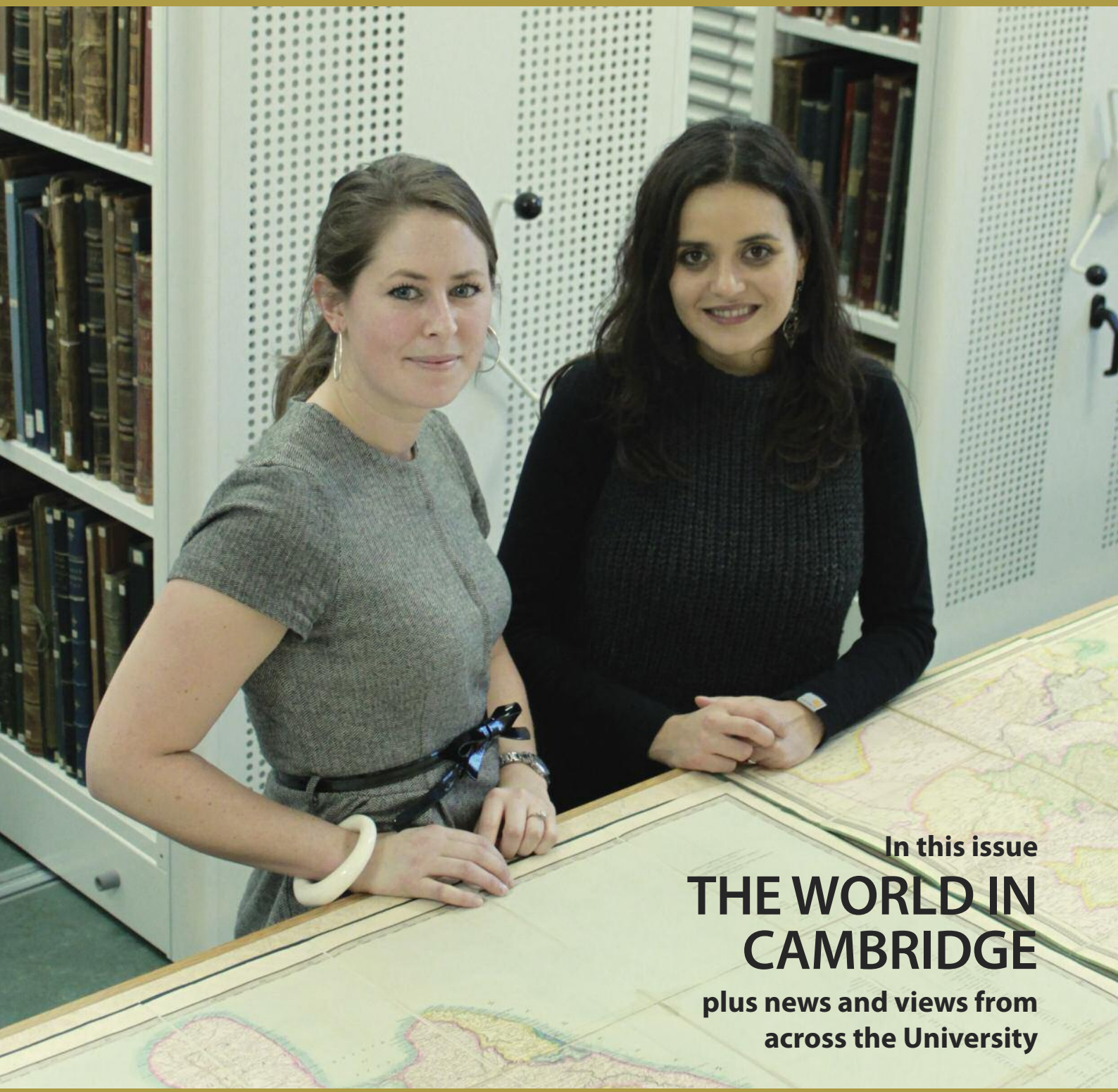
RESEARCH HORIZONS



In this issue

THE WORLD IN CAMBRIDGE

plus news and views from across the University

UNIVERSITY OF CAMBRIDGE

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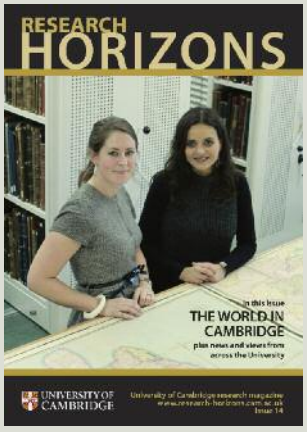

Cover: Dr Philippa Williams (left) and Dr Marta Magalhaes: scholars whose fieldwork-based research is adding to understanding of regions of the world (see pages 10 and 14); photographed in the Map Room of Cambridge University Library. Photograph: Mark Mniszko

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The world in Cambridge

Cambridge has long had active research interests in diverse regions of the globe. Our scholars are helping to transform the way we understand the world, with benefits that impact directly on society.

An innovative building is shortly to open on the University's Sidgwick Site that will provide a powerful focus for some of this international and interdisciplinary research in the humanities and social sciences. The new building has been designed to maximise collaboration between disciplines; light and airy, it is structured around open staircases and a large atrium, and is designed to the highest environmental standards.

It will be a place for academics, graduate students and visiting researchers to come together to further their common interests in the particular cultures and politics of Africa, of Inner Asia, of Latin America and of South Asia. They will be joined by the Department of Politics and International Studies – with its research centres on governance and human rights, political thought, and rising powers – as well as by those concerned with the well-established graduate programme of Development Studies.

All of these groups have their own taught or research-based graduate programmes and their own global academic networks; the scope for their further collaboration and growth is endless.

The potential for interdisciplinary work across the institutions within the new building and beyond will be further enhanced by the fact that the ground floor will be occupied by CRASSH – the Centre for Research in the Arts, Social Sciences and Humanities. Formed 10 years ago, it has come to play an indispensible role in the University as a nurturer of links across and beyond the humanities. CRASSH's seminars, conferences and visitors' programmes are vitally important in engaging Cambridge with the wider academic world.

The new building is splendidly conceived to further all this work beyond territorial and intellectual boundaries. The contributors to the Spotlight section of this edition of *Research Horizons* convey something of the excitement this research engenders.

Professor Willy Brown
Head of the School of the Humanities and Social Sciences

The *Map of Life*: convergent evolution for all

A newly launched interactive website is dedicated to enhancing public and academic understanding of evolutionary convergence.

Ants that farm and sea cows that graze, and spiders and worms that spit, are just some of the hundreds of examples assembled by the *Map of Life* website to demonstrate how evolution has repeatedly converged on the same solutions to life's challenges.

Convergent evolution occurs when unrelated organisms acquire similar adaptations to life in similar environments but from very different starting points. In this way, creatures with common solutions to challenges in their unique habitats can occupy very distant branches of the tree of life.

Co-ordinated by Professor of Evolutionary Palaeobiology Simon Conway Morris in the Department of Earth Sciences, the *Map of Life* draws comparisons among examples gleaned from peer-reviewed journals and presents them in an accessible cross-referenced and topic-based resource for the benefit of students, academics and the public.

Emphasising the opportunity for the perspective offered by convergent evolution, Conway Morris says: 'Understanding convergence offers a uniquely valuable window onto biological constraints that is not only of academic interest but also promises to make a real impact on the way we treat the world around us and respond to ecological change.'

One of the most well-known examples of biological convergence is the camera eye, a specialised structure conferring superb vision in both vertebrates and cephalopod molluscs such as the octopus and cuttlefish. *Moloch horridus*, the thorny devil lizard of Australia, and *Phrynosoma cornutum*, the desert horned lizard of North America, also illustrate convergence: both are spiky anteaters that collect drinking water through special structures within their skin, although they are separated by 150 million years of evolution.

JENNY HUANG

Convergent evolution of good vision: the camera eye in vertebrates and cephalopod molluscs

Conway Morris, developmental biologist Dr Chloë Cyrus-Kent, and behavioural ecologist Dr Verena Dietrich-Bischoff have spent several years writing the content of the *Map of Life*. Conway Morris hopes to 'raise the profile of convergent evolution in the thinking of today's researchers.'

Sponsored by the John Templeton Foundation, the *Map of Life* shows that organisms not only evolve, changing over time as successive generations inherit modified information from their predecessors, but often do so along strikingly similar pathways despite being unrelated to each other. 'With Darwin we saw our world through new eyes,' says Conway Morris, 'but perhaps with convergence we see new landscapes in evolutionary biology, reflecting a deeper order within living systems.'

For more information, please visit www.mapoflife.org/

Middle aged diabetics can die six years earlier

Having diabetes in mid-life may reduce a person's life expectancy by an average of six years, according to a large, multinational study.

Diabetes is already known to approximately double the risk of heart attacks and strokes, but new findings show that people with type 2 diabetes are also at greater risk of dying from several other diseases, including cancer and infection. The findings highlight the importance of preventing diabetes, which affects more than 2.5 million people in the UK and nearly 285 million people worldwide.

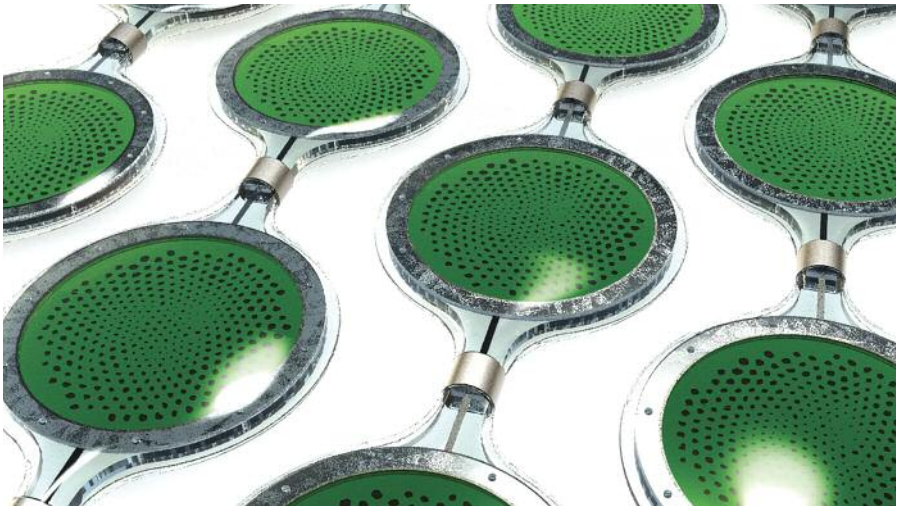
Scientists from the Emerging Risk Factors Collaboration, which involves over 250 scientists from 25 countries and is coordinated by the University of Cambridge, analysed data on 820,900 people, each of whom was monitored for about a decade. Even after accounting for other major risk factors such as age, sex, obesity and smoking, the researchers found people with diabetes are at increased risk of death from several common cancers, infections, mental disorders, and liver, digestive, kidney and lung diseases. About 60% of the reduced life expectancy in people with diabetes is attributable to blood vessel diseases (such as heart attacks and strokes), with the remainder attributable to these other conditions. Only a small part of these associations are explained by obesity, blood pressure, or high levels of fat in the blood – conditions which often co-exist with diabetes.

'These findings broaden and intensify the need for efforts to prevent and understand diabetes,' said Principal Investigator Professor John Danesh, from the Department of Public Health and Primary Care. 'In particular, the findings highlight the need for more detailed study of whether treatments against diabetes may also be relevant to lowering the risk of a range of diseases, including common cancers.'

The study, which was funded by the Medical Research Council, British Heart Foundation and Pfizer, is published in the *New England Journal of Medicine*.

The appliance of design in science

Designers have shaped the way we live today, created iconic products and disrupted industries – but could design also shape scientific research?



IfM

An array of algal solar panels

From the car you drive to the clothes you wear, there are few areas in which design hasn't played an integral role. Now a major research project at the University's Institute for Manufacturing (IfM) is investigating the potential benefits to science of collaborating with product and industrial designers, especially in the early stages of research.

The 'Design in Science' project, which was set up by Dr James Moultrie, Head of the Design Management Group, is being carried out by research associate Alex Driver and doctoral student Carlos Peralta. It was initiated after the publication of the Sainsbury Review, which suggested scientific research might benefit from collaboration with the creative industries, and is funded by the Engineering and Physical Sciences Research Council.

'The literature shows not only that design has a beneficial impact when it comes to developing new technology, but also that the earlier the involvement, the more successful the project,' says Driver. 'We wanted to explore this within scientific research.' Already, the project is showing promising results with collaborations that range from stem cell research to biological chemistry.

One such example is work with the Department of Chemical Engineering and Biotechnology and the Department of Plant Sciences on biophotovoltaics – devices used to generate energy from the photosynthesis of living micro-organisms such as algae. The collaboration has helped to generate a series of conceptual designs to demonstrate future applications of the technology, which the team are currently prototyping.

Working also with biological chemists, who had an idea for a fluid-handling device to carry out a common laboratory task more efficiently, Peralta and Driver have helped to develop prototypes to support a funding bid. The biochemists were later awarded £150,000 for further development of the product.

It is hoped that the study could lead to positive benefits for the scientific research community, in terms of opportunity identification, helping to turn research into commercial spin-offs, communicating the impact of University research and inspiring new research directions.

For more information, please contact Alex Driver (ajd95@cam.ac.uk) or Carlos Peralta (cmp60@cam.ac.uk) at the Institute for Manufacturing (www.ifm.eng.cam.ac.uk/).

Investing in innovation

A system for the early detection of brain tumours in children and droplets that serve as 'miniature test tubes' – just two of the Cambridge innovations that were commercialised in 2010.

Dr Louise Allen

Cambridge Enterprise, the University's commercialisation group, recently announced its results for the 2010 financial year. Income from commercialisation activities continued to rise, as did the number of licensing, consultancy and equity transactions.

A wholly owned subsidiary of the University, Cambridge Enterprise currently provides support to almost 1,000 Cambridge researchers at all stages of the commercialisation process, from supporting grant proposals, to licensing technology to existing companies, through to funding new companies and ventures.

One of the innovations supported by Cambridge Enterprise was an augmented reality application for smartphones, which was developed by Simon Taylor and Connell Gauld, two graduate students in the Department of Engineering, along with Dr Tom Drummond. The application processes images from a camera on a smartphone to recognise real-world features and overlays virtual graphics on top. The inventors are now talking with potential customers about incorporating their software into additional products.

