starting to arrive in Cambridge thanks to a pioneering radio receiver known as HARP. Astrophysicists at the University of Cambridge's Cavendish Laboratory have led the development of the radio receiver, recently installing it on the James Clerk Maxwell Telescope (JCMT) in Hawaii. At 15 m in diameter, the JCMT is the largest telescope in the world operating at submillimetre wavelengths. The astrophysicists are now engaged in making the first scientific observations using HARP, with the aim of understanding the elusive origins of stars and planets in our galaxy.

Stellar birth

Over the past 20 years or so, astronomers have made remarkable breakthroughs in understanding how stars form. About 4.5 billion years ago, when the Universe was two thirds of its current age, a cloud of molecular gas in our galaxy collapsed to form the Sun and its planets. The events that led to this are believed to be similar to what we see in newly forming stars today.

Molecular clouds are complex objects. They are cold, heated only by the faint light of nearby stars and by the occasional cosmic ray. They are tenuous, containing only a few hundred molecules of molecular hydrogen per cubic centimetre – a significantly lower density than in the best laboratory vacuum. And their fate depends on the delicate balance between forces of gravity and pressure. Although the gravitational attraction between molecules in the cloud is feeble, within the densest parts of the clouds, called cores, the gravitational force can overcome the cloud's weak pressure, and cloud collapse begins.

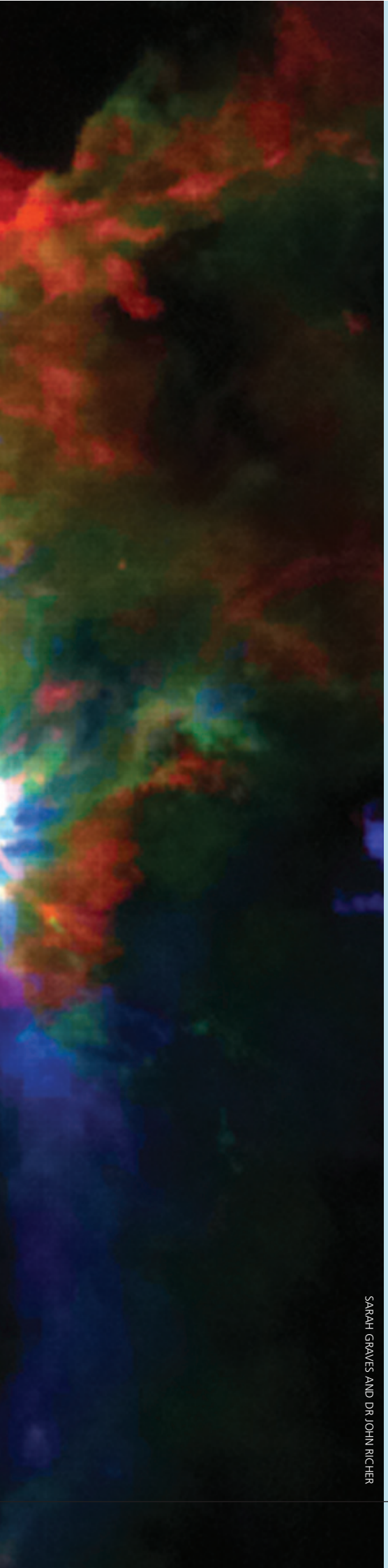
The collapse is fastest at the centre of the cloud core, where the material grows to high density and forms a hot protostar. These objects are deeply enshrouded in dust and therefore invisible to optical telescopes. Material from the cloud rains down onto the growing protostar, dragged in by gravity. Because cores in general possess a small amount of rotation before collapse, the infalling material carries this rotation inwards, which leads to the formation of a molecular gas disk rotating around the central protostar. So far, the collapse has taken a few hundred thousand years, a relatively brief time in astronomical contexts. As the collapse proceeds, bipolar jets of material are produced by the spinning disk and protostar, generating spectacular shock waves in the clouds. After a million years or so, the protostar's growth ends, the disk is destroyed and a new star becomes visible to optical telescopes.

Mapping the molecular clouds

The molecular clouds of our own galaxy contain as much mass as a billion suns, and in these clouds about five new stars per year on average are created by gravitational collapse. Although the picture of stellar birth outlined above is widely accepted, many key details remain to be understood. The detailed physical structure of the clouds, including their temperature, density and velocity, remains poorly defined, and the processes that initiate the formation of cores and protostellar collapse are not understood.

The dramatic impact of outflows and winds from the newly formed protostars is also a matter of much debate. What are the processes that eventually terminate the build up of gas onto a protostar, and so set its final mass? And what are the conditions that lead to the creation of binary star and triple star systems?

To try to answer these questions, astronomers need to make precise observations of the conditions within molecular clouds. One of the main challenges to doing this is the coldness of the clouds, which weakens their emissions. Despite this, it is possible to detect molecules such as carbon monoxide and hydrogen cyanide in the clouds because they emit radio waves



SARAH GRAVES AND DR JOHN RICHER

when they change their rotational state, producing characteristic 'spectral lines' that can be detected on Earth using specialised high-frequency radio receivers. But to do this, observations must be made from a high-altitude site, such as the 14,000 ft volcanic peak of Mauna Kea in Hawaii, home to the JCMT and HARP. At this location, the water content of the atmosphere is very low, permitting even the faint spectral line emission from molecular clouds to be detected. By scanning the telescope over interesting patches of sky, large-scale images are constructed.

The HARP radio array receiver has been designed and built at the Cavendish Laboratory to improve the speed at which astronomers can make their observations of molecular clouds. At its heart is a four-by-four array of superconducting tunnel junctions, cooled to 4ºC above absolute zero. HARP's advantage is its speed: its highly sensitive array of detectors allows astronomers to map clouds of gas more than 25 times faster than previous systems used at the JCMT, meaning that bigger and more sensitive images can be made. This is key to revealing the properties of star-forming clouds in the galaxy in greater detail.

First impressions

The Cambridge team has recently finished the scientific commissioning of HARP, and the first images and spectra are starting to be taken. At the Cavendish Laboratory, the first complete set of data is currently being analysed: it is the largest and most detailed image of the spectacular Orion molecular cloud ever made at this wavelength.

Orion lies some 1400 light years from the Sun. It contains some of the most rapid star formation in the galaxy and the HARP image reveals incredible detail in the gas distribution and flows. The highly dynamic nature of the cloud has been revealed: large-scale gas motions pervade the cloud, and the race is on to understand how these arise and what their effect on the future evolution of the cloud will be.

Further leaps

The Cambridge team expects that they and astronomers worldwide will be busy acquiring data with HARP and carrying out detailed scientific analysis for at least the next five years. But they already have their sights on the next goal. The disks of gas that are known to spin around forming stars are too small to be resolved by HARP on the JCMT. Within these disks, material must spiral into the protostar, jets must be generated to drive the observed bipolar flows and planets are expected to condense. To make detailed images of these protoplanetary disks requires astronomers to use the technique of radio interferometry. In this technique, which won Cambridge astronomers Martin Ryle and Antony Hewish the 1974 Nobel Prize in Physics, signals from similar telescopes are combined to create images with much higher resolution than a single telescope.