Another device that shows great promise has been developed by Dr Louise Allen of the Department of Medicine. Cambridge Enterprise supported Dr Allen in her development of a specialised visual-field test system to detect vision defects in children. Because it can identify defects that result from tumours on or touching the optic nerve, it could be a lifesaver in picking up tumours at an early stage. The device is currently in trials at Addenbrooke's Hospital.

Cambridge Enterprise also invests intellectual property and cash to create new companies and ventures based on University research. One of the companies to receive funding last year was Sphere Fluidics, originating from the research of Professors Chris Abell and Wilhelm Huck of the Department of Chemistry. The company aims to commercialise picolitre droplet technology to enable researchers to carry out large numbers of simultaneous reactions contained within aqueous droplets a fraction of a millilitre in volume. The technology has potential uses across a wide range of fields, including biopharmaceutical discovery and algal biofuel development.

The Cambridge Enterprise Annual Review is available for download from www.enterprise.cam.ac.uk/

Read all about it!

A new study of wrongdoing and its cultures in Spain from 1800 to 1936 will explore the fascination of popular versions of crime and other misdemeanours.

The flip side of contemporary fear of crime is our fascination with it. Repelled we might be, but the popularity of watching CCTV footage of real crimes or reading the latest salacious scandals in tabloids is testament to modern society's appetite for stories that shock.

But this fascination with crime is not new; nor is the popularity of the materials that purvey it. Cambridge researcher Professor Alison Sinclair has set out to discover what Spain thought about wrongdoing between 1800 and 1936 by examining a wide range of sources, and in particular the equivalent of the mini-tabloids of the time – so-called chapbooks or *pliegos sueltos* – of which an extensive archive exists in Cambridge University Library.

Sold on street corners by hawkers and luridly illustrated, the *sueltos* carried vivid tales of the unlawful, the improper and the morally corrupt.

'Spain in the 19th century was chaotic and troubled. It has no literary work that is the equivalent of Dostoyevsky's *Crime and Punishment*, and yet the figures for violent crime in the 19th century in Europe place Spain as one of the countries highest on the list,' explains Professor Sinclair, whose three-year research project has been funded by the Arts and Humanities Research Council.

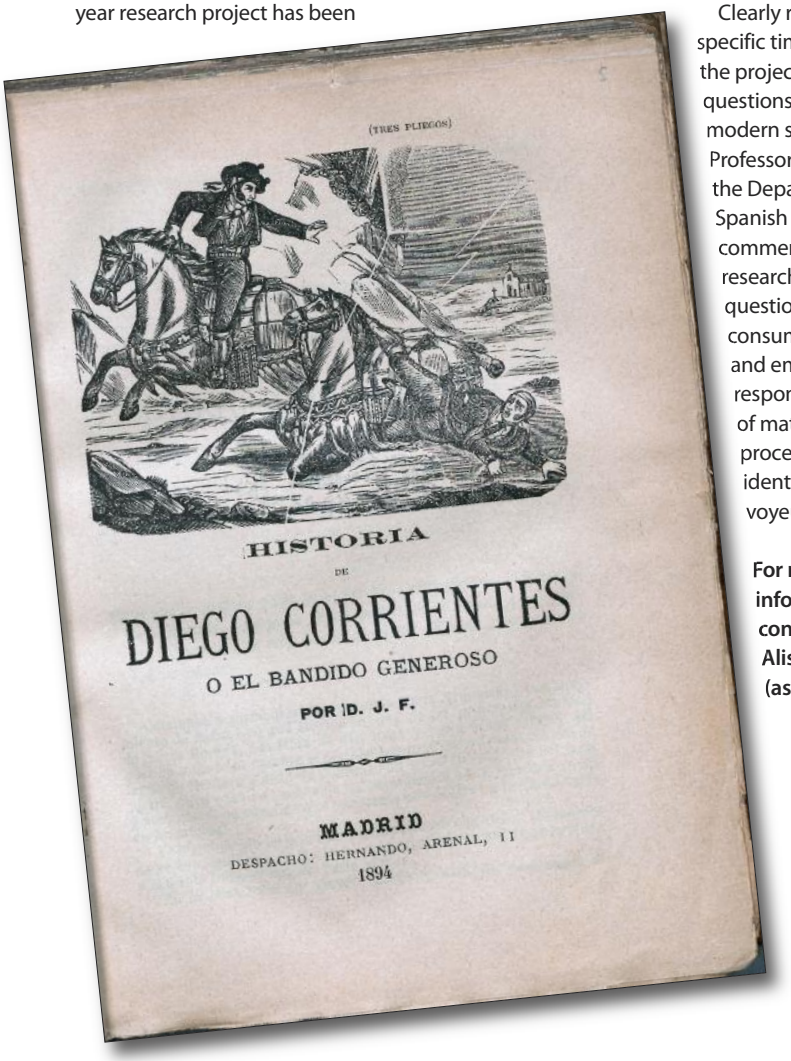
'With their mix of fact and fantasy, the *sueltos* provide a window not only into wrongdoing at the time but also into its representation and the way people perceived it, thus complementing in a completely original way other literary and cultural representations of wrongdoing.'

The *sueltos* spoke to an audience entranced by the exploits of such characters as Francisquillo the Tailor, a boastful chap whose scissors turn out to be his major weapon in a series of dramatic standoffs about honour. A recurring (and real) character is Diego Corrientes, a Spanish Robin Hood figure who took from the rich and gave to the poor, and who died by hanging aged 24 years.

A key feature of the project will be to catalogue and digitise 4,470 *sueltos* held in the University Library and the British Library. Many are in an exceptionally fragile state and a goal of the project is to create a world-class and accessible collection, which will be held in the University's central repository DSpace@Cambridge (www.dspace.cam.ac.uk/).

Clearly related to a specific time and place, the project raises questions relevant for modern society. As Professor Sinclair, from the Department of Spanish and Portuguese, comments: 'The research will help us to question, as cultural consumers, our excited and emotional responses to this sort of material, including processes of identification and voyeurism.'

For more information, please contact Professor Alison Sinclair (as49@cam.ac.uk).


(TRES PLIEGOS)

HISTORIA

DE

DIEGO CORRIENTES

O EL BANDIDO GENEROSO

POR D. J. F.

MADRID

DESPACHO: HERNANDO, ARENAL, 11

1894

***Pliegos sueltos* Diego Corrientes (S743.1.c.8.2)**

Leap for fleadom

New research sheds light on how fleas jump, reaching speeds as fast as 1.9 metres per second.

In 1967, Henry Bennet-Clark discovered that fleas store the energy needed to catapult themselves into the air in a pad made of the unique 'elastic' protein resilin.

However, in the intervening years, debate raged about exactly how fleas harness this explosive energy. Scientists came up with competing hypotheses, but it wasn't until recently that the technology necessary to record and analyse the data became available.

Using high-speed recording equipment and sophisticated mathematical models, Professor Malcolm Burrows and Dr Gregory Sutton from the University's Department of Zoology have been able to prove that fleas use their toes to push off and propel themselves into the air, resolving the 44-year-old mystery.

To view a short film of a jumping flea, please visit http://bit.ly/eddr2N

Launch of £20 million sustainability programme

The inauguration of the Winton Programme for the Physics of Sustainability begins a revolution in physics research.

An inaugural celebration on 24 March marks the launch of the new Winton Programme for the Physics of Sustainability at the Cavendish Laboratory in the Department of Physics. In supporting research that explores the basic science needed to generate new technologies and industries, the Programme will apply physics to meet the growing demands on our natural resources. The Programme, which was made possible following a gift of £20 million from David Harding – the founder, Chairman and head of research of Winton Capital Management – will help the Cavendish Laboratory cement its position at the forefront of the next revolution in physics.

'While it is not quite as simple as using physics to save the world, this is an opportunity to use, for example, quantum physics to develop materials with seemingly miraculous properties that could combat the growing effect humans are having on the planet,' said David Harding. 'I want to encourage research to keep the skies blue.'

Where empires meet

How two 'rising powers' – China and Russia – interact across the border they share with resource-rich Mongolia is the focus of a network led by the Mongolia and Inner Asia Studies Unit, as the researchers involved explain.

Buryat horsemen at Dadal, Mongolia

As rising economic and political powers, China and Russia often attract attention in relation to the West, but their interactions with one another, and comparisons between them, are less understood. Yet the two powers share thousands of miles of border, with the country of independent Mongolia lodged in-between them in the central part of the long frontier.

Our multidisciplinary project, based in the Mongolia and Inner Asia Studies Unit (MIASU), has for the first time brought together international discussion on the theme of the border economies of the three countries.

Over the course of the past year, with funding from the Economic and Social Research Council, the network has provided a unique opportunity for social scientists from Russia, China and Mongolia to meet with their counterparts in the UK at two workshops and through an online network. And to maintain collaboration among the physically dispersed scholars, a virtual experimental and empirical research environment – a 'collaboratory' – has been built, in which researchers can share research and ideas and, ultimately, trace the cross-border trajectories taken by people, goods and ideas.

Global relevance

Global uncertainties are at issue in this region: China's search for energy resources and the employment of its huge population; Russia's fear of Han infiltration of its Siberian expanses; and the precarious independence of Mongolia as both neighbours negotiate to obtain rights to extract resources there.

Greater knowledge is needed on how the changing socioeconomic conditions of neighbouring states affect migration flows between China and Russia, as well as the different citizenship regimes that are practically operative between the three countries.

Deeper understanding is also needed about conflicts of interest – in cross-border practices, local governments and central state policies – and what the reality is of Chinese expansion into Siberia and Mongolia. With international ventures, such as oil or gas pipelines, or uranium mines, it is important to establish what the local reactions are and what implications such ventures have for environmental policies.

An in-depth analysis of these dynamics requires not only the kinds of accounts provided by political science and economics, but also the information and insights that anthropology can furnish. The rationale for this project lies in the lack of accessible and reliable accounts of the practical workings of the Chinese and Russian states, especially in minority-inhabited regions such as those along the frontier. Where new information about the situation on the ground does exist, much of it is ongoing and unpublished, or is buried in local publications and published in languages that are difficult for all to access.

If Russia and China are to be properly understood, both by scholars and policy makers based in the West and by those of the countries concerned, there is a need to collect, translate and disseminate this research and to analyse it comparatively.

Frontier knowledge

The frontier zone linking China and Russia with eastern Mongolia is a region where MIASU has built strong links, engaging in policy debate as well as academic research. Although this 4,400-mile border is not an area of global economic advertisement for either country, it is a significant region for strategic policy.

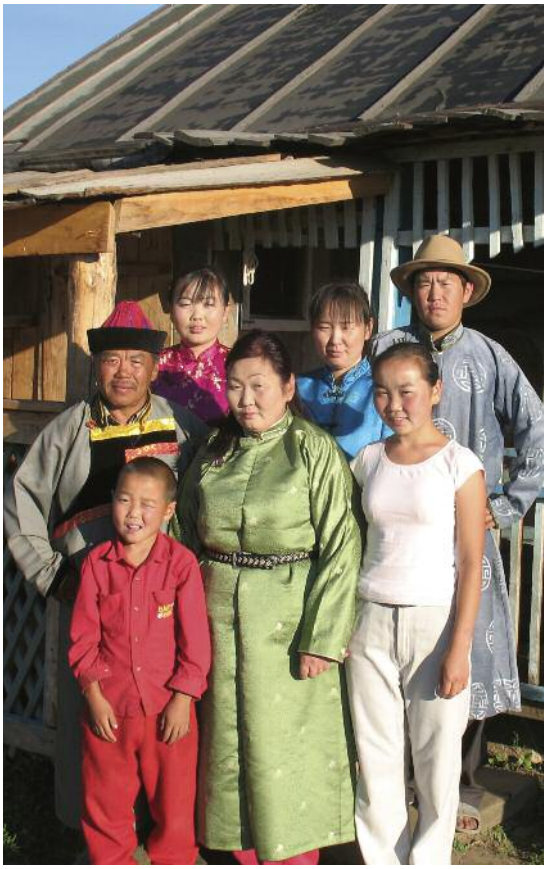
Already, findings from the network are identifying how these hinterlands out of the public eye can tell us much about emergent processes of economic and political governance, through analysis of the practical operations of these post-imperial states.

For instance, two ongoing, and so far little-studied, regional processes are likely to be particularly illuminating. Russia has a policy of amalgamating small, ethnically defined territories into larger units with Moscow-appointed leadership. And China has a policy of relocating herding populations, almost all of which are from ethnic minorities, and closing pastures for purposes of environmental protection. Each of these policies may be compared with parallel, but different, solutions to problems of governance and environment on the other side of the border.

Such comparison is aided by the fact that the main indigenous population of the studied frontier zone consists of one ethnic

Siberian timber being delivered to China via Mongolia

Parts of the border are still heavily militarised



ALL IMAGES: SAYANA NAMSARAEVA

Buryat family

group, the Buryat, a people of Mongolian origin. The two above-mentioned administrative decisions have aroused considerable anxiety for the Buryat and other local people. Work has begun through the network to assess existing information on the forms of protest and compliance found, and the effects on migration and trade.

The inclusion of Mongolia in the network is also significant because it allows us to explore how Russia and China attempt to include such countries in their sphere of interest. Mongolia is resource-rich but underdeveloped, and a prominent object of resource extraction for both China and Russia.

This study allows us to examine processes of infrastructure construction and resource extraction that are comparable with Chinese and Russian ventures elsewhere in the world. It also enables us to investigate what particular consequences Russia and China's rise might have for future regional divisions of labour, and for examining the social consequences of economic adjustment within Mongolian society.

Zones of uncertainty

Both Russia and China like to imagine themselves as centralised, vertically organised states that control all of the territories up to their borders. Yet, distant hinterlands remain zones of uncertainty, where there may be a potentially flammable mix of anxieties surrounding the extraction of valuable resources and mobile ethnic populations.

Recent anthropological research by MIASU members on the topic has shown that another phenomenon is to be added to the mix: laterally organised, informal, partially legal, local economies operate to some degree in opposition to central state policy and make their profits precisely because of the existence of the border.

Global uncertainties are at issue in this region: China's search for energy resources and the employment of its huge population; Russia's fear of Han infiltration of its Siberian expanses.

One example is illegal salmon fishing and fish trade in the Amur River (the border), where ethnographers have shown the existence of networks of poachers and phoney companies linked across the border. The Siberian–Chinese–Mongolian frontier is alive with 'transmigrants', guestworkers, joint ventures, smuggling, mediators, shuttle-traders, illegal work gangs and fictitious companies.

Our discussions of the real situation on the border are addressing policy stakeholder's concerns, such as poverty and survival strategies, transparency and social adjustment. The relation of this burgeoning frontier economy to more formal ventures, such as the Russia–China gas pipeline, Russian mining in Mongolia, or Chinese railways in Mongolia, as well as to potential ethnic conflict, will also be investigated, especially given that the same conditions do not apply everywhere.

But our end goal will be to contribute some answers to questions of global significance: is China expanding, and if so, how? And how do China and Russia actually govern their frontier provinces and potential disturbances therein?

Dr Franck Billé (left), Professor Caroline Humphrey and Dr Gregory Delaplace

For more information, please contact Professor Caroline Humphrey (ch10001@cam.ac.uk), Dr Gregory Delaplace (gd307@cam.ac.uk) and Dr Franck Billé (franck.bille@gmail.com) at the Mongolia and Inner Asia Studies Unit (http://innerasiaresearch.org/).

JENN WARREN/FLICKR USAID AFRICA PHOTOSTREAM

Queueing of voters at the southern Sudan referendum this year; the Cambridge–Carnegie Project is supporting negotiations over implementing the referendum result

Research on the front line

An ambitious project with global reach seeks to address the most difficult and persistent internal conflicts – struggles for ethnic identity and national self-determination – as its Director Professor Marc Weller describes.

Advising on peace settlements in countries ranging from Georgia and Moldova to Bosnia, Macedonia and Kosovo, the Cambridge–Carnegie Project has been combining cutting-edge academic work with practical action for over a decade. Now supporting negotiations to implement the January 2011 referendum result in southern Sudan, the research effort involves an international team comprising 40 leading specialists in ethnic conflict around the world.

War: the only remedy?

The struggle for ethnic identity and national self-determination has been a persistent cause of internal conflict since the conclusion of the Cold War. Instead of a world dominated by proxy wars fuelled by superpower competition, internal conflicts have claimed more and more victims and international attention. The dreadful disasters of Bosnia and Herzegovina, Kosovo, the Caucasus, Rwanda, the Great Lakes Region and Sri Lanka were only the most prominent examples of this fact. Some 40 other internal conflicts remained active or re-ignited during this period.

Conflicts over who controls the state are difficult enough to settle. The United Nations (UN) and African Union have attempted to address this issue in Liberia and Sierra Leone for several decades now. Only very recently, Cote d'Ivoire was added to this list along with the crises over governance in Egypt, Bahrain and Lybia.

However, when the contestation over state power is combined with a quest for ethnic dominance within the state, or with a demand for formal autonomy or even secession, the conflict has traditionally been deemed unresolvable. The international system has been very reluctant to involve itself in what was regarded as essentially a domestic matter potentially affecting the very existence of the state concerned. Short of international action, the only remedy has traditionally been war.

Some 70 self-determination conflicts outside of the colonial context have been fought since 1945. Up to the end of the Cold War, only a handful of these were ultimately settled through peace agreements. The others either continued, sometimes over decades (Burma), or were eventually terminated by way of decisive victory for the central government (Biafra).

A new departure was possible in the early days of the New World Order that was envisaged around 1990. UN-sponsored peace settlements in Namibia, Cambodia, Angola, Mozambique and Central America seemed to demonstrate that peace was, after all, possible. In other instances, the outbreak of internationally unacceptable violence demanded international action – in relation to Kosovo in 1999, even to the point of significant military engagement by NATO. It was at this point that the Centre of International Studies, in the Department of Politics and International Studies (POLIS),

launched its major international project addressing internal peacemaking. The Cambridge–Carnegie Project commenced in 2000, with the support of the Carnegie Corporation of New York, and is still ongoing.

In Kosovo, for instance, the research team was involved in the official Ahtisaari mediation and the eventual drafting of the constitution for independent Kosovo. Indeed, more or less the entire system of minority governance – a particularly sensitive issue in the country – was designed by the members of the Project, from the law on the protection of national minorities to the statute of the Presidential Minority Consultative Council.

Complex power-sharing

Although independent statehood is no longer precluded as a negotiation outcome, the Cambridge–Carnegie team has however mainly focused on attempts to ensure the continued territorial integrity of existing states. Towards this end, a step-by-step approach was adopted, commencing with path-breaking work on the doctrine and practice of complex, internationally supported power-sharing as an alternative to secession.

Power-sharing aims to dilute unipolar sovereignty allocated only to the central institutions of the state. Instead, public authority is distributed widely among regions and stakeholder groups. This is backed up by modest autonomy for territorially compact ethnic groups, by a strong human and minority rights regime, and by provision for the equitable sharing of state resources. Moreover, cross-border co-operation is encouraged, along with international stabilisation measures during the initial phase of conflict transformation.

In a further phase of the Project, we considered independence options more particularly, including the creation of complex, asymmetrical autonomy options. Asymmetrical autonomy retains the overall structure of the central state, but grants strong devolved autonomous powers to some regions.

The next major area to be addressed concerned the ways and means of enhancing political participation of non-dominant groups in the state. As opposed to majoritarian democracy, which asserts that the majority group in a state makes the decisions, we explored and developed softer forms of state design that enable numerically smaller groups to gain influence in public life, encouraging them to develop a sense of shared ownership of the state. And, in a new phase of the Project, we are now considering the use of human and minority rights mechanisms within threatened states as a means of achieving stability.

Our raw material, which has resulted in several major books, will be available through an online database on ethnic peace settlements, to be launched later this year. And, in a major new development, we shall be leading the effort to develop model clauses for internal peace settlements, along with practical guidance for mediators and the parties engaged in negotiations, for the UN.

POLIS: studying politics in all its dimensions

Research at the Department of Politics and International Studies (POLIS) is rising to the pressing need to understand the multiple levels of change occurring in world politics.

The international environment is more complex than ever. With 192 member states of the UN displaying a huge variety of regime types and degrees of stability, new powers emerging to challenge Western predominance, a complex cobweb of governance mechanisms, and the rise of transnational terrorism, we face major dilemmas of analysis, politics and ethics.

POLIS is making a distinctive contribution through research that crosses state boundaries and academic disciplines. From a strong research base at both theoretical and empirical levels, it is able to reach out to practitioners in both government and civil society.

One cluster of research in POLIS focuses on the issues associated with war, security and foreign policy, including the interplay with domestic society. Regional and comparative politics figure strongly, with particular strengths on Europe, Russia, parts of the Middle East, Africa, Latin America and South East Asia. Human rights and international law are prominent, especially through the Cambridge–Carnegie Project (described here) and the new Centre of Governance and Human Rights.

International and comparative political economy is another active area, and is closely associated with the study of international organisation, negotiation and transnational networks, as well as the politics of economic policy. Also well represented is the history of international relations, especially through the Centre of International Studies, and the history of political thought both about the state and the condition of the international system.

POLIS also has a wider public role, with its members often providing advice to government departments, companies, non-governmental organisations and the media in policy areas where expertise and research outcomes can contribute to policy debate and influence decision-making.

For more information, please visit www.polis.cam.ac.uk/

Now supporting negotiations to implement the January 2011 referendum result in southern Sudan, the research effort involves an international team comprising 40 leading specialists in ethnic conflict around the world.

Professor Marc Weller

For more information, please contact Marc Weller (mw148@cam.ac.uk), Professor of International Law and International Constitutional Studies in the Department of Politics and International Studies, Director of the Lauterpacht Centre for International Law and a Senior Mediation Expert for the UN.

South Asian studies in the age of globalisation

The Centre of South Asian Studies fosters a vibrant University-wide research community whose interests span the societies of India, Pakistan, Bangladesh, Sri Lanka, Thailand, Malaysia, Singapore and Indonesia.

South and Southeast Asia command an increasingly prominent position on the world stage and research that focuses on the region has broadened hand-in-hand with its rising significance.

'Not only is India one of the world's largest economies, but current predictions indicate that, by 2030, South Asia will overtake China to become the largest human population anywhere on the globe,' explains Professor Sir Christopher Bayly, Director of Cambridge's Centre of South Asian Studies. 'The research portfolio of the Centre's cross-disciplinary community reflects both the long-term and the widening interest in the region.'

Today, the Centre provides a focus for more than 50 academics and postdoctoral researchers and hundreds of students spread across the humanities and social sciences departments of the University.

As well as organising regular seminars and public lectures, the Centre houses one of the best libraries, archives and film collections of South Asian material in Europe (see panel). It has also recently become the base for a new MPhil in Modern South Asian studies, which ranges from business management and development economics, through history and politics to the study of the Hindi and Urdu languages.

'Broadly speaking, the research interests of academics linked through the Centre encompass South Asia's past, present and potential future,' says Professor Bayly. 'Colonial history is vitally important for understanding the region's present, but scholars are also looking beyond this period at the origins of the paths of development taken by these different nations and the processes that will continue to shape their, and our, future.'

Migration and religion

A defining moment in South Asian history that continues to have ramifications today was the 1947 Partition of the subcontinent, which created India and Pakistan and led to the displacement of millions of people. Dr Joya Chatterji, from the Faculty of History, has been investigating what happened to the resulting wave of migrants. This large-scale study, which was carried out in collaboration with the London School of Economics, has found some unexpected answers.

'One might have expected the highly skilled to have moved to the West but in fact they tended to migrate to the cities of the newly formed countries of India and Pakistan,' she explains. 'Similarly, the working class might have been expected to stay in South Asia but many sought work in the UK, hoping to continue the work they had been doing under British rule.' She suggests that patterns of migration and settlement are shaped by the particular grouping of skills, assets and networks that a person might have – their 'mobility capital' – with people of a similar grouping tending to move in similar directions.

The population exchange that occurred during Partition resulted in the Muslim majority state of Pakistan. The work of Dr Humeira Iqtidar, research fellow at the Centre, is providing new understanding of the emerging trends, misconceptions and long-term impact of Muslim politics. Over many months of fieldwork, her research has resulted in an in-depth analysis of the highly influential Islamist party Jama'at-e-Islami and the more militant and little-studied Jama'at-ud-Da'wa, widely blamed for the November 2008 terrorist attack in Mumbai, India.

One particularly illuminating discovery was the finding that the Islamists, despite being vehemently opposed to the project of secularism, are inadvertently facilitating the process of secularisation. 'By forcing a critical questioning about the place of religion in public and private life in societies that did not need to engage with these questions previously,' she explains, 'the Islamists are

By 2030, South Asia is predicted to overtake China to become the most populated region anywhere on the globe

'The research interests of academics linked through the Centre encompass South Asia's past, present and potential future.'

South Asian treasure chest

A unique archive at the Centre of South Asian Studies affords a precious personal insight into the days of the British Raj and after.

The cinefilms, papers, photographs, films, diaries and accounts books that make up the archive are the result of a unique collection process that began in the 1960s. For over two decades, the Centre's first archivist, Mary Thatcher, travelled around Britain, visiting the families of those who had lived and worked in India during the final years of British rule, and collecting the ephemera that people brought home.

The resulting archive provides a fascinating and personal insight into the period of British rule and the early years of independence. Its holdings are both eclectic and rare: from unique footage of the chaos surrounding the Partition of British India to the beautifully illustrated journal of Miss Millicent Pilkington, who travelled around India in the 1890s; and from photographs of the planning and building of New Delhi to a recording of the surviving target of a would-be assassin.

To enhance the collection yet further, some donors were asked to write retrospective memoirs after the material was initial collected, and a large oral history project comprising 400 interviews was begun.

The film and oral history collections have recently been made available online, so researchers from around the world can now have easy, free access to a treasure chest of information and material from one of the world's most significant South Asian collections.

For more information, please contact Dr Kevin Greenbank (kmg23@cam.ac.uk) or visit www.s-asian.cam.ac.uk/

facilitating the emergence of objectified, rationalised religious belief.'

Also studying religious identity is Dr Philippa Williams, Smuts Research Fellow in Commonwealth Studies at the Centre. Her research has taken her to Varanasi, Uttar Pradesh. Here, in one of India's sacred Hindu cities, she has carried out in-depth research into the experiences of the community to understand how 'everyday peace' is constructed and reproduced between the Hindu majority and the Muslim minority.

Rather than perpetual inter-community violence, she finds that their everyday life is characterised by a 'peaceful' but not perfect coexistence: 'The Muslim community has taken a pragmatic approach, often devising their own mechanisms of citizenship, which represent both their resilience and acceptance in the face of a perceived lack of national citizenship. The net result is that tensions and conflict that might once have led to violence are actively avoided and averted.'

Shaping identities

To understand the particular paths of development of South Asian nations, several scholars are focusing on the ideas and political thought that have shaped their identities.

Dr Shruti Kapila, Lecturer in History, for instance, is interested in canonical figures such as Gandhi, and how he grappled with global ideas, but located them in the Indian context. She has also studied the radical anti-colonialist B. G. Tilak, who domesticated the idea of sacred violence in the subcontinent. Another fascinating figure is the 20th century's 'first terrorist', Har Dayal, who led an armed revolution against the Empire in the 1910s and 1920s. Her work is shedding new light on the political formation of modern India, stressing the need to understand ideologies of violence as well as non-violence in its political transformation.

From a different perspective, Professor Bayly is exploring how features of public life in India today, including its vibrant democracy, derive in part from the inheritance of the South Asian liberal tradition. This tradition stretched from the Bengali reformer Rammohan Roy in the early 19th century, through to Dadabhai Naoroji, one-time MP for Finsbury in London, but has continued to influence major figures, including Jawaharlal Nehru, first Prime Minister of independent India.

'Together, the vibrant mix of studies connected through the Centre is attempting to create an understanding of the whole of modern South Asia – explaining why these countries came to be how they are today and foreshadowing what might come next,' explains Professor Bayly. 'But perhaps above all, the Centre illustrates the continuing vitality of the connection between Britain and the countries of South and Southeast Asia.'

For more information, please visit www.s-asian.cam.ac.uk/

Conversations across continents

Each year, academic dialogue is enriched at the Centre of African Studies by the arrival of a group of African scholars who spend up to six months researching and working together.