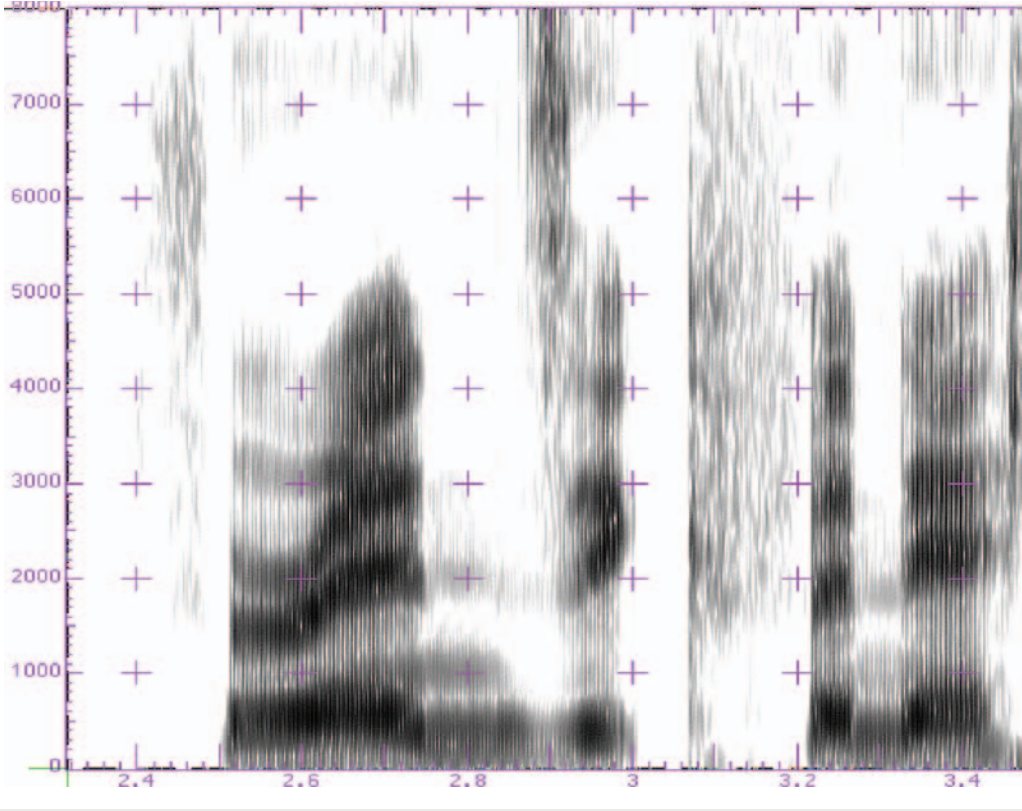
In the Atacama Desert of northern Chile, on a barren plateau 17,000 ft high, the most ambitious radio interferometer ever built is coming to life: the Atacama Large Millimetre Array (ALMA). ALMA's 66 radio antennas will be combined electronically to generate images of molecular gas clouds and protostars at unprecedented resolution.

ALMA is a collaboration between 17 countries worldwide. In Cambridge, astronomers have been involved in several aspects of ALMA's planning and design. Of particular note is a system of radio receivers that monitor the water vapour in the atmosphere, which allows ALMA to correct the 'twinkling' of the radio sources caused by the Earth's unstable atmosphere.

Construction of ALMA will be complete by 2012 and astronomers will then be able to make detailed images of protostars and protostellar disks, and start to understand the details of planet formation and disk evolution as never before. Using this technique, astronomers hope to make pin-sharp images of these objects and so understand better the detailed origin of our Sun and its planets.

For more information, please contact the author Dr John Richer (jsr@mrao.cam.ac.uk) at the Cavendish Laboratory.

Dr John Richer



Can a voice identify a criminal?

Innovative research in the Department of Linguistics suggests that dynamic features of speech could provide a clue to forensic speaker identification.

Recognising a voice is a familiar experience for most people – identifying a friend's voice over the telephone, recognising the voice of a well-known personality on the radio, hearing the voice of a colleague call out from behind. But why do voices sound distinctive? Given our ability to recognise individuals, it seems reasonable to assume that voices are unique, but it has not been scientifically demonstrated that all voices are measurably distinctive. In spite of the impression given by televised crime shows, as yet there is no technique available to identify a speaker with 100% reliability.

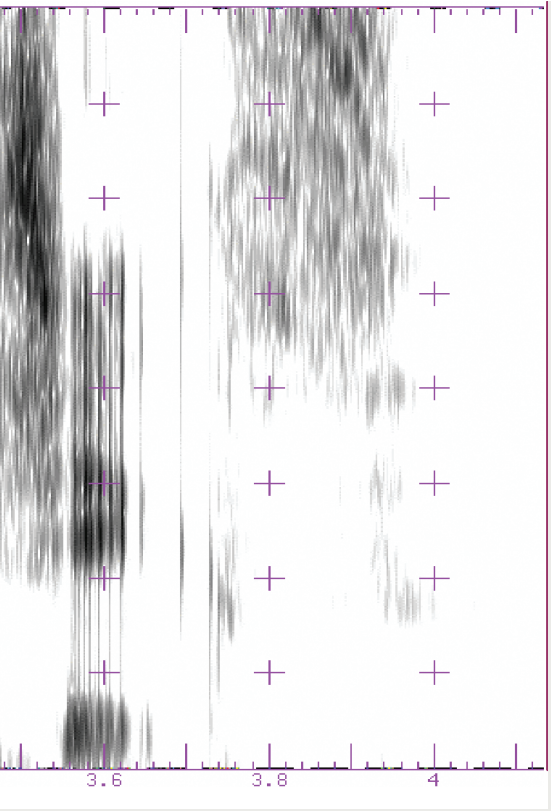
This is a serious problem for forensic speaker identification, a branch of forensic phonetics in which a phonetician is asked to identify an unknown speaker whose voice has been recorded during the committing of a crime, for example a bomb threat, ransom demand, hoax emergency call or drug deal. The phonetician compares the incriminating recording with samples of speech from a suspect with a view to identifying the perpetrator or eliminating the suspect. These cases are often controversial, and since the extent to which an individual's voice is idiosyncratic has not yet been established, research in this area is crucial.

A key problem in attempting to characterise a speaker is that each individual's voice can vary greatly. We change our voices depending on who we are talking to, how formal the situation is, the emotion we wish to express and whether there is background noise. Speakers' voices also change if they are tired, drunk or have a cold or sore throat, and of course speakers can disguise their voices. So a voice is much more complicated to capture than a fingerprint, which is a fixed, unchanging feature of an individual.

DyViS: investigating speech

A team of researchers in the Department of Linguistics – Dr Kirsty McDougall, Dr Gea de Jong, Toby Hudson and Professor Francis Nolan – is carrying out innovative research in speaker identification in the DyViS project (Dynamic Variability in Speech: A Forensic Phonetic Study of British English), funded by the Economic and Social Research Council.

To investigate the problem of variation within a speaker's voice, the DyViS team have compiled a large-scale database of recordings of southern British English spoken across a range of speaking styles. Speakers participated in several tasks: a mock police interview where they were required to 'lie' about a particular scenario, a telephone call with a friend involving a more casual and relaxed style of speech, and a number of reading tasks. All of the speaking tasks included a particular selection of words that the participants had to utter in different contexts. These data enable the researchers to investigate how phonetic features of these words change for a given individual across the different speaking styles, and to what extent these features can be used to distinguish individuals.