A programme of academic exchange at the Centre of African Studies is providing African scholars with a much-needed opportunity to step away from their overwhelming teaching and administrative burdens and develop their research during a six-month sabbatical in Cambridge. In so doing, the Cambridge/Africa Collaborative Research Programme is also stimulating the richness of Africa-centric research in Cambridge.

'It has become increasingly difficult to pursue academic research in African universities,' explains Professor Megan Vaughan, Director of the Centre. 'Aside from teaching commitments, which can hinder researchers from having the time to complete their PhDs, there is a severe lack of funding to maintain their research. As a result, many African scholars feel increasingly isolated from academia at an international level in the social sciences and humanities.'

Over the past seven years, a total of 43 academics from 14 African nations have taken part in the Cambridge/Africa Research Collaborative Programme. Funded by the Leverhulme Trust and the Isaac Newton Trust, the Programme provides the visiting scholars with an opportunity to renew their access to international scholarship and to develop collaborations in Cambridge and beyond that will continue to vitalise their research after they return to their home universities.

Myth and modernity

The research of the five scholars currently visiting takes its cue from this year's theme – Myth and Modernity in African Literature – and is providing a fascinating glimpse of how African nations place themselves in a global context.

Dr Chris Warnes, a specialist in postcolonial literature in the Faculty of English and a member of the Centre, leads the research programme: 'This is a very exciting topic,' he explains. 'The talented scholars we have with us are using mythology as a key to unlock important questions about Africa both past and present, exemplifying the contributions that such research can make to societal concerns of today.'

For instance, mythology can tell us about national identity, explains Dr James Tsaaior, one of the visiting scholars: 'How African novelists have dealt with mythology reveals the struggle to construct nationhood and a sense of an African identity.'

'By studying authors such as Naguib Mahfouz from Egypt, Ngugi wa Thiong'o from Kenya, Ayi Kwei Armah from Ghana and Ben Okri from Nigeria,' he continues, 'it is clear that there is a confluence of certain strong and

From left: Dr Oyeniyi Okunoye, Obafemi Awolowo University, Nigeria; Dr Tunde Awosanmi, University of Ibadan, Nigeria; Dr Kenneth Simala, Masinde Muliro University of Science and Technology, Kenya; Dr Eiman El-Nour, Ahfad University for Women, Sudan; not shown: Dr James Tsaaior, Pan-African University, Nigeria

recurrent themes, including slavery, the slave trade and (neo-)colonialism, which have shaped the way that Africans think about Africa and perceive the world.'

Understanding relations between identity and myth is an issue that is particularly salient in the Sudan where religious tensions have increasingly divided the country. In her research, Dr Eiman El-Nour is hoping to document and record some of these myths, which frequently take the form of verbal storytelling. 'Mythology is tremendously strong and influential in Sudan, providing the codes by which ordinary people live their lives,' she explains. 'I'm interested in looking at how myth influences the recreation of Sudanese identity, whether Islamic, African or both.'

Likewise, in the west of Africa, mythology has had a major influence on the identity, culture, philosophy and beliefs of the Yoruba people, one of the largest ethnic groups in Africa. Dr Oyeniyi Okunoye is interested in how a genre of Yoruba poetry (Ewi) is being shaped by modernity.

'My task,' he maintains, 'is to clarify why Ewi, despite being rooted in the past, dynamically responds to the various experiences that Yoruba people have witnessed within the global environment.' He will be looking at how the poetry, which is both written and chanted, is actively involved in inventing a pan-Yoruba identity today.

Mythology also has the potential to sustain and preserve the literature of African modernity, says Dr Tunde Awosanmi: 'A challenge set by novelist Ayi Kwei Armah has been to encourage African writers not just to use ancestral myth and history as a cultural resource, but also to engage in the creative modernisation of primitive mythology. I am interested in how this is being played out in modern African drama, through identifying contrasting attitudes in terms of orthodox and unorthodox users of myth.'

'Myth and modernity are concepts that have increasingly come to mark our world,' adds Dr Kenneth Simala. 'From African mythology we can make deductions that tell us not just about times that have passed but also about issues that are relevant today. The legend of Fumo Liyongo [see side panel] is a wonderful example of this modern-day resonance for what it has to say about civilisations in conflict and the need for civilisations to engage in dialogue.'

Unlocking research potential

As the African scholars come to the close of their sabbatical, they will have attended a seminar series that brings international speakers to Cambridge, presented their findings at a workshop at the Centre in March and a conference in Nigeria in August 2011, as well as published their research as a book.

Professor Vaughan and her colleagues are immensely proud of the Programme: 'Without an initiative such as this, there is a real danger that African countries will fall further behind in a global economy that is ever more dependent on expert knowledge. This Programme provides our hard-pressed colleagues in African universities with a break during which they can carry out research and create new research networks based on collaborations that are just as valuable for the University of Cambridge's Africanists.'

'Without an initiative such as this, there is a real danger that African countries will fall further behind in a global economy that is ever more dependent on expert knowledge.'

MARK MNISZKO

Dr Chris Warnes and Professor Megan Vaughan
For more information, please visit www.african.cam.ac.uk/

Swahili Odyssey: a tale of civilisations, conquests and resolving conflict

A centuries-old epic poem describing the travels of a Swahili hero could provide valuable lessons for modern society on avoiding conflict between civilisations.

Among the abundant myths, legends and stories of the Swahili people of eastern Africa, perhaps the most celebrated are those attributed to the Swahili Chieftain Fumo Liyongo and his epic poem of almost 232 stanzas.

Passed down for centuries as an oral tradition, the poem includes a narrative of how he interacted with the other civilisations that came to explore, trade with, proselytise or conquer the African territories he ruled over. Although the poem is shrouded in mystery – it's unclear how much of the poem is accurate and even when Liyongo lived (variously given as the 13th–17th centuries) – it is generally agreed that it has a strong historical basis.

African scholar Dr Kenneth Simala is attempting to resolve some of the questions surrounding the poem. But, as he explains, it is the relevance of the poem's content to modern times that especially fascinates him: 'Fumo Liyongo observed how different civilisations interacted at a time when East Africa was at the crossroads of meeting cultures. As a result, he provides lessons of experience on disputes, tensions, conflicts, power, globalisation and the need for peaceful coexistence.'

'Through powerful metaphorical language, Liyongo shows how diversity can be turned into an opportunity for mutual understanding. His wise and tolerant stance shows us how we can avoid conflict through frank and respectful dialogue.'

Fumo Liyongo, said to have been a mighty warrior and seasoned traveller, has been likened both to Achilles and Robin Hood. Dr Simala's research will provide new recognition of the philosophical and prophetic dimension to Fumo Liyongo. He hopes to show how this literary treasure, in its relevance to understanding conflict between civilisations, can illustrate Africa's contribution to intellectual thought on modernity.

For further information, please contact Dr Kenneth Simala (inyani@yahoo.com).

New perspectives on Latin America

At the Centre of Latin American Studies, interdisciplinary research is offering a new perspective on the creativity, challenges and lessons that can be learned from Latin America.

DR MARTA MAGALHAES

Shaped by indigenous cultures and colonial influences, and with a contemporary history that encompasses acute political competition, social unrest and economic change, Latin America is a stimulating region for academic enquiry. Cambridge's Centre of Latin American Studies – with its extensive library and one of the largest collections of Latin American films in the UK – provides a hub to link the many Latin Americanists based in faculties across the University.

For researchers such as Dr Charles Jones, who is based in the Department of Politics and International Studies and will take up the Directorship of the Centre at the start of the academic year, the region provides unique insights into international relations. 'The republics of Latin America became independent from their European colonisers 200 years ago,' he explains. 'After two centuries of separate existence, they are still largely dominated by elites of European descent, yet conduct their relations with one another very differently, holding distinctive views about international law, diplomacy and conflict resolution. Being able to compare regions is fascinating – it's rather like being able to conduct a laboratory experiment in international relations.'

Research linked through the Centre is diverse: ranging from the study of modernist architecture to the colonial history of the Andes; and including, as highlighted here, cinema, violence, religion and multiculturalism.

Visualising Argentina

The study of Latin American film and visual arts is a particular area of expertise at the Centre. Drs Joanna Page, Geoffrey Kantaris, Erica Segre and Rory O'Bryen are shedding light on the region's vibrant creative legacy and opening up Latin American culture to a wider audience.

Dr Page has focused on Argentina, where the visual arts have responded in innovative ways to the experience of dictatorship, rising costs, unemployment and crime. Argentine cinema, which entered a boom period in the 1990s, is a compelling period of film-making for her, as she explains: 'Film directors had to create a new kind of aesthetic, born of economic necessity. They often shot in black and white, on streets with natural lighting or in a single apartment, using friends as actors. The films register the anxieties and fears, civil unrest and social disintegration in contemporary Argentina.'

> **'We can learn from the Latin American experience.'**

Other forms of visual culture have also been important vehicles for social and political critique in Argentina, especially in response to the military dictatorship from 1976 to 1983, a period of state-sponsored violence. 'One example is the post-apocalyptic comic *El Eternauta* written by Héctor Oesterheld,' she explains. 'It typifies the intellectual and philosophical heritage of the science fiction genre in Argentina in engaging with political issues and was written before Oesterheld himself was kidnapped and became one of the disappeared.'

'Argentina's appropriation of science fiction is often heavily ironic given the genre's strong association with European and North American imaginaries,' adds Page. 'The result is a radical form of social critique.'

Violence in 'Black Rome of the Americas'

Social anthropologist Dr Marta Magalhaes works in Salvador, Bahia. This UNESCO World Heritage Centre, once capital of colonial Brazil, is often referred to as the 'Black Rome of the Americas' because of its strong Afro-Brazilian heritage. The aim of her research was to examine what the ongoing urban regeneration of the colonial historic centre meant to its original, now-displaced, residents, but what she found instead was that Bahians wanted to speak about their experiences of violence in the city.

'Brazil is a powerhouse – a resource-rich, technologically competent, vigorous democracy that has made great strides to close the gap between rich and poor,' she explains. 'But it also suffers from a persisting cocktail of violence, drugs, gangs and police intervention.' In recent months, escalating violence in the favelas (shantytowns) of Rio de Janeiro has taken centre stage as police operations have attempted to take control.

Dr Magalhaes' fieldwork in Salvador has uncovered a perception by its inhabitants of

Urban regeneration in Salvador, Bahia, Brazil

©FRANCISCO VALDEZ, ROSARIO, ARGENTINA

Street graffiti in Argentina depicting the post-apocolyptic comic book *El Eternauta*

violence as a constant presence. 'My research has focused on understanding what this sense of violence does to people's relation to themselves. On my last trip, I was struck by the fact most Bahians I spoke to were articulating their views on violence as an epidemic, not as a war as in Rio. By sensing violence as an epidemic that can claim them at will, they became potential victims of this faceless phenomenon, effectively feeding the fear.'

As her work continues, she hopes that a better understanding of the complexities of how violence is perceived and affects different people in practice might inform discussions on the effective solutions to bring about its reduction.

Born again in Latin America

In recent decades, predominantly Catholic Latin America has undergone what has been referred to as 'the largest mass conversion in history', as Pentecostalism has grown explosively across the region and beyond its shores.

Dr David Lehmann, from the Department of Sociology and Acting Director of the Centre, was among the first to draw attention to this apparent revolution in Latin American culture: 'Pentecostalism, which had been growing gradually, exploded into the public consciousness in the 1980s, and grew to number almost 20% of the population in some countries. In recent years, Latin American Pentecostalism has been exported, and churches such as the Brazilian Universal Church of the Kingdom of God are now present worldwide.'

Pentecostalism has long been associated with developing countries and migrant groups. 'It gives a voice to the voiceless and supports people in setting themselves ambitious targets, emphasising salvation by worldly success in this world as opposed to the afterlife,' explains Lehmann. His work asks what the economic and political implications are of the spread and what it tells us about globalisation.

Connected with the underlying theme of religion, Dr Lehmann is also working on multiculturalism in Latin America, focusing on how issues of ethnicity and cultural difference are accepted and promoted. Funded by the British Academy, he is documenting and understanding developments in Latin America, and looking from a Latin American standpoint at Europe's struggle with the contested issue of multiculturalism.

'Latin America deserves academic attention because it is a region where, despite serious issues of racial, ethnic and socioeconomic exclusion, it does not have the history and bitterness of racial confrontation in the modern period that we find in Europe and the United States,' he explains. 'That's not to say that discrimination doesn't exist. But knowledge of policies to counter racial exclusion, such as the almost unique investment in intercultural universities, should be of interest elsewhere in the world. We can learn from the Latin American experience.'

Legacy of *El Libertador*

For the past 40 years, the academic community has benefited from the arrival of distinguished Latin American scholars through the Simón Bolívar Chair in Latin American Studies.

The Fellowship was established by the Venezuelan Government in memory of Simón Bolívar (*El Libertador*) – the foremost leader of Latin American independence in the 1820s – and has brought a host of illustrious figures to Cambridge. Among those who have taken up the Chair for a one-year teaching and research sabbatical are Mario Vargas Llosa, winner of the 2010 Nobel prize in Literature, and sociologist Fernando Henrique Cardoso, who later became President of Brazil.

For more information, please visit www.latin-american.cam.ac.uk/staff/bolivar.html/

Dr Joanna Page (left), Dr David Lehmann and Dr Marta Magalhaes

For more information, please contact Dr Joanna Page (jep29@cam.ac.uk), Dr Marta Magalhaes (msradm2@cam.ac.uk) and Dr David Lehmann (adl1@cam.ac.uk) at the Centre of Latin American Studies (www.latin-american.cam.ac.uk/).

At CRASSH, researchers in the arts, humanities and social sciences have the opportunity to intersect, generating fresh thinking and innovation, as Director Professor Mary Jacobus explains.

CRASSH: convener and gateway to the humanities

Now reaching the end of its first decade at Cambridge, the Centre for Research in the Arts, Social Sciences and Humanities (CRASSH) – once a fragile newcomer with a controversial moniker – has established itself as a focus for humanities activity, while its post-modern acronym has won international name-recognition.

CRASSH was conceived as a way to create interdisciplinary dialogue across the University's many faculties and departments in the arts, social sciences and humanities. It brings together early career researchers, established faculty members and visiting scholars – for research groups, workshops, colloquia, lectures and conferences – across an array of established and emerging fields.

Indispensible to the research environment, it serves at once as a centripetal hub, drawing together different disciplinary perspectives, and as a centrifugal force for disseminating new ideas. It provides a space for both reflection and interaction, where researchers can step beyond the frames of their disciplines.

Hunger for dialogue

As well as fostering interdisciplinarity, the Centre, with the support of the Andrew W. Mellon Foundation, has taken on the challenge of disciplinary innovation. Some of the most innovative work has originated in the Centre's graduate/faculty research groups – currently spanning Endangered Languages, East European Memory Studies, GreenBRIDGE (sustainable architecture), the Mediterranean and Middle Eastern Network, and the Science, Technology and Bio-Social Studies Forum.

Meanwhile long-running groups such as Cities, Post-Conflict Reconstruction and the Interdisciplinary Reproduction Forum continue to flourish, along with recent comers such as Late Antiquities, Health and Welfare, and Postcolonial Empires. Each year brings fresh proposals and new graduate cohorts.

Like the 20 or so conferences sponsored by CRASSH each year, research fora do more than challenge familiar disciplinary silos: they create collaborations from which fresh ideas and projects grow. Many of the conferences run by CRASSH – convened by early career researchers as well as established faculty – produce edited books; some form part of ongoing projects; others spearhead new initiatives and propel them forward to the next stage.

Research today involves networking, often internationally. But the term 'network' hardly begins to evoke the research culture engendered by face-to-face meetings and discussion. One of the discoveries made by the Centre at the outset was not just Cambridge researchers' hunger for dialogue, but their need for a physical space where it could take place: a hospitable interdisciplinary location with common intellectual ownership.

Humanities world view

Recent CRASSH conferences have made an implicit argument for the importance of the humanities perspective and remind us how the world is changing before our eyes: forays into science like *Have You Ever Seen a Molecule? Art, Science, and Visual Communication*; attempts to grapple with modernity such as *Understanding New Wars* or *Can I see your ID? Personhood and Paperwork in and after the Soviet Union*; and, topical today, *New Media/Alternative Politics: Communication Technologies and Political Change in the Middle East and Africa*.

During 2009–10, a Mellon Sawyer seminar on *Modelling Futures: Understanding Risk and Uncertainty* ran throughout the year, with seminars on finance, health, environment, policy making and democracy, bringing together faculty from across the University, including the Statistical Laboratory, History and Philosophy of Science, Geography and the Cambridge Judge Business School.

This year's Mellon-funded CRASSH conference in June, *The Future University*, will address urgent questions about the role of the humanities, including the arts and social sciences, in a modern technological university. The theme asks what universities are for – examining their evolving character and changing concerns in the digital age – a poignant theme at a time when cuts to university funding and fees threaten especially (but not only) the humanities.

For the Centre's new theme kicking off at the start of the next academic year (see panel), we have selected visiting fellows from our largest ever application pool, along with new India and EUIAS fellows and two new Mellon postdoctoral fellows working on subjects relating to the theme. The generous support of the Mellon Foundation, the Newton Trust and the Charles Wallace India Trust has helped to establish CRASSH as an academic destination for researchers.

As the fellowship group grows, it becomes clearer than ever not only what our visitors gain from access to Cambridge research resources, but also how much they bring to Cambridge: the lively intellectual traffic that energises an international university.

Transregional research in a transregional building

CRASSH's next theme will be *Cultures and Politics of the Transregional*, responding to the need to approach 'regionality' from a humanities perspective.

Historically, geographical and legal borders have marked the reach of regional identities. But in an age of globalised movement, borders are constantly being crossed by the flow of travellers, by the transit of goods, by the transfer of new narratives and forms of language, and by the transmission of political and other ideas.

Flows across borders and the systems that control them are ever more large-scale and complex in character, and demand rethinking in interdisciplinary and comparative ways. With this focus in mind, *Cultures and Politics of the Transregional*, which runs for two years from the start of the academic year in 2011, will encompass a visiting fellowship scheme and a programme of interdisciplinary conferences, workshops and public lectures.

Fittingly, the theme coincides with a symbolic move to the University's new humanities building at 7 West Road, where CRASSH will form part of an expanded international and cosmopolitan research community consisting of the regional studies Centres (African, Latin American, Mongolian and Inner Asian, and South Asian) and the Department of Politics and International Studies.

For more information about the CRASSH theme, please visit www.crassh.cam.ac.uk/

The vision that underpins CRASSH involves distance and engagement: both stepping outside one's own discipline or institution, and getting together with like-minded collaborators.

Crystal-ball gazing

From the start, the CRASSH ethos has been strongly participatory. Even as the major research councils look for bigger and better research applications, they note the importance of the bubbling up of new ideas that lead to innovative work. CRASSH plays a part here, through competitive funding for graduate-led research groups, sponsorship of graduate-convened conferences, and Early Career Fellowships for Cambridge faculty beginning a new project. Our postdoctoral and early career fellows this year are working on projects that span terror and terrorism, complex simplicity in architecture, educational innovation and the economics of infectious diseases.

If one function of research is to keep us from forgetting the past – its achievements or its failures, its languages, histories and literary productions – another is to anticipate future concerns: energy, intergenerational justice, the environment; new forms of art, music and culture that cross media; new possibilities for peace as well as war; or new forms of human interaction, whether via digital media or ID papers.

Gateway to the humanities

The vision that underpins CRASSH involves distance and engagement: both stepping outside one's own discipline or institution, and getting together with like-minded (or unanticipated) collaborators. It aims at the indispensible combination of reflection and argument that gives rise to the best research.

Contact among opposed positions, the ability to learn from working with other people, bridging differences without conceding essential ground – these are facets of the 'human' face of the humanities that we teach and encourage through critical study and practice of humanities disciplines.

The argument for the humanities made by CRASSH is that fresh thinking and innovation take place in the interaction between independent research and research collaboration, in the interstices of disciplines, and in the collaborative ethos and international perspective that characterise humanities research at its best. CRASSH aspires to provide this unique form of encounter: a gateway to the humanities.

For more information, please visit www.crassh.cam.ac.uk/

YUE JIN, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

A mathematical toolkit could dramatically reduce crop losses from pests and pathogens, helping to safeguard future food security.

Defending crops with maths

The world faces a potential food crisis in the coming decades as the population grows inexorably and as climate-related changes intensify pressures on food production. Given that the most productive land is already being used around the globe, simply increasing crop production is not the answer. One way to safeguard food security is to increase the yield of crops from the same amount of land and also to minimise the amount lost to pests and pathogens – the so-called untaken harvest.

Moreover, outbreaks of disease can sometimes reach epidemic proportions, wiping out entire crops, often with substantial social and economic consequences. Today, epidemics such as cassava mosaic disease, citrus canker, sugar beet rhizomania and a particularly alarming new wheat pathogen, Ug99, threaten important agricultural and food crops in regions across the globe.

'Each year, despite remarkable improvements in crop-protection strategies such as breeding disease resistance, a quarter of the global crop production is still lost in the untaken harvest, and plant pandemics are a constant threat,' explains Professor Chris Gilligan of the Department of Plant Sciences. 'One way to reduce these losses is to develop mathematical models that can help regulators, policy makers and growers to track disease and to develop surveillance and eradication strategies.'

This is precisely what Professor Gilligan, a Biotechnology and Biological Sciences Research Council (BBSRC) professorial fellow, and his team of mathematicians and statisticians have developed. Their mathematical toolkit not only provides a new way of predicting the associated risks and hazards but also, crucially, generates intelligence on the cost-effective management and control of that threat.

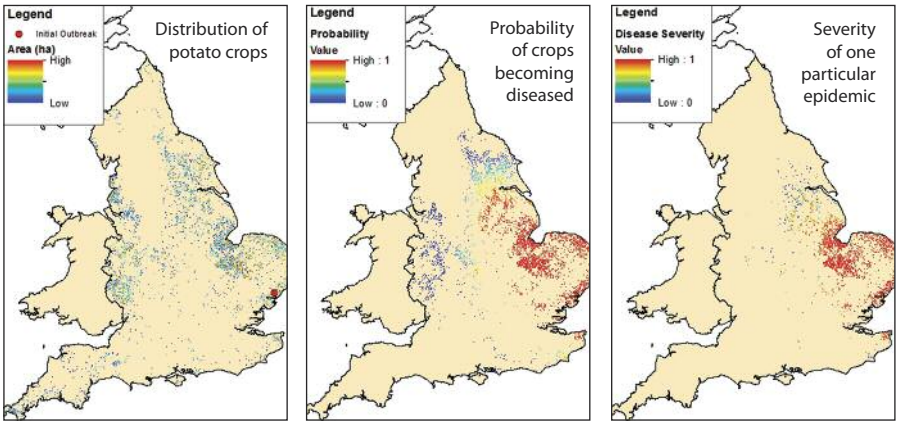
Uncertain behaviour

When the invasion and persistence of a disease reaches a level where it requires monitoring and controlling, working out where to look for it and how frequently, and then predicting what will happen and how best to control it, can be fraught with challenges.

Not only can the scale of an epidemic be hidden – for instance some infected plants might be symptom-free and yet transmit infection – but, as Gilligan explains, there is also an element of uncertainty: 'Dealing with complicated systems that have a biological, economic and social component is inevitably challenging. In addition to this 'noise' is the potential for the disease to take what you might imagine to be an unlikely turn. The art of modelling is to identify as simple a model as possible that captures the inherent features of the system and then to use it to explore the

Left. Stem rust on wheat; a new strain of the pathogen that causes stem rust has been spreading towards the major wheat-growing areas in Europe and the Indian subcontinent

Epidemic spreading on potato crops



Right. The toolkit is used to predict the potential for epidemic spread under uncertainty by integrating an epidemiological model with data for the distribution of susceptible crops and local weather conditions

certainties – and the uncertainties – in disease spread.'

As the Cambridge scientists have discovered, the secret has been to allow many possible scenarios to play out through the model. Bayesian methods of statistical inference are used to allow for uncertainty in understanding how an emerging epidemic spreads, and the model is then updated as new data become available. This allows the Cambridge group to predict the most likely future spread of disease based upon current knowledge.

'We need to be ready – and this means having the capability to detect, track and control the disease effectively.'

Working in collaboration with the UK Department for Environment, Food and Rural Affairs and the United States Department of Agriculture, the Gilligan group has successfully integrated fundamental biological understanding of how certain diseases spread into epidemiological models that incorporate data from geographic information systems about landscape and weather. The result is a toolkit that enables end-users to identify the risks and hazards of disease detection, spread and control.

Balancing detection and eradication

Any form of disease control involves costs and crucial decision making. Where mathematical modelling can help is to enable regulators to use resources strategically in the most effective way.

One recently published report from the team looked at Asiatic citrus canker, a bacterial disease of the economically important citrus crop of the USA, Brazil and Australia. Eradication attempts have already proved to be extremely costly – a decade-long attempt in Florida which began in 1995 cost in excess of $1 billion and led to the removal of millions of citrus trees.

The new results flagged up an important point that informs a political dilemma concerning the removal of diseased trees to eradicate the disease when the pathogen infects both residential and commercial trees. The two constituencies, home owners and growers, are linked by dispersal of the pathogen, and what happens in one constituency affects the other. Hence, an eradication effort must be co-ordinated in both areas.

'It is precisely this type of intelligence about disease dynamics that is so important for regulatory bodies to be aware of,' explains Gilligan. 'With this knowledge, it would be possible to choose a control strategy that satisfies the objectives of both commercial and residential citrus tree owners.'

Often the recommendations of the models are counter-intuitive. 'Contrary to expectations, for some diseases, the best strategy is to operate an intermediate level of detection rather than a high level of vigilance,' he says. 'In fact, even a slight change in the balance between the resources allocated to detection and those allocated to control may lead to drastic inefficiencies in control strategies.'

For some diseases, the best control method for an outbreak in two regions is to control the smaller outbreak first and then to concentrate on the larger one. 'The common assumption would be to treat both at the same time but for some diseases this is the worst you can do – much better to concentrate resources on eradicating in the region with the lower infection,' explains Gilligan. 'The models allow us to identify where best to deploy control and where there would be wasted effort.'

As well as for studying plant pests and pathogens, the models have also been used to study the spread of pesticide resistance, and the transfer of genes from genetically modified crops to wild populations. And, because the underlying mathematics and epidemiological modelling are similar regardless of the disease, the toolkit can also be targeted towards the surveillance of human diseases and pandemics.