DR KIRSTY MCDOUGALL

Computer-generated representation of the acoustic speech signal showing formant frequencies

'Speaker identification has proven an effective tool in the fight against crime, yet there is a constant need for more research due to the difficulties involved. We particularly welcome the initiative of the DyViS project, which is the most systematic and comprehensive of its kind and will undoubtedly be of great value for us and other forensic laboratories.'

Dr Michael Jessen,
Federal Criminal Police Office, Germany

Dr Kirsty McDougall

Identifying the speaker

One particular feature being examined is a phenomenon known as 'formant frequency dynamics'. Formant frequencies are the resonances of the vocal tract during speech – the frequencies at which vibrations of air are at maximum amplitude in the vocal tract in speech sounds such as vowels. Formant frequencies appear as roughly horizontal dark bands on a spectrogram, a computer-generated representation of the acoustic speech signal. These frequencies are powerful cues to speaker identity since they are determined by both the physical dimensions of a speaker's vocal tract and the way the speaker configures the vocal organs to produce each sound.

Previous research on speaker differences has typically measured the formant frequencies only at the centre of the sound. The DyViS research goes beyond these 'static' measures to investigate the dynamics of formant frequencies, which reflect the movement of a person's speech organs and are likely to reveal more fine-grained differences among speakers. Just as people exhibit personal styles for walking, running and other skilled motor activities, they move their vocal organs in individual ways when producing speech.

Dr McDougall's experiments have investigated the speaker-distinguishing potential of the formant frequency dynamics of the vowel sound in spoken words like *bike* and *hike*, of the vowel sound in *who'd*, and of sequences containing an 'r' sound preceded and followed by vowel sounds such as *a route* and *a rack*. The work shows that formant frequency dynamics carry considerable speaker-specific information. By taking measurements along the formant contours surrounding the centre of a speech sound, a significant improvement in speaker discrimination is achieved.

Forensic phonetics

Together with research into other features of speech being investigated by the DyViS team, this work offers crucial new directions for solutions to the problem of extracting a speaker's 'signature' from the speech signal. Findings from the DyViS project suggest that dynamic features of speech could provide a clue in speaker identification, which has clear applications in forensic evidence – in comparing voices and speech for purposes of identification, and in analysing speech recordings.

The research also has important implications for phonetic theory. Current models of speech production and perception do not provide a good explanation of the role of individual variation in speech communication. The analysis of dynamic features of speech being undertaken by the DyViS team will lead to important theoretical developments in these areas, contributing to our understanding of how individual speakers can communicate with the same language yet sound so different from each other.

For more information, please contact the author Dr Kirsty McDougall (kem37@cam.ac.uk) at the Department of Linguistics (www.ling.cam.ac.uk/dyvis/).

The common view has been that parasitic infections cause disease and must be eliminated. But can we live without them?

Parasites: the master manipulators

The human race used to have a consensus attitude towards the organisms that we call parasites. They were simply pests, causative agents of disease that warranted nothing else other than extermination. As soon as new life-cycles were described in the literature, the race began to find a way of interrupting transmission and end the misery. The literature is therefore full of examples of control programmes for just about every parasite that has ever been identified. Some, such as the programme against the guinea worm, *Dracunculus medinensis*, have been so successful that complete eradication is now on the World Health Organization's agenda.

As we wave goodbye to the guinea worm, it will be time to re-visit the hit-list, and to see how far we've progressed. In doing so, we are likely to observe that not much has changed. In fact, the guinea worm is the only parasitic infection that has ever been described and then systematically eradicated. There are even signs that the parasitic fauna of the planet is flourishing – recent estimates put the toll of malaria at between 300 and 660 million cases a year, and there are still hundreds of millions of people infected by each of several parasitic worm species. This group includes the trematode parasite *Schistosoma mansoni* – a blood fluke that infects approximately 200 million people in the tropics and sub-tropics, and which has been the focus of research efforts at the University of Cambridge Department of Pathology for the past 30 years.

Fighting the fluke

Theodor Bilharz formally described schistosome parasites in 1851, at which point the centimetre-long, red-blood-cell-eating worm joined the most-wanted list. Like every other parasitic infection, *S. mansoni* was viewed with fear and loathing – and with good reason. Infection occurs through contact with free-living larvae in freshwater, with rapid penetration of intact human skin. The adults live in the mesenteric veins between the liver and gut. Females produce eggs that become trapped in the liver, promoting an inflammatory response that eventually leads to a form of hepatic fibrosis and portal hypertension. About half the eggs pass through the gut wall, each puncture causing a small amount of blood to be lost. As the worm burden increases with repeated exposure, so the number of eggs in both the liver and gut increases, leading to ever more severe disease.

Early attempts at large-scale control of schistosome infections relied on crude drugs and environmental modification, with success in some areas, but in most places the parasite persisted. Although treatment (praziquantel) is available, re-infection occurs rapidly, especially in children. The lack of effective, non-toxic medicine, and the success of vaccination programmes against bacterial diseases, led to the emergence of renewed research efforts aimed at understanding the biology of the worm and its relationship with the human host.

But, despite promises of an anti-schistosome vaccine 'within five years' for the past 20 years or so, there is still no vaccine available, because we don't yet understand the biology of the schistosome worm. Like a fractal puzzle, as we peer more closely we see even greater complexity.

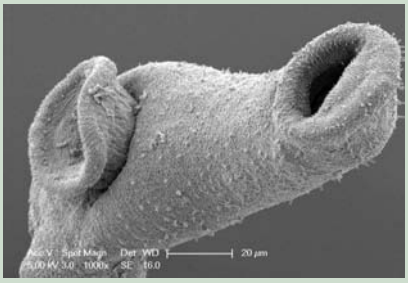
Keeping things quiet

Such is the intimate relationship between host and parasite that we can use the study of schistosome parasites to understand how humans work. One of the key questions that has kept scientists busy is how schistosomes manage to evade the immune response for extended periods. It has been estimated that adult worms live for up to 10 years in their human host. To make this possible, the worms have evolved several mechanisms for diverting, blocking and repressing the immune response. The adult worms coat themselves in host proteins to appear invisible to the immune system. They induce the host to produce ineffective immune responses and they manipulate host cells to produce molecules that signal a general downregulation of the host's response. This essentially produces a drowsy immune response with impaired vision against a camouflaged target – perfect conditions for the parasite to thrive and reproduce

Recent studies in Cambridge in the laboratory of Professor David Dunne have demonstrated the magnitude of this repressive effect by treating people who are already infected with the parasite and measuring their immune responses before and after taking praziquantel. Responses that are thought to be effective against the parasite often increase several fold after drug treatment, and this 'boosting' of the host's ability to respond appears to

DR MARK BOOTH

People at risk of schistosomiasis often live in close proximity to water, on which they depend for both domestic and occupational activities (Namiti Island, Lake Victoria)



DR JENNIFER FITZPATRICK

A sucker at the anterior end of the worm enables them to attach securely to the inside of the mesenteric veins where they reside; they can live like this for up to 10 years, procreating and ingesting their host's blood

help prevent re-infection in the future. Recently, the scientists also reported that the ability to respond after treatment is genetically restricted – an observation that has important implications for the development of any therapy or vaccine that relies on increasing the magnitude of the immune response for its protective effect.