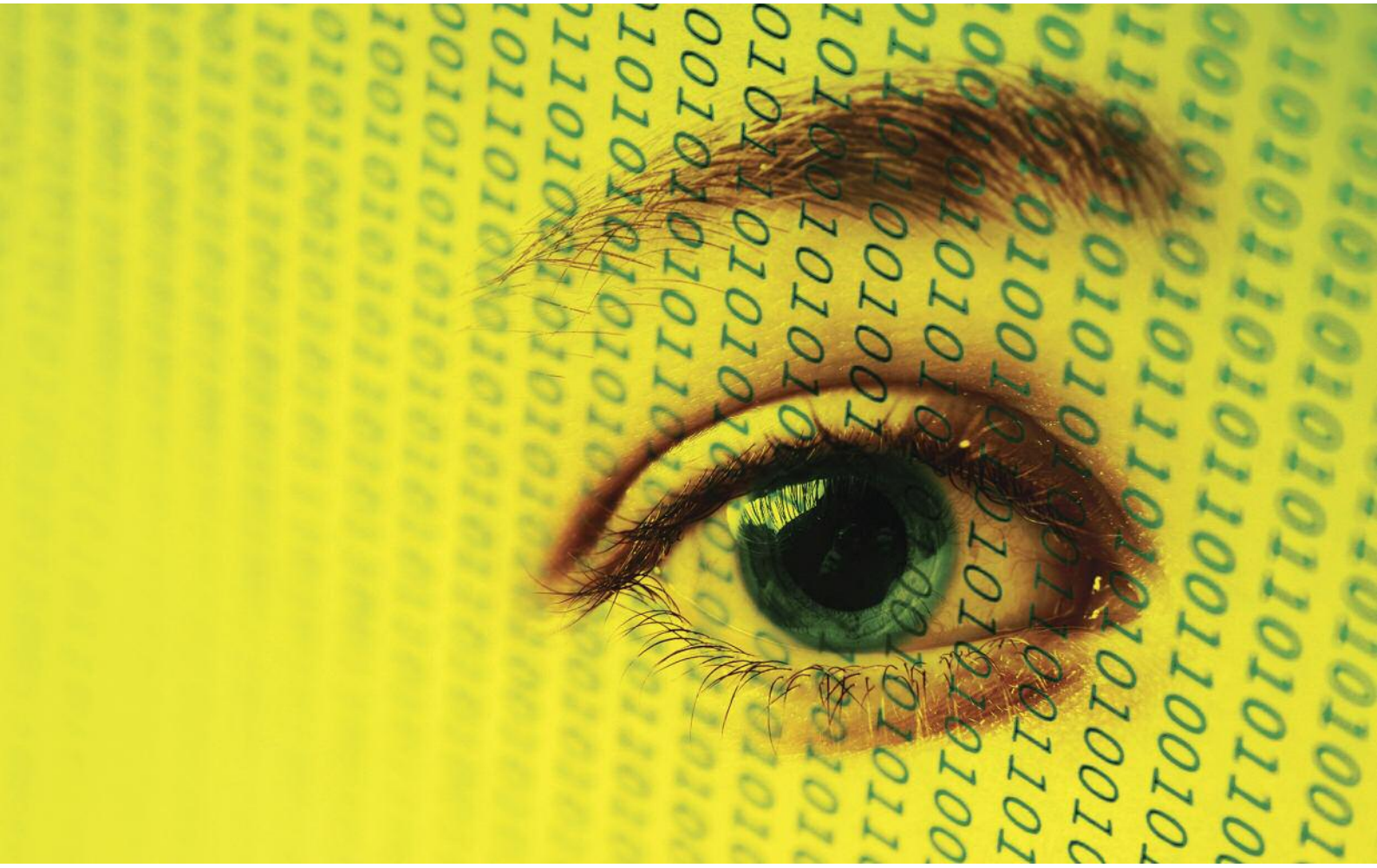
Communicating disease threats

A key aim of the research programme has been to develop a resource within which end-users can easily try out and simulate a range of control scenarios – juggling parameters such as how often surveys are conducted, how successful detection is, what level of eradication is aimed for, and which control strategy to use.

Professor Gilligan anticipates one particularly important use for the toolkit in the near future: 'A new strain, Ug99, of stem rust, a wheat pathogen, emerged in Uganda in 1999 and has been spreading north, across the Red Sea and into the Middle East. We don't yet know when it will arrive in major wheat-growing areas such as Europe and the Indian subcontinent, but we are at least five years away from having a wheat variety that can resist the pathogen. When the pathogen arrives, and it is very likely that it will, it could inflict severe shortages in wheat production costing billions of pounds. We need to be ready – and this means having the capability to detect, track and control the disease effectively.'

Professor Chris Gilligan

For more information, please contact Professor Chris Gilligan (cag1@cam.ac.uk) at the Department of Plant Sciences (www.plantsci.cam.ac.uk/).



Trust on the wild web

Philosopher Tom Simpson asks: can we build a trustworthy and safe Internet?

Mark Zuckerberg is the world's youngest billionaire. He got there by founding facebook.com, one of the biggest beasts in the Internet jungle. In the early days, so the story goes, he boasted to a friend on instant messenger that he had the personal details of over 4,000 students in Harvard, and if he ever wanted to know anything he should get in touch. Understandably, his incredulous friend wanted to know how Zuckerberg had access to this information. His reply? 'People just submitted it. I don't know why. They trust me, dumbf***s.'

The online environment is no longer merely an aid to living well offline; for many, it has become a forum where much of life is now conducted. But one issue that raises its head again and again is this question of trust on the Internet.

Examining whether and how we can design the Internet for online trust is the focus of my research in the Faculty of Philosophy, supervised by Dr Alex Oliver. The project is sponsored by Microsoft Research, whose Socio-Digital Systems group in Cambridge looks at how technology interacts with human values.

The research is a chance to do some practical philosophy, reflecting on and engaging with applied issues. And as the Internet increasingly becomes a more pervasive part of our lives, issues of trust online are only going to grow in importance. So there is a unique and timely opportunity – and challenge – to break new terrain.

Trusting me, trusting you

It is easily overlooked, but when you stop to think, it is striking how much we trust to other people. It is a fundamental precondition for the smooth functioning of society. Like the air we breathe, or the cement in brickwork, trust is both essential and usually taken for granted.

One consequence is that we tend to notice our reliance on trust only when things go wrong. And although it is easy to eulogise trust, it is not always appropriate. Trusting the untrustworthy is often a dramatically bad idea. But distrusting the trustworthy may have equally serious consequences.

Certainly, most people want to live in a world where it makes sense to trust people, and for people to trust them. But they also don't want to be taken for a ride. So we have to work out when trust is appropriate. The trouble is, it is much harder to work out online when trust is appropriate and when not. It is much more difficult to determine online whether a particular person is

trustworthy – much of the personal and social context of offline forms of interaction are stripped away in cyberspace, and online identities can be less stable.

But perhaps more seriously, it is still relatively unclear what the norms and mores are that govern appropriate behaviour online. This applies both to the informal norms that spontaneously arise in interpersonal interaction, and also to the apparatus of formal law.

The web, in this sense, is a bit like the Wild West. It is not that life is impossible there – far from it. Indeed, it's often pretty flamboyant and colourful, and a stimulating place to be. But people can also act unpredictably, and there is little recourse for those who get stung.

Building trust

One moral of the story about the Facebook founder's comment is that you've got to be careful who you trust online. That's obvious enough, and no different to what we tell our children.

But there are some more challenging issues. For the online world has an important feature: it is malleable. How something is built often serves particular ends, whether intended or not, and these ends in turn serve to realise particular visions of how people ought to live. Were I a metalsmith, for instance, I would rather make ploughs than thumbscrews – I don't want to contribute to making a world where thumbscrews are plentiful.

This applies to contemporary technologies too. At the last count, 500 million people now have their social relationships partially structured by Zuckerberg's vision of connecting people, according to whether they have confirmed or ignored the one-size-fits-all 'friends request' on facebook.com. The basic IP/TCP structures of the Internet were built according to a broadly libertarian vision widely shared among the early computer science pioneers, which denies central control or ownership in order to facilitate free expression.

So the more pertinent question is: can we build the Internet in a way that facilitates well-placed trust, and encourages trustworthiness? In short, can we design for online trust? To answer this, we need to look at why people are trustworthy and untrustworthy; what counts as good evidence for a person's trustworthiness online; the effects of online anonymity and pseudonymity; and the role of institutions in grounding trustworthiness. For instance, one mechanism through which we can secure others' trustworthiness is to develop better online reputation systems and track past conduct.

These questions cannot be answered once and for all. Technology is dynamic: cloud computing, for instance, is considered by many to be a step change in the way we compute, and it too raises specific questions around trust (see panel). As technology changes, so too will the philosophical challenges. The hope is that collaborative work between computer engineers, lawyers and philosophers can help to make the Internet a safer place.

'Engineering is always about solving problems for people and the society in which they live. Philosophy can help understand what those problems are and how they are to be solved, allowing those who want to fabricate a different and better world to know which need to be solved technologically and which need to be solved in other ways.'
Professor Richard Harper, Socio-Digital Systems Group, Microsoft Research Cambridge

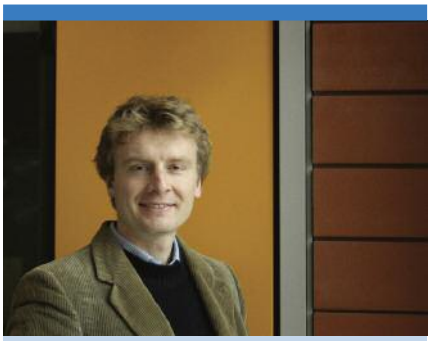
Cloud computing

Cloud computing is widely heralded as one of the most radical changes to the way we compute, and its full impact is thought to be just around the corner. First and foremost, the cloud is a change in the geography of computing – instead of having your PC store your data and run everything, your computing will be done on banks of servers and accessed remotely. Along with the change in geography, the move to the cloud is also a change in the scale of computing, with access to far more powerful computing facilities than ever before.

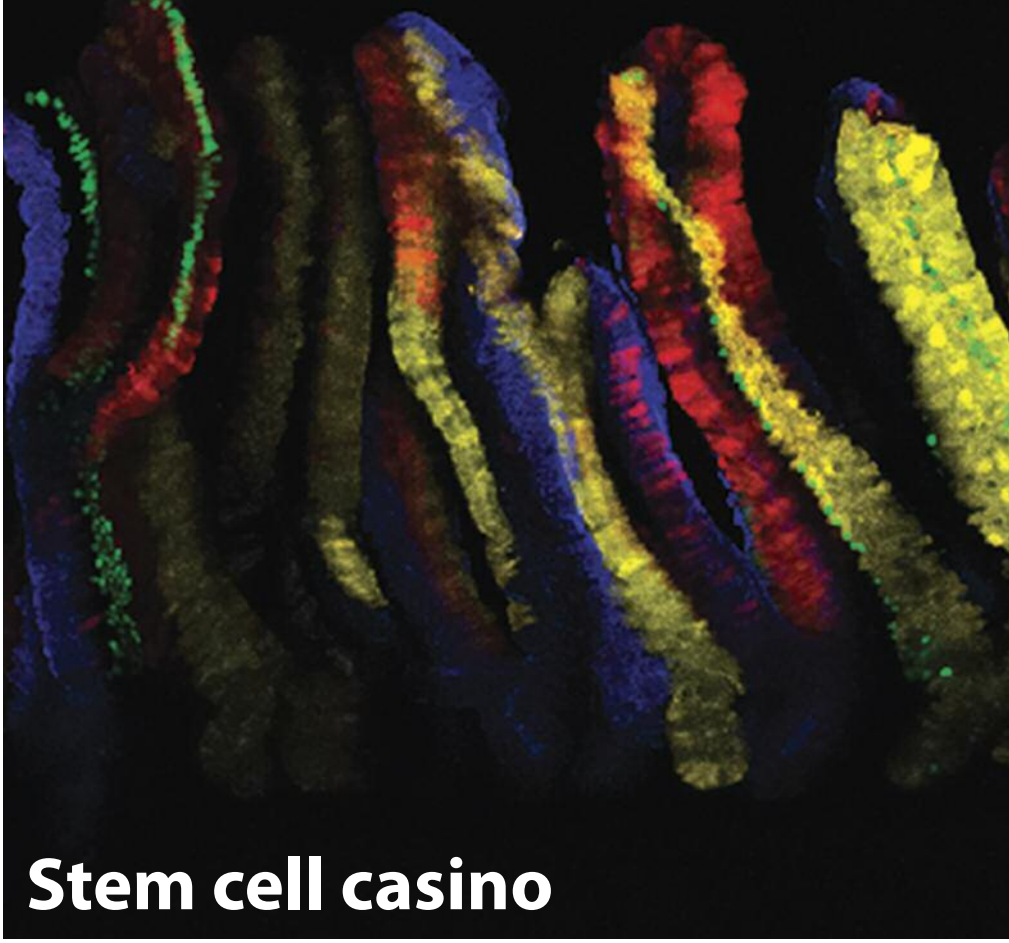
But the cloud raises a host of philosophical issues, particularly questions of responsibility. Who should own what data? When are 'crowd-sourcing' techniques appropriate, and when not? What are the effects of more powerful techniques of profiling individuals? What happens to privacy when we compute in the cloud?

To discuss these and related issues, the Faculty of Philosophy and Microsoft Research are co-hosting an international conference in Cambridge, gathering together leading philosophers and practitioners. Two open lectures will be held on the evenings of 5 and 6 April 2011.

For further details, please visit trustandcloudcomputing.org.uk/



Tom Simpson
For further information, please contact Tom Simpson (tws21@cam.ac.uk), whose PhD research in the Faculty of Philosophy (www.phil.cam.ac.uk/) is being sponsored by Microsoft Research Cambridge. His article on 'e-Trust and Reputation' is published in *Ethics and Information Technology*.



Stem cell casino

A shake of the dice and a nod from the neighbour – new facets of stem cell biology uncovered when methods in theoretical physics were used to solve a biological problem.

Physicist Professor Ben Simons, newly appointed Herchel Smith Professor of Physics of Medicine, has spent the past two decades working with ultracold atomic gases and quantum chaos. But his research took a biomedical turn after a chance conversation with clinician and cancer researcher Dr Phil Jones, the results of which have shaken up long-held views about how stem cells behave and how tissues renew themselves.

A perfect balance

We depend on the ability of our cells to renew and repair, both for when we are injured and for the normal maintenance of tissues like skin that suffer continual cell loss. This astonishing capacity for regeneration is down to our stem cells, which are able both to renew themselves indefinitely and also to give rise to daughter cells that mature into the multitude of different cell types needed to replenish tissue.

'Key to this process is the perfect balance that tissue stem cells must maintain between cell loss and cell replacement. Working out the mechanism that controls the balance represents one of the defining questions of tissue stem cell biology, not least because too much cell production could cause cancer, and too little could contribute to tissue failure,' explains Professor Simons.

The prevailing view has been that the balance is maintained because a long-lived slow-cycling stem cell divides asymmetrically to produce a copy of itself and a daughter cell that matures – at once maintaining the stem cell population and replacing the cell lost from the tissue. However, using an innovative lineage tracing technique and concepts from statistical physics, Professor Simons and his collaborators have amassed data that suggest a new paradigm for stem cell behaviour.

Throwing dice

In 2001, Dr Phil Jones at the Medical Research Council (MRC) Cancer Cell Unit had set out to confirm the theory that stem cells divide in an asymmetrical fashion so that he could use it as a platform to study mechanisms of dysregulation and cancer progression.

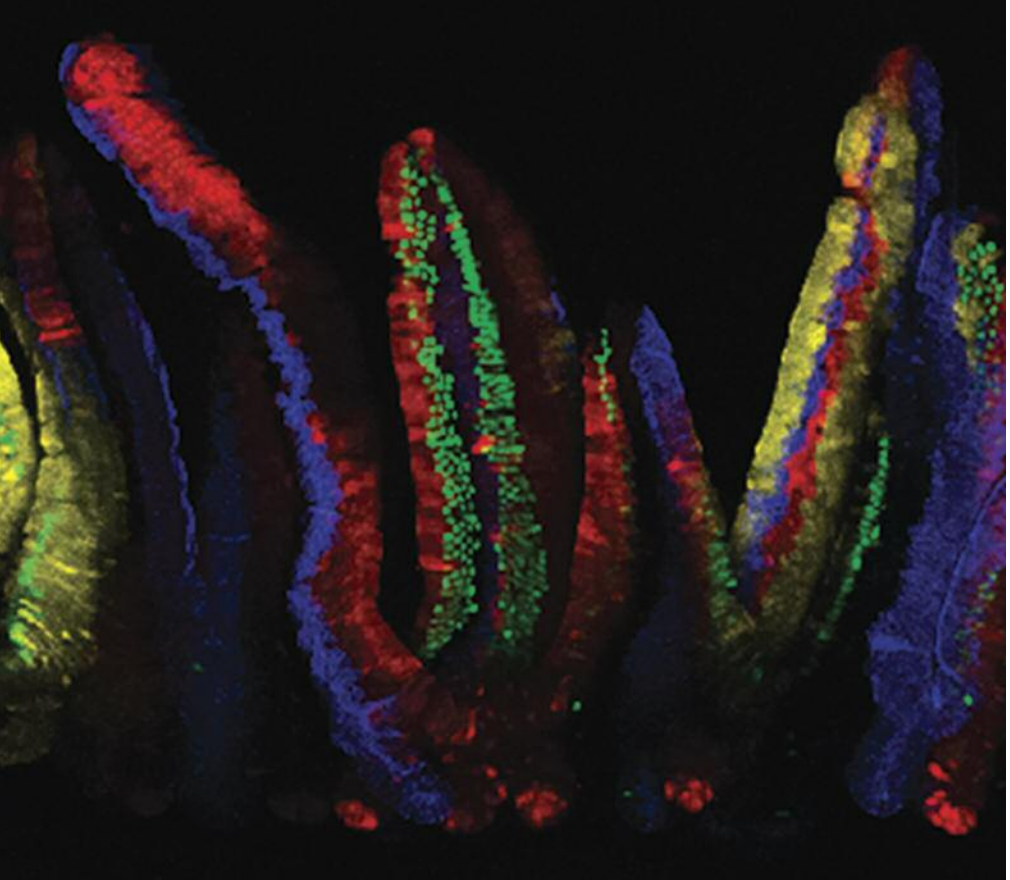
'Normal cells follow a remarkably simple set of mathematical rules of behaviour that become distorted in cancer,' he explains. 'Once we know what the rules are, we can test how drugs alter cell behaviour and apply this to understanding how to prevent cancers developing and improve cancer treatment.'

He used a remarkable tool for tracking what stem cells do: a transgenic mouse made by Dr Douglas Winton at the Cancer Research UK Cambridge Research Institute that carries a genetic reporter which can be induced to fluoresce. Using 3D imaging, it is possible to trace what happens to the lineage that individual stem cells create.

After several years of observations, the result was an enormously complex dataset. It was at this stage that Simons became involved. As a physicist, he realised the dataset had a certain familiarity: 'For all its complexity, there was a simple feature of the dataset that physicists would recognise as scaling. Once we spotted this, we knew that the data didn't fit the predictions of the paradigm.'

'Most cells expand by doubling, producing 2, 4, 8 daughter cells and so on,' adds Jones. 'But we found that these cells followed a 1, 2, 3, 4 growth model, where on average one of the daughter cells stops growing while the other carries on.'

It seems that the cells are not dividing in the asymmetrical fashion expected of stem cells: instead, they produce two identical copies of themselves, or two identical cells that mature,



Lineage tracing using multicolour genetic labelling reveals the dynamics of intestinal stem cell behaviour

HUGO SNIPPERT, HUBRECHT INSTITUTE, UTRECHT; REPRINTED FROM CELL (2010), 143, 134-144 WITH PERMISSION FROM ELSEVIER

We depend on the ability of our cells to renew and repair, both for when we are injured and for the normal maintenance of tissues like skin that suffer continual cell loss.

or one of each. 'These cells are behaving rather like they are throwing dice,' Simons explains. 'Of course this dice throwing game is the product of very complex regulation but the outcome is both unpredictable and perfectly balanced between three possible fates.'

What the neighbours do

Inspired by the success of the collaboration with Jones, the results of which were published in *Nature*, Simons began to look through the scientific literature for examples of similar datasets – very high-quality lineage tracing experiments yielding vast amounts of data – and discovered the work of Dr Shosei Yoshida from the National Institute for Basic Biology in Okazaki, Japan.

Dr Yoshida had been looking at another instance of a tissue that is constantly renewed – the mammalian spermatogenesis system. With the help of an MRC Discipline Hopping grant, Simons embarked on a statistical analysis in collaboration with Yoshida and found evidence for the same unpredictable fate behaviour similar to that seen in skin. This time, however, stem cells symmetrically self-renew in response to the chance loss of a neighbour, leading to a random drift of the stem cell population.

Encouraged by these findings, Simons and Winton turned to the fastest self-renewing tissue in mammals – the lining of the intestine. Here, the burden of replenishing the millions of cells that are lost daily falls on a small group of stem cells at the base of the intestinal crypts.

Once again, by tracing the lineage of dividing stem cells, they were able to define the pattern of stem cell fate. 'It's amazingly simple,' Simons explains. 'In effect, all cells have the same 'life chances'; if the roll of the dice determines that it will differentiate and move out of the crypt then it is replaced by a stem cell that simply divides into two stem cells.' Following collaboration with Professor Hans Clevers, from the Hubrecht Institute in Utrecht, vivid evidence of stem cell dynamics has now been found using a multicolour labelling system in mice.

Physics, stem cells and cancer

Following that serendipitous conversation five years ago, Simons has built a host of collaborative activities that use methods in theoretical physics to solve biological problems. Fittingly, his professorship is associated with the Physics of Medicine initiative (www.pom.cam.ac.uk/), which aims to establish and co-ordinate new interdisciplinary activities between the physical and life sciences, and he now contributes to both Cambridge's Stem Cell Initiative (www.stemcells.cam.ac.uk/) and the thriving cancer research community (www.cancer.cam.ac.uk/).

His ongoing collaborations with stem cell and developmental biologists are now looking at other adult tissues and also at carcinogenesis. So far, all tissues Simons and his collaborators have looked at show the same characteristic stem cell behaviour.

'This tells us important information about the rules of normal stem cell biology,' says Simons. 'We can for instance use this as the basis to interrogate the action of drugs and to understand what goes wrong in cancers. Cancer cells clearly have a growth advantage, but what is the origin of that advantage? There is a classical view about the progression of tumours that postulates a sequence of mutation events – we are now in a position to address at single cell resolution what is really going on.'

Professor Ben Simons

For more information, please contact Professor Ben Simons (bds10@cam.ac.uk) who currently works between the Cavendish Laboratory of the Department of Physics and the Wellcome Trust and Cancer Research UK (CRUK) Gurdon Institute, and also has an adjunct faculty position at CRUK Cambridge Research Institute.

Divine innovation: the economics of religion

Religious organisations in India are diversifying their 'business model' to maintain the loyalty of their followers and attract new devotees.

Businesses often dream up innovative ideas to keep customers and attract new clientele. After all, in a competitive environment, it's important to stand out from the crowd to keep ahead in the market place. Now, new research has shown that religious organisations may not be so very different.

In fact, scholars have long been interested in how religions change over time as society changes. A common observation has been that religions demonstrate resilience and a capacity to evolve. But what defines such resilience and how do organisations compete to attract new 'customers'?

Dr Sriya Iyer in the Faculty of Economics has led a large-scale research survey to examine these questions in India, a country in which religion is woven into the cultural, educational and political fabric of people's everyday lives. The project has involved an interdisciplinary team of researchers from the Faculty of Economics and the Cambridge Judge Business School.

Surveying religion

As part of the survey – one of the first of its kind to examine religion in India – a total of 568 religious organisations (272 Hindu, 248 Muslim, 25 Christian and 23 Sikh and Jain religious groups), spread across seven major Indian states, were interviewed to collect data on their economic, competitive and innovative behaviour. The states, although chosen at random, reflected a broad cross section of Indian society.

'It was important to ask these organisations not only about their religious service provision but also about their non-religious service provision,' explains Dr Iyer. 'Religious organisations might differentiate themselves on the religious spectrum, with respect to their ideology, but also through offering non-religious services that retain and attract adherents.'

The survey was conducted with the help of Indicus Analytics, a research and data analysis firm based in New Delhi, together with a total of 52 researchers spread all over India who helped to conduct the multiorganisation, multiregion study.

Then, using the types of economic theories and mathematical modelling more usually employed in the analysis of firms, Dr Iyer analysed the data in collaboration with economists Dr Chander Velu (Cambridge Judge Business School), Dr Jun Xue (now at the University of Victoria, Canada) and Tirthankar Chakravarty (now at the University of California, San Diego).

'Economic theory has much to offer in the study of contemporary religion and religious markets in developing countries,' says Dr Iyer, who received funding for the project from the Pennsylvania-based Metanexus Institute and the John Templeton Foundation. 'Game theory and theories about industrial organisation, for instance, can tell us about strategic interactions between organisations.'

Using these theories, the research shows that as income inequality increases, the poor demand more non-religious services, and that religious organisations are providing these by responding to this demand in a competitive religious market place.

Innovative service providers

Not only is India a country characterised by the multiplicity of religions but, for any particular religion, followers are often faced with a choice of many organisations within their community. Individuals might therefore, for the purposes of economic modelling, be viewed as customers who adhere to a particular group because it is optimal for them to do so, based not only on the ideology of the group but also on benefits such as education, health, food distribution and other welfare services.

In this competitive environment, as Dr Iyer explains, organisations begin to innovate: 'Religious groups are showing the same rational economic responses as businesses to changes in the political,

'Religious groups are showing the same rational economic responses as businesses to changes in the political, ecological and economic environments in which they operate.'

New research sheds light on how religious organisations in India attract devotees

ecological and economic environments in which they operate. The results of the survey show that religions are substantially increasing their provision of religious and non-religious services.'

On the one hand, organisations might offer interpretations of doctrine or new practices that set them apart from other organisations. In practice, though, such changes are often difficult to accomplish.

On the other hand, one of the main findings of the project was the remarkable diversification in non-religious services: computer-based learning, health camps, sewing classes, aerobics classes, organised mass marriages for the poor and cow-lending microfinance schemes feature alongside religious services.

Many of the activities appear to have arisen in response to a gap in social welfare. As a result, healthcare programmes such as blood donation, drug rehabilitation programmes and vaccination camps, and responses to societal needs such as old-age homes, informal employment networks and widow welfare programmes have sprung up. Education too is perceived as an area where services can be provided, either in addition to or instead of state-run education.

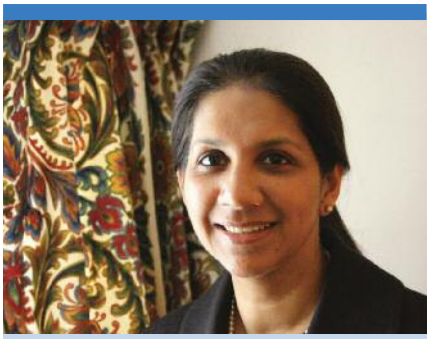
'Although variations are observed across religions in the types of services provided, we find that groups act out of a willingness to do good and help where the state may be providing less, and also in response to their competitors,' says Iyer.

It is this altruistic feature that Iyer emphasises is not often acknowledged: 'Frequently in discussions about religion and development in poor countries, it is common to highlight the many negative consequences that religion might engender. In contrast, in our study we would like to emphasise the very positive role that many religious organisations are playing in their local communities by building social capital and addressing economic necessity in India.'

Emerging economies

India is in the midst of pronounced economic growth and is predicted to be one of the world's leading economies within a decade, but the country is also characterised by increasing income inequality. Dr Iyer believes that this is one of the explanations for the innovative behaviour and the resilience of religion across the country: 'The existence of inequality makes for the provision of more religious and non-religious services by religious organisations as the latter are demanded especially by the least well-off.'

The results of this study could have resonance for emerging nations around the globe who are experiencing appreciable modern economic growth in the context of a large, diverse population, as Dr Iyer explains: 'We are hopeful that the outcome of our research will have considerable policy relevance for India but also for the management of religiously pluralistic populations in developing countries more widely.'



Dr Sriya Iyer

For more information, please contact Dr Sriya Iyer (sriya.iyer@econ.cam.ac.uk) at the Faculty of Economics (www.econ.cam.ac.uk/).

Cambridge computer scientists are building computers that read minds – and robots and avatars that express emotion.

The new face of human–computer interactions

When humans talk to each other they communicate in far greater ways than simply speaking. The way that they speak matters – their facial expressions, tone of voice and body language. Without these added cues, it's much more difficult to communicate in speech or writing, as anyone who has experienced misunderstandings by email knows full well.

Imagine, then, the challenge of communicating properly with a computer or a machine. Such human–computer interaction (HCI) is widely regarded as fundamental to the 21st century, and is predicted to change the face of technology in our homes and vehicles, in education, in manufacturing, and in settings as diverse as care homes and nuclear reactor control rooms.

'For HCI to live up to expectations,' explains Professor Peter Robinson, 'intelligent machines need to understand humans and the context in which they are communicating and then respond to them in a meaningful way.' His team at the Computer Laboratory is building systems that can infer human feelings by looking at facial expressions, analysing pitch and tone of voice, and assessing body language and posture. And the team is also building computer avatars and physical robots that can recognise and express emotions.

Mind-reading machines

Most computers are 'mind-blind'. They are unaware of what the user is thinking and unable to respond to a change in the user's emotional state – witness the insistent demands of a vehicle navigation system to perform a U-turn, oblivious to the rising exasperation and confusion of the driver.

Although humans notice the mental states of others and use these cues to modify their own actions, a process known as the 'theory of mind', this ability is not shared by everyone. In fact, one characteristic of autism spectrum conditions is a profound difficulty in interpreting the feelings and emotions of others from non-verbal cues such as facial expressions.