Medical benefits

Although a vaccine is not yet in sight, recent discoveries have raised an interesting conundrum: rather than simply being agents of disease, it appears that parasitic infections, including schistosome worms, may bring medical benefits. Scientists in Cambridge are leading the field in efforts to find out just what is going on.

As more knowledge of the host–parasite relationship is gained, it is becoming increasingly clear that parasitic infections are not necessarily pests that need to be eradicated. Nobody used to have any sympathy for leeches or maggots, but both creatures are now used in medical settings: leeches to clear blood from congested tissues after surgery, and maggots to liquefy dead tissue and kill harmful bacteria in infected wounds. The same thing is now happening to parasites, as it emerges that their influence on the immune system can benefit both host *and* parasite.

In the Department of Pathology, a clear example of this win–win scenario was demonstrated when researchers in Professor Anne Cooke's group prevented type 1 diabetes from developing in mice by injecting them with antigens of schistosome parasites. This is likely to be due to the same skewing and downregulation of the host immune response described above.

It seems that by diverting and subverting the immune response, schistosome parasites may prevent the immune system from over-reacting to other proteins. One hypothesis gaining popularity is that, when parasites are removed, the immune response finds new targets, either in harmless allergens (leading to allergy), or in the host itself (leading to autoimmune diseases such as type 1 diabetes).

With such tantalising evidence, it may be time to look at the parasite hit-list with fresh eyes, and ask: can we exploit the intimate relationship parasites have with humans at the same time as reducing their tremendous burden on affected populations?

For more information, please contact the author Dr Mark Booth (mb350@cam.ac.uk) at the Department of Pathology (www.path.cam.ac.uk/~schisto).

Dr Mark Booth

The Matangini Project

The Matangini Project was created by Dr Mark Booth, in the Schistosomiasis Research Group at the Department of Pathology, to raise funds for community projects in Kenya and Uganda. The aim in 2007 is to raise £5000 to bring safe water to thousands of school children in areas of Kenya affected alternately by drought and water-borne infections such as schistosomiasis.

For further information, please go to www.matangini.org.uk

Cambridge Infectious Disease Initiative

The University of Cambridge is currently developing a major Infectious Disease Initiative, with the aim of increasing the University's contribution to reducing the global impact of infectious diseases. By building new partnerships based on core strengths, the vision is to establish the University as a leading international centre for infectious disease teaching and research.

For further information, please contact the Co-ordinator Dr Gill Rands (gfr21@cam.ac.uk).

Conflict in Cities

Conflict is inherent to the urban condition, yet only in some cities do contention and dissent erupt to unacceptable and destructive levels. How do contested cities absorb and reflect this conflict?

For embattled cities fractured by national, ethnic and religious conflicts, the 'peace process' may seem oriented on a single goal, like a distant light at the end of a long tunnel; however, this road is rarely linear and resolution is often frustratingly elusive. Even more disturbing, apparently rejuvenated and peaceful cities may slip back into patterns of sectarian strife and division. Not to diminish the value of negotiated political settlements, emergence from long-term damage to everyday life in contested and sometimes violent urban settings will usually require more than a collection of agreements. If a city is to be viable for all of its inhabitants, not only must there be equal measures of justice and security, but also the opportunities to take action, contribute to and benefit from the wider civic culture. The city itself must be healed. And, in turn, a robust city will underlie and help to encourage the positive impacts of a political peace process.

There are no clear means for achieving this sort of reciprocity. Moreover, the nature of cities as receptacles for both commonality and diversity means that discord will always exist in some form; in fact, it would be fair to say that conflict is inherent to the urban condition. However, we don't fully understand why it is that in some urban centres contention and dissent are contained and channelled but in others they reach levels that are clearly unacceptable and destructive.

Researching conflict in cities has been ongoing in Cambridge since 2003, funded by the Economic and Social Research Council (ESRC) New Security Challenges programme under the leadership of Dr Wendy Pullan in the Department of Architecture. The research is driven by an interest in the capacity of architecture and the urban environment to absorb and manifest conflict, a concern grounded in history but made painfully evident by the iconic nature of the the World Trade Center in the 9/11 attacks. Dr Pullan takes the approach that solution-oriented negotiations may not always reflect the tangled conditions of contested urban situations; rather, it is necessary that the city and the conflict itself be studied and understood. As our ordinary civic spaces and activities become increasingly susceptible to geopolitical struggles, she believes we need to acknowledge that many crises are still played out in the local and mundane life of cities, in streets and squares, neighbourhoods, shops and public places.

Jerusalem: a contested city

To reach beyond questions of policy and planning, to investigate how ordinary people are affected by and respond to conflict situations, and to examine the extent to which resilience may exist in

Israeli checkpoint at an entrance to the Islamic Haram al-Sharif in Jerusalem's Old City

DR WENDY PULLAN

urban cultures, Jerusalem has been central to the study. Site-oriented fieldwork is vital to the research, and this project has a team of Palestinians and Israelis carrying out mapping, physical analysis, photography and interviews at selected areas that underline the historic, religious and secular significance of the city, as well as old borders and new fissures.

The urban topography plays a role in forming civic identity and, in a contested city like Jerusalem, where continuing tensions between Israelis and Palestinians are evident in many aspects of everyday life, the presence of posters, graffiti, national colours and religious trappings mark territory that may change radically in the space of a few metres. Temporal distinctions are important: a procession route may be populated by Muslims on Friday morning and Jews by Friday evening, with Christians passing through at midday. To what extent space may be shared rather than divided is a key question.

Much of the world has looked in dismay at Israel's recent construction of the Separation Barrier to separate Israel from Palestine. There is little doubt that this concrete structure, 6–8 m in height, has severely disabled Palestinian communities. Conflict in Cities' research points to a more enduring and potentially more severe problem in the establishment of a segregated transportation system, and a huge infrastructure of bypass roads, bridges, tunnels and checkpoints, built to reinforce the divisions created by the Separation Barrier. In Berlin, a concentrated building initiative has erased the path of the Berlin Wall with remarkable speed; but we know that road alignments are by nature divisive and have tremendous longevity.

Infrastructure has become a key feature of Jerusalem and is used to control large segments of the population. Although the root of the conflict centres on territory, it is perpetuated through mobility; human movement has become both a weapon and the key to success. While mobility is a critical component of any modern city, here its more extreme forms provide particularly explicit insights.

Jerusalem today is a fragmented city where Israelis and Palestinians live apart, gazing at each other across a valley or a street, never to exchange a word. Yet, despite political deadlock, violence, daily misery, fear and distrust, both populations continue to function with certain aspects of social, economic and cultural exchange. Such interactions are mostly unplanned and uncontrolled, and they undermine the official politics of division through planning. These events happen mostly in ordinary public places – markets, transportation hubs, places of entertainment, some inextricably linked places of worship, and certain institutional settings like hospitals – and may result in clashes, peaceful interaction or various combinations of the two. Conflict in Cities' research endeavours to identify and analyse places and events for their role in the wider urban topography, both as potential flashpoints and as they might emerge in future, more interactive scenarios.

Looking further afield

A recently awarded £3.1 million, five-year grant from the ESRC will allow Conflict in Cities to develop a more contextual mode, focusing on both Jerusalem and Belfast but involving an international network of researchers who work on other divided cities such as Brussels, Berlin, Mostar, Nicosia, Beirut and Kirkuk.

Given the complexity of modern cities, no single discipline can hope to address urban phenomena fully; this is reflected in the collaborative basis of the new award, which is bringing together politics (Professor Mick Dumper, University of Exeter), geography (Professor James Anderson, Queen's University Belfast), sociology (Professor Liam O'Dowd, Queen's University Belfast) and architecture (Dr Pullan, leading the project).

The national conflicts that so often feed urban conditions will take on a larger role in this research, hence the extended title: Conflict in Cities and the Contested State. The cities under study may be seen as parts of a spectrum, some emerging from severe conflict, others unfortunately falling back into dangerous patterns; together, they offer simultaneous insights into different stages and manifestations of contestation, violence and renewal.

For more information, please visit the Conflict in Cities website (www.conflictincities.org) or contact the author Dr Wendy Pullan (wap10@cam.ac.uk) at the Department of Architecture.

Dr Wendy Pullan

Mark de Rond spent 200 days with the Cambridge University Boat Club as an organisational ethnographer researching the social dynamics of high performance teams.

The Making of a Boat Race Crew

BRCL/PHIL SEARLE

The champions celebrate: success for the Cambridge Boat Race team 2007

Founded in 1828, the Cambridge University Boat Club (CUBC) has one purpose only: to beat Oxford in the annual Boat Race. This race has always been a thing of sharp contrasts: it remains a private match between two universities but enjoys a following of millions worldwide; it is marked by intensive rivalry yet mutual respect too; it is quintessentially British though clones of it exist everywhere; it is all about taking part and yet the pain of losing is unimaginable.

So what does it really take to earn a seat in the coveted Blue Boat? How does one create a world-class crew from a dysfunctional cohort of 39 hopefuls? And how are relationships affected by ongoing selection pressures? Unsurprisingly, the answers are not straightforward.

Crew selection

The performance of individual rowers is only ever meaningful in the context of the crew. It is easy to establish what rowers are capable of as individuals. However, place them in a crew and they perform differently depending on who else is in the boat and what seat they are assigned. The implication for coaching and team building is twofold: first, crew selection becomes a matter of finding the right combination of rowers; and, second, coaches need to decide whether to cater to someone's ego (e.g. by giving him a particular seat) or to suppress it in the interest of the team. Moreover, in crew selection it occasionally makes sense to sacrifice technical competence to gain social cohesion. Although a particular rower may be sub-optimal in terms of technique, he may optimise crew performance by virtue of his social skills in drawing better performances out of the others, even for a sport reliant on technique, synchronisation and rhythm.

Pulling together

Those bold enough to compete for a seat in Cambridge's Blue Boat can only do so effectively by collaborating effortlessly with their rivals. Rowers express individuality in wishing to remain on the coaches' radar screens, but collectivity in building team spirit. They are expected to adopt a rowing style that is quintessentially Cambridge, but, in so doing, to sacrifice what they know has made them go fast in the past.

In the aftermath of yet another defeat in 2006, Cambridge's chief coach decided to part with tradition by granting athletes more voice in training, selection and race planning. Given that rowing coaching is almost universally undemocratic, this rather more egalitarian approach is not risk-free. While the athletes welcome more participation, being asked to take responsibility for each other's development feels unnatural. Even so, their shared commitment to turning the tables on Oxford, to exploiting their superior blade-work, to avoiding division within the crew and to pulling together seamlessly drove Cambridge to take a leap and innovate. It was to become one of their most daring team-management experiments in two centuries of Oxbridge rowing.

After months of anxiety, conflict and rejection – including the controversial decision to drop a veteran coxswain just 14 days before the race – the training season came to a conclusion for the Cambridge crew on 7 April 2007: although Oxford started well, Cambridge recovered to find their rhythm and won by over a length. And in a real sense, it is the unremitting search for rhythm that explains selection choices. It explains why five returning Blues fought to get one socially gifted oarsman selected despite being technically further removed from the Cambridge ideal than the oarsman he would unseat.

It explains why Cambridge won the 2007 Boat Race, and why it almost lost.

For more information, please contact the author Dr Mark de Rond (mejd3@cam.ac.uk) at Judge Business School. Dr de Rond was recently awarded a prestigious Fulbright Distinguished Scholar Award.

Dr Mark de Rond

Dr Carenza Lewis

A passion for communicating the thrill of the 'dig' and for uncovering evidence of lives long gone is what inspires archaeologist Dr Carenza Lewis. Her latest endeavour is to raise educational aspirations among schoolchildren through involvement in excavation – a venture that is unearthing new information on rural medieval settlements.

Dr Carenza Lewis inspects a find from a test-pit

The chance discovery of an ichthyosaur vertebra on the East Anglian farm she grew up on set Dr Lewis on the path to becoming an archaeologist at the young age of seven. Her enthusiasm for unearthing archaeological evidence of rural medieval settlements has resulted in a career that combines research within the Department of Archaeology, with media and broadcasting – most notably as part of Channel 4's award-winning Time Team – and outreach to secondary schools.

Conveying the excitement of 'getting your hands dirty' has led naturally to her new enterprise – the Higher Education Field Academy (HEFA; www.arch.cam.ac.uk/aca). HEFA is a ground-breaking initiative within the Department of Archaeology that is funded by Aimhigher, the Higher Education Funding Council for England (HEFCE) and the European Social Fund (ESF). From digging square metre test-pits in their back gardens to introducing them to University life, HEFA is all about encouraging young people to get a flavour of academia through their own hunt for history beneath their feet.

And the icing on the cake for Dr Lewis and the schoolchildren is that their hard work and achievements are recognised in research publications – each of the 10–30 test-pits that have been dug in each of 20 villages across six counties is contributing to a 'scatter-effect' analysis of medieval occupation that is overturning previous assumptions. For Dr Lewis, outreach and research have become symbiotically linked.

What would others be surprised to learn about you?
Most of the people I meet through work are usually quite surprised to discover that I juggle my career with three children, who span quite an age range: 5, 11 and 15! Also that I've had a huge suite of medical problems – I was diagnosed with breast cancer when I was 33, had a double mastectomy and then three years later I was told it was a mistake. It was a very difficult time. So on the outside I probably look very capable, with a career that looks like it's been a fantastically smooth progression, but it hasn't all been plain sailing.

Who or what inspires you?
What I find inspiring is that sudden moment when you discover that something really has potential. When you have an idea and you realise: 'I don't think anyone has really thought like this before.' It's like when you see through a chink in the door and there's a whole world out there, when things suddenly come together and you think: 'Yes, this will work.' Increasingly, working as I do with young people, my inspiration also comes from the enjoyment and excitement that they get out of the time they spend with us.

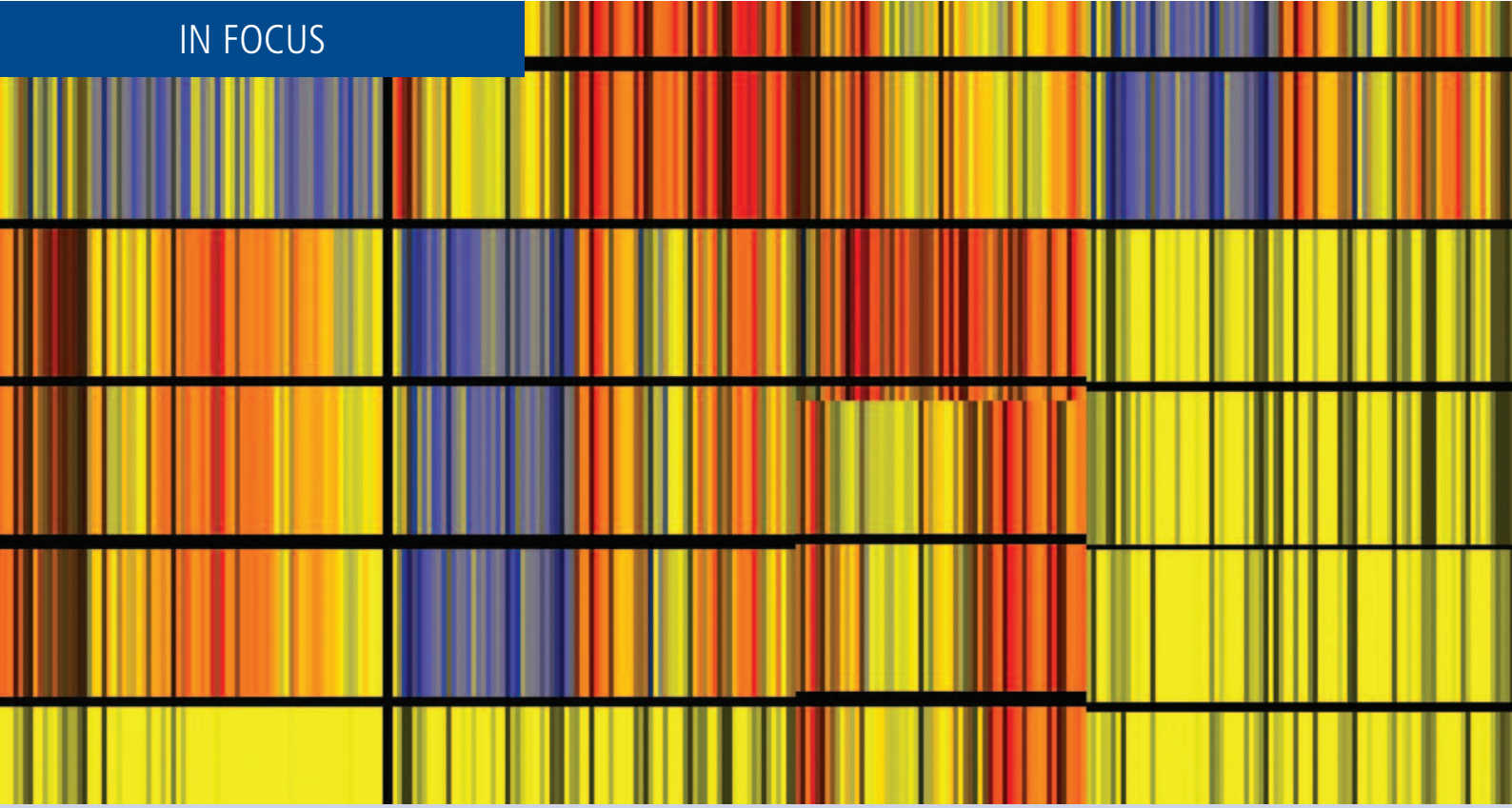
Have you ever had a Eureka moment?
In a way, my Eureka moment came with the idea for the Academy, combining aspiration-raising work with young people with original research on villages, both of which need to be done on a large scale. I realised that we could give children the vital enthusiasm, confidence AND skills they need to succeed in fulfilling their academic potential by getting them involved in independent new archaeological research, where their contribution is as valuable to us as it is to them. By digging and analysing their own archaeological test-pit, they're creating one part of a huge jigsaw – the more pieces we have, the clearer and more accurate is the picture. We've got all these young people who need to do something really challenging, but who will also really value developing their abilities, interest and confidence. Uncovering, recording and interpreting new archaeological discoveries can do this.

What's the best piece of advice you've ever been given?
I always say to the young people we work with that it's not what you've got, it's what you do with it that makes the difference to what you can achieve, and I think that's so true – just like with university admissions, it's not what someone knows that's crucial, but what they're capable of learning. Another thing I learned very quickly from doing television is not to be too worried about being wrong, so long as your reasoning is right, otherwise it can be a huge obstacle to ever attempting anything. Ultimately you just have to get on with it and take a little bit of a risk.

If you could wake up tomorrow with a new skill, what would it be?
The ability to create an extra number of hours in the day and to have the energy to use them to do all the things I want to!

What motivates you to go to work each day?
The excitement of novelty and new discoveries; the fact that there's always something new to do. I just really love what I do – every day is different, the people and challenges are different and you don't know what's going to come next. It's also great seeing the way the work we do affects the kids. That's REALLY worth getting out of bed for.

What will the future look like in 2050?
As an archaeologist I have a particular time-deep view of this sort of thing. Society today is very unusual when you look at it in terms of past history, particularly the unparalleled rate at which we consume and our awareness of each other's lives – locally, nationally and worldwide – through the media. I think it's creating unprecedented stresses and potential for conflict, and I just hope the generation that is growing up today will be able to find solutions to these problems.



Manipulated image of DNA chip analysis

The Wellcome Trust is well known as the leading funder of biomedical research in the UK, spending many millions on major research projects that have tangible impacts on health and disease. This ethos is abundantly evident in the £9 million support given to the Wellcome Trust Case Control Consortium, a collaboration of leading human geneticists across the UK, to analyse thousands of DNA samples and identify genetic predispositions to common diseases. The Trust also embraces studies on how biomedical research affects people and society; the funding of a research project being undertaken in the University of Cambridge's Centre for Family Research is an example of this rounded view.

wellcome trust

The Wellcome Trust is the UK's largest source of funds for biomedical research and the second largest medical research charity in the world. Spending around £500 million each year in the UK and internationally, the mission of the Trust is to support the brightest scientists with the best ideas, and to 'respond flexibly to medical needs and scientific opportunities'. Through support of a broad portfolio of biomedical research from immunology and infectious diseases to physiological sciences, the Trust aims to make a difference by advancing understanding of the processes that underpin health and disease. And, as the leading funder of translation research in the UK, the Trust is also committed to translating research innovations into health benefits. Technology Transfer at the Trust can help bridge the gap between fundamental research and commercial application by funding research that is sometimes deemed 'too early' or 'too high-risk' to be pursued by the corporate healthcare or investment sectors.

Perhaps less well known are the Trust's funding streams across medical humanities and public engagement. Through these, the importance is recognised of engaging with society to foster an informed climate within which biomedical research can flourish. This understanding can inform many things, from the ethical conduct of research, to the development of public policy and regulatory environments, to the enlightened debate about biomedical science, its achievements, applications and implications.

Money matters

The University of Cambridge and nearby institutes have been long-standing beneficiaries of funding from the Wellcome Trust:

- The University currently receives Wellcome Trust funding worth a total value of £67 million, including 66 University fellowships funded and studentships funded to a total value of £8.1 million.
- The Wellcome Trust Sanger Institute's successes, including their role in the Human Genome Project, the HapMap Project and the Wellcome Trust Case Control Consortium, have been recognised by funding from the Wellcome Trust of more than £330 million for 2006–11.
- The Wellcome Trust Centre for Stem Cell Research opened at the University in 2006 with £10 million funding from the Wellcome Trust, plus additional funding from the Wolfson Foundation and the Medical Research Council.
- The Cambridge Institute for Medical Research (CIMR) received a £4 million Wellcome Trust Strategic Award in 2006.

For more information on the Wellcome Trust, please go to www.wellcome.ac.uk

Finding the 'genetic signposts' of disease

One of the biggest projects ever undertaken to identify genetic variants that predispose some people to certain diseases was begun in 2005, thanks to £9 million funding from the Wellcome Trust. The ground-breaking results of this study were published in June this year.

The Wellcome Trust Case Control Consortium (WTCCC) brought together 50 research groups from dozens of institutions in the UK, including the Wellcome Trust Sanger Institute at Hinxton, Cambridge, and the University of Cambridge. The success of the project depended both on capitalising on the knowledge built by the Human Genome Project and the HapMap Project, two consortia in which the Sanger Institute was a major partner, and also on the sheer size of the collaboration across the UK.

Dr Panos Deloukas, who led the team at the Sanger Institute, explains: 'This was unprecedented in the UK. The sharing of samples and data on this scale has changed the ethos of the research community – through working with 50 laboratories across the country and conducting large-scale disease genetics at a level that has never been done before.'

The collaborators contributed their large national collections of DNA samples collected from different patient groups – totalling an incredible 17,000 samples across the UK (2000 patients for each of the diseases studied plus 3000 healthy controls) – allowing over 10 billion pieces of genetic information to be analysed by genome scan using the Affymetrix GeneChip assay. Tiny genetic variations between individuals that predispose to type 1 and type 2 diabetes, Crohn's disease, bipolar disorder, coronary heart disease, hypertension and rheumatoid arthritis were sought. By identifying these 'genetic signposts', scientists might understand which people are most at risk and why.

'We have found 24 genomic regions with very strong evidence of harbouring variants that underlie six of the phenotypes we studied and we saw a spectrum of genetic architectures among these common diseases,' explains Dr Deloukas. 'Once we had these findings then the medical collaborators provided insight into the significance of the gene associations and tried to replicate them.'

Significant new breakthroughs have been made for Crohn's disease and type 1 diabetes, and a link between the two diseases has been discovered. Dr Miles Parkes (Gastroenterology Unit, Addenbrooke's Hospital, Cambridge) and Professor John Todd (Department of Medical Genetics, University of Cambridge), both participants in the WTCCC, are now leading studies to follow up these findings. 'It's rewarding to see that the highly significant genetic associations are now being replicated in independent samples,' says Dr Deloukas. 'The framework set up by the WTCCC clearly works.'

Dr Mark Walport, Director of the Wellcome Trust, views the WTCCC as a success: 'It is an excellent illustration of the importance of knowing the human genome sequence and cataloguing its variations. Hopefully, with the insight gained into these diseases we will be able to make real progress in combating them.'

For more information on the Wellcome Trust Sanger Institute and the WTCCC (including a full list of participants), please go to www.sanger.ac.uk and www.wtccc.org.uk

Dr Panos Deloukas

Examining the psychosocial effects of molecular genetic diagnosis

What does it mean to be a member of a family that is affected by a genetic disease? What is it like for a woman at risk of being a carrier of a faulty gene? These are some of the questions that concern Helen Statham, Deputy Director of the Centre for Family Research (CFR) within the Faculty of Social and Political Sciences.

Considering the social aspects of genetic testing and its meaning for families has been one of the enduring interests of the CFR for nearly 20 years. For Helen Statham and her colleagues, Professor Martin Richards and Maggie Ponder, a Wellcome Trust funded project has provided a unique opportunity to study the psychosocial effects for families of being part of a genetic research study.

The study has run in parallel with the Genetics of Learning Disability (GOLD) study – a joint project between the Department of Medical Genetics and The Wellcome Trust Sanger Institute, and headed-up by Dr Lucy Raymond. The aim of the GOLD study has been to search for new mutations on the X chromosome that result in significant learning disabilities in boys. 'We worked alongside the GOLD study, talking to families about why they had taken part in the research, what their expectations were and, at the end of the project, how they felt either having got a genetic diagnosis or not.'

Of about 400 families taking part in the GOLD study, the CFR team interviewed 120 members of 37 family groups. Five of the 37 families have received a confirmed genetic diagnosis. 'For these families,' says Helen Statham, 'their greatest concern was for their daughters, who would now be able to have carrier testing and make reproductive choices, even though these might be difficult. The other families were very disappointed not to have a confirmed diagnosis, particularly those families whose children were not as severely affected and therefore not as fully supported by statutory services, and yet whose day-to-day existence was still a challenge.'

Studies such as these complement projects that yield advances in our genetic understanding of disability and disease. 'As a funder, the Wellcome Trust is innovative,' says Helen Statham, 'because they provide opportunities to social scientists to undertake empirical research in areas that are ethically challenging.'

For more information on the Centre for Family Research, please go to www.sps.cam.ac.uk/CFR

Helen Statham

NEWS FROM RESEARCH SERVICES DIVISION

'Foodomics?' Horizon Seminar

An eclectic mix of researchers, whose academic interests ranged from medicine, social anthropology, plant biology, chemical engineering, archaeology to veterinary science, met on 19 June for the latest Horizon Seminar organised by Research Services Division: 'Foodomics? Why we eat, what we eat, and what's next on the menu'.

This unique event began with the importance of healthy eating and why nutrition is on the public agenda as never before. Delegates heard about the genetics of obesity and the complex and sometimes opposing social factors concerning the way in which food is regarded in different cultures. Archaeologists explained how their studies tell us about ancient diets and how food-sharing behaviour first developed. Salutary information was delivered on dietary vitamins and iron, and the relationship between certain diets and cancer. The Seminar ended with a look to the future: the technological developments needed for efficient and consistent food production, as well as the ongoing advances in guarding against food-borne pathogens.

The excellence of the talks combined with the diversity of the subjects was well received: 'I learnt a great deal about things I didn't even know I didn't know!' said Dr Alison Smith in the Department of Plant Sciences. Dr Andrew Wadge, the Food Standards Agency's Chief Scientist, summed up the general feeling of the day: 'It is extremely rare to see clinical scientists and social anthropologists on the same programme. Rare but incredibly valuable.'

For more information about the Horizon Seminar series and to book online, please go to www.rsd.cam.ac.uk/events/horizon or email horizon@rsd.cam.ac.uk

'Cell–Material Interface' Horizon Forum

How do interactions with natural and artificial materials affect cell behaviour? Delegates from across the University met at the recent Research Services Division Horizon Forum to debate this issue.

Research at the cell–material interface is vital for shedding light on how cells react to their surroundings. Understanding these interactions will have far-reaching implications for how we design artificial materials to direct nerve and bone regrowth, and therefore how spinal cord and skeletal injuries might be treated. Experts from a range of disciplines presented their research on the way cells interact with and respond to surfaces, materials and bound growth factors, and the ways these interactions can be measured.

Horizon Forums are interdisciplinary workshops designed to inspire new generations of research scientists to create innovative projects and collaborations. Evidence of one such collaboration was the presence of Professor Krystyn Van Vliet from MIT, whose visit to Cambridge was supported by the Cambridge-MIT Institute to build links with Dr Jochen Guck at the Cavendish Laboratory and present her research at this Horizon Forum. Professor Van Vliet commented on the success of the day: 'I was impressed by the range and depth of approaches that Cambridge researchers were using to learn about and to control the cell–material interface. As a result of this meeting, we've been able to start valuable discussions with Cambridge experts in specific cell pathologies and protein characterisation, and to exchange protocols with those now interested in exploring the mechanobiology of the cell.'

For more information about Horizon Forums please email horizon.forum@rsd.cam.ac.uk

NEWS FROM CAMBRIDGE ENTERPRISE LTD

An invention to help the ageing eye

Progressive loss in accommodative power by the lens of the human eye – a condition known as presbyopia – affects almost everybody who enters middle age and interferes with their ability to focus on close objects. As we live longer and continue to pursue challenging visual activities, the demand for presbyopic correction is increasing.

The effects of presbyopia are particularly felt by regular computer users – the screen lies at a middle distance, which varies as the subject's posture alters and is rarely catered for by current presbyopic spectacles. Until now, the solution has been to use bifocal or varifocal lenses, but these offer limited fields of view at various fixed distances. Instead, the ideal presbyopic correction should provide a full field of vision with clear focus for any distance between infinity and the near point – and this is what has been accomplished by Dr Paul Meyer, in the Department of Ophthalmology, Addenbrooke's Hospital, Cambridge.

Developed in conjunction with NHS clinical engineers, the technology gives users a wide field of view with no distortion and high resolution at any distance. The new lenses are based on the simple optical principle that the air gap between a pair of nesting concave and convex lenses develops increasing positive power as it widens. A compact, low-friction movement above the bridge of the nose allows the wearer to focus easily using a single roller situated on either side of the frame. Dr Meyer is commercialising the technology through Cambridge Enterprise Ltd, who are looking for licensing partners or investors.

For more information, please contact Dr Iain Thomas (iain.thomas@enterprise.cam.ac.uk; Tel: 01223 760339) at Cambridge Enterprise Ltd.

Can I patent and publish?

A patent for an invention is granted by the state to an inventor, giving the inventor the right for a limited period to stop others from making, using or selling the invention without the permission of the inventor. In exchange for this limited monopoly, the inventor discloses the invention to the public via publication of the patent application. It is vital to file a patent application before the information is put in the public domain. If a publication is made before the first filing, then the publication counts as prior art and reduces the territories in which a patent application may be filed as follows:

- within six months of the first publication date an application may be obtained in the US and Japan only;
- within 12 months of the first publication date an application may be obtained in the US only.

This may not be sufficient protection for commercialisation of the invention. No patent protection can be sought for any invention after 12 months of its first publication.

If you are a member of the University of Cambridge and wish to disclose an invention, contact Cambridge Enterprise Ltd (enquiries@enterprise.cam.ac.uk; Tel: 01223 760339), or submit an invention disclosure form www.enterprise.cam.ac.uk/pdfs/pdf_library.htm). One of the Cambridge Enterprise team will be pleased to meet with you to discuss your options for commercialisation together with the services and support Cambridge Enterprise can offer.

For further information, please go to www.enterprise.cam.ac.uk/inventions/inventions.htm#how_to_disclose on the Cambridge Enterprise Ltd website.

FORTHCOMING EVENTS: SAVE THE DATES!

10 October 2007

Horizon Seminar
'Energy in Cities: What does the future hold?'

Energy is essential to every aspect of our economic and social well-being. Today, the world faces two big challenges: climate change and the security of energy supplies. Cities and regions have both a responsibility to reduce their carbon emissions and the opportunity to take advantage of new energy-efficient systems and renewable energy. At this Horizon Seminar, leading experts will describe their ground-breaking research in energy use in built environments, clean and efficient urban transport, and renewable energy generation in cities (see page 10). This event will be held at Buckingham House, New Hall, Cambridge.

4 December 2007

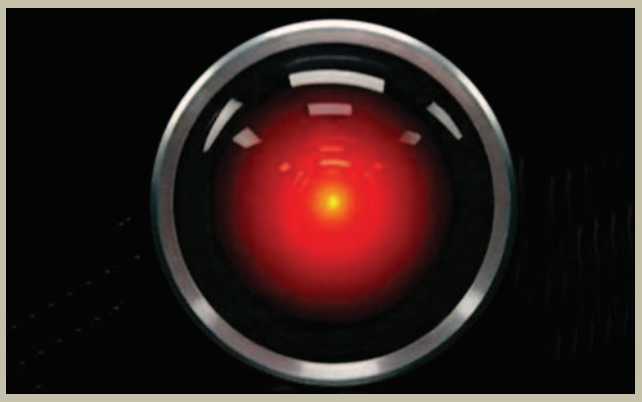
Horizon Seminar
'Live Long and Prosper? Ageing in the 21st century'

In the developed world, two centuries' worth of ongoing improvements in health and sanitation are increasing our longevity. In Europe, the fastest-growing age group is the over-80s. We are poised both for further medical advances and for technologies that will assist us to live and work independently for longer. Will the 'population pyramid' become a 'skyscraper'? How might an age boom affect the individual, society and economies in the 21st century? Could the 'demographic time bomb' in fact be an opportunity? Visit the Centre for Mathematical Studies and hear the opinions of academics and thought leaders from Cambridge and beyond at this Horizon Seminar (see page 16).

10–20 March 2008

Cambridge Science Festival
'The World of Science'

The 15th Cambridge Science Festival will feature science from all points of the globe and beyond in 2008. Coinciding with the national China Now festival, there will be talks and demonstrations on historic Chinese science as well as discussions of global challenges and hands-on science events for all ages. For more information, please contact Nicola Buckley (nicola.buckley@admin.cam.ac.uk); all of the festival events can be viewed on www.cambridgescience.org from early February 2008.



18 March 2008

Horizon Seminar
'The Thinking Machine?'

Our understanding of the process of cognition in human beings – how we perceive, think and process information about our environment – is highly developed. This Horizon Seminar will explore cross-disciplinary research on cognisance and cognitive systems, which is relevant to such disciplines as psychology, neuroscience linguistics, philosophy and computer science. In the overlap between these disciplines, what will we learn about the extent to which man is a machine or whether a sentient machine can ever be developed? This Horizon Seminar will be held at Emmanuel College, Cambridge.

Horizon Seminars are organised by Research Services Division. For more information and to book online, please go to www.rsd.cam.ac.uk/events/horizon or email horizon@rsd.cam.ac.uk

We are looking for article ideas for Issue 5 of Research Horizons and welcome suggestions from all areas of research across the University. Please send ideas to the Editor at Research.Horizons@rsd.cam.ac.uk

Your way into Cambridge

Research Services Division (RSD) helps academics to identify, secure and manage research funding from external organisations.

We identify funding opportunities through our relationships with regional, national and international sponsors and then support academics through every step of the awards process, from applying for a research grant and checking applications are correct, through negotiating contracts to protect the interests of academics and the University, to supporting departments in managing funding throughout the life of a research project.

RSD also encourages collaboration between the University and industry, and fosters long-term research partnerships between sponsors and academics for mutual benefit.

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