What Professor Robinson's group has accomplished is to engineer computers that can read minds, giving them the ability to extract, analyse and make sense of facial information. The team has drawn on recent work led by Professor Simon Baron-Cohen, Director of Cambridge's Autism Research Centre, who has devised a detailed classification of 412 finely distinguished mental states and produced a library of 2,500 video clips of them being performed by actors. This library was part of a computer-based guide to help individuals with autism, and the Computer Laboratory team has used it to train their computer systems.

Armed with the library, and using a digital video camera, the computer tracks 24 feature points on the face, analysing in real time facial expression, head movement, shape and colour. To infer what this means, the system uses Bayesian algorithms and machine learning to work out the probability that, for example, a combination such as a head nod, a smile and raised eyebrows

might mean interest. Amazingly, the overall accuracy of the computer is over 75% when analysing actors and over 60% for non-actors, which places it among the top 5% of human observers.

Complex emotions

'HCI is a growing research area,' explains Professor Robinson. 'Our innovation has been to go beyond building machines that simply recognise basic emotions to ones that recognise complex mental states.'

The face expresses basic emotions like fear, anger, disgust and surprise so clearly that they can be recognised in a static photograph. Other mental states, such as the lack (or dawning) of understanding and confusion, are too complex to capture in a photograph because they take place over several seconds or appear as a shifting combination of movements.

It is precisely these complex emotions that Ian Davies, one of six research students in the team, is capturing through physiological measurements and eye-tracking for the types of applications he is working on: command and control systems, such as those used by the emergency services or in power stations. Here, being able to identify when an individual is overloaded or confused could aid both safety and efficiency. There are even benefits for more common tasks like driving, as he explains: 'If the car's system could recognise that the driver is confused, it could avoid overloading them with additional information – perhaps turning down the radio or simplifying the navigation instructions.'

'Our innovation has been to go beyond building machines that simply recognise basic emotions to ones that recognise complex mental states.'

A common problem for facial analysis systems is the tendency of people to pass their hands across their faces. Often treated as unwanted 'noise' by such systems, hand-to-face gestures are in fact an important source of information – people might hold their chin, for instance, when concentrating, or cover their mouth when shocked. Marwa Mahmoud is looking at ways of mapping the meaning of these gestures, adding this information to a multimodal analysis of facial expression. Likewise, Ntombi Banda is building multimodal systems that combine facial analysis, tone of voice and body movements to improve recognition accuracy.

Robots and avatars

Speaking at a conference recently, Microsoft's Chairman Bill Gates predicted that the next big thing in technology would be robotics. Imagine, for instance, how useful it would be to have a robot strong enough to accomplish heavy tasks in the home – like lifting patients requiring assisted care at home – and yet capable of understanding what a human is feeling. Or imagine an avatar-based teaching aid that is sensitive enough to pick up that the lesson is going too fast and adapt accordingly.

'It's important that robots or avatars express the right thing at the right time,' says Professor Robinson. 'They not only need to recognise nonverbal behaviour by sensing accurately what humans are expressing but also need to generate such expressions themselves.'

Alyx, a computer-generated avatar from Valve Software's game Half-Life 2, recognises and responds to happiness, surprise, confusion, interest and boredom. She has been 'trained' by Tadas Baltrušaitis, using examples of human facial expressions to make the avatar's emotions instantly recognisable. Alyx's emotions, he explains, have been especially chosen: 'This range fits well with applications in remote communications, such as call centres, Internet shopping or online teaching, where the service needs to adapt to the feelings of the user.'

Charles, on the other hand, is a robotic head made specifically for the team by Hanson Robotics. With cameras in his eyes to monitor facial expression, and 24 motors in his skull that pull his pliable silicon-based 'skin' into expressions in response, he is capable of showing a remarkable range of expressions. Laurel Riek has been testing how Charles might be used to train young doctors: 'Using data collected from real patients, Charles can realistically simulate movement disorders that manifest themselves in the face, such as cerebral palsy and dystonia. We are hoping such a realistic simulator will allow student clinicians to practice their communication and diagnostic skills.' She predicts that one day robots like Charles might also be used for patient rehabilitation, for instance helping to teach and motivate stroke patients to re-master their facial muscles.

MARK MNISZKO

Laurel Riek working with Charles

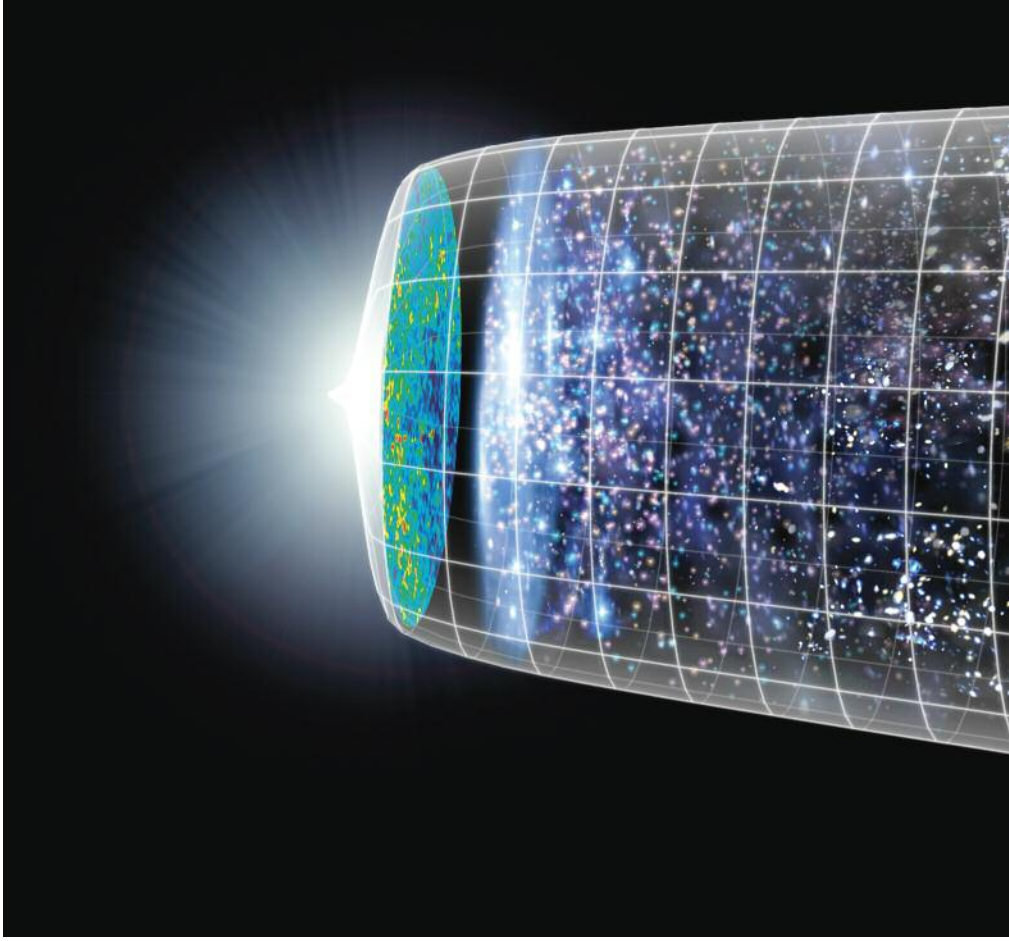
Charles, who was trained using expression data provided by the Autism Research Centre, is now being prepared by Andra Adams as an instructional tool to help individuals with autism spectrum conditions. 'Children with this condition have difficulty with the nuances of social interaction. Charles can help them practise turn-taking in conversation, holding eye gaze and recognising emotions from facial expressions.'

Working at the very frontiers of HCI research, Peter Robinson's group combines expertise in psychology, computer vision, signal processing and machine learning, as well as building and evaluating complex computer systems. As he explains: 'Many of the most interesting challenges in HCI lie at the boundaries between disciplines.'

See a Cambridge Ideas video about this research at http://bit.ly/fWYL09

From left: Ian Davies, Laurel Riek, Tadas Baltrušaitis, Marwa Mahmoud, Professor Peter Robinson and Andra Adams

For more information, please contact Professor Peter Robinson (pr10@cam.ac.uk) at the Computer Laboratory (www.cl.cam.ac.uk/emotions/).



NASA/WMAP SCIENCE TEAM

Quasars shine a light on the earliest stars

New research is bringing astronomers closer to unlocking the 'dark ages' of the cosmos.

Astronomers can now look back in time over almost all of the 13.7-billion-year history of the universe, from the present epoch to when the universe was still in its infancy, thanks to ever more powerful telescopes that detect light reaching us from billions of light years away. But one observational frontier still remains – a period lasting perhaps less than half a billion years after the Big Bang that astronomers refer to as the 'dark ages.'

One of the many questions about this time is how our universe evolved from one consisting only of the two simplest elements, hydrogen and helium, into one that boasts the wonderful mix of elements that make up our familiar world, such as carbon, oxygen and iron.

A new understanding of this process has been made possible by the work of Professor Max Pettini and colleagues at Cambridge's Institute of Astronomy (IoA). To do this, they have turned to the most luminous objects in the universe, quasars, using the light they emit as a tool to pick out the characteristics of what lies between us and the quasar – rather like a torch being shone through the universe.

Written in the stars

What makes the dark ages of the universe opaque to astronomical telescopes are the clouds of neutral hydrogen and helium gas that were formed when temperatures had cooled enough for protons and electrons created at the Big Bang to recombine.

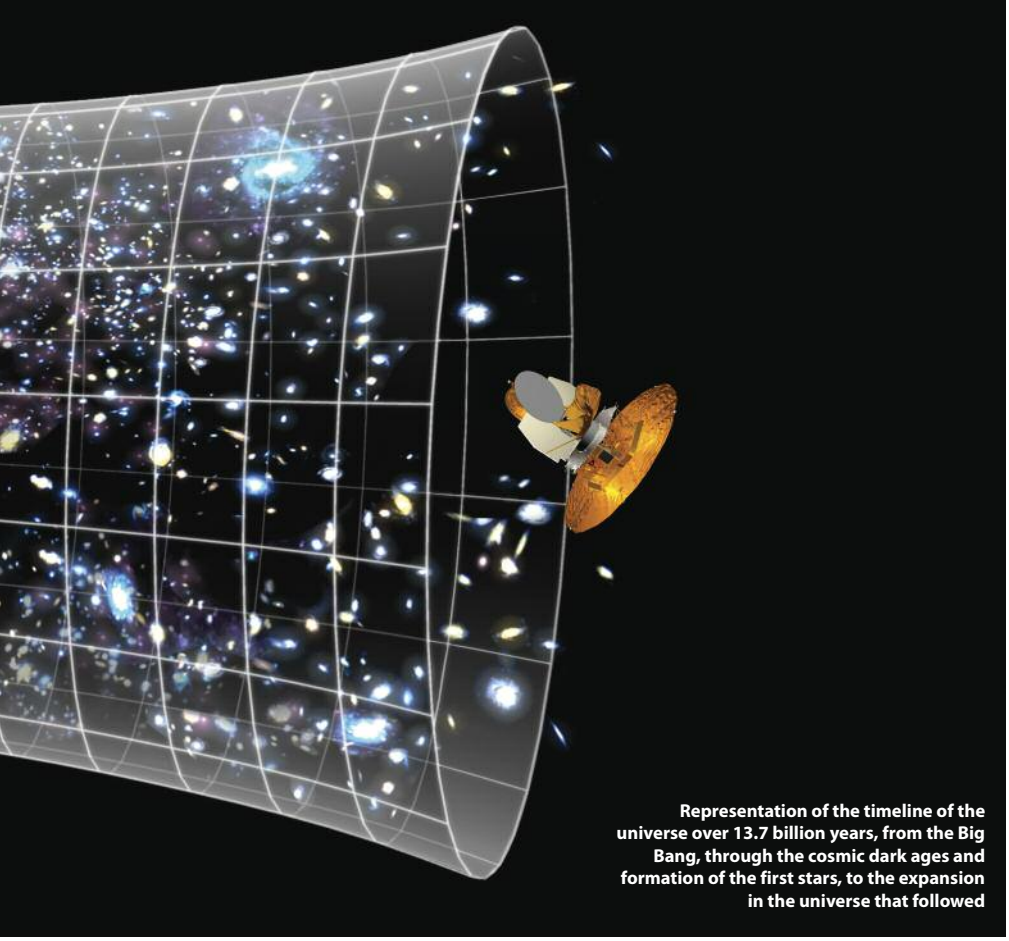
The epoch ended when dense areas of gas collapsed in on themselves to form the first stars – massive, intensely hot, cosmic 'ovens' of nuclear fusion. Astronomers believe that the ultraviolet light these primitive stars emitted caused the gas in their surroundings to ionise, with the result that the universe became increasingly transparent to optical and infrared telescopes. This was the 'epoch of reionisation', which eventually put an end to the cosmic dark ages.

Too unstable to last longer than a few million years, and dying in spectacular supernova explosions, the early stars left a legacy – they began the chemical evolution of the cosmos. They seeded further generations of stars (including some that we still see today) with the chemical elements synthesised in their hot interiors from the primordial hydrogen and helium.

'One of the most exciting opportunities offered by these observations is the possibility to go even further back in time than the epoch of reionisation, to a few minutes after the Big Bang.'

'Computer simulations have painted a broad-brush picture of what we understand occurred during the transition from the dark ages, before reionisation, to today's rich tapestry of galaxies and intergalactic matter. But only experimental observations with telescopes can fill the many gaps still present in our knowledge of this cosmic evolution,' explains Pettini. 'The difficulty is how to observe what is now unobservable. The first stars no longer exist and the earliest observable galaxies are several generations younger.'

The solution has been to look indirectly at the remnants left by the earliest stars using a



Representation of the timeline of the universe over 13.7 billion years, from the Big Bang, through the cosmic dark ages and formation of the first stars, to the expansion in the universe that followed

technique known as Quasar Absorption Line Spectroscopy. The technique was pioneered in the mid-1970s by, among others, Professor Alec Boksenberg (Pettini's PhD supervisor), formerly at University College London and now at the IoA, and Professor Wallace Sargent at the California Institute of Technology in Pasadena. The latest research from the Pettini group represents the first time the technique has been used to identify a chemical imprint of the earliest stars to be born after the Big Bang.

Missing link

Quasars are black holes with the mass of a billion suns. Although the black hole itself emits no light, the force of its gravity is so huge that any matter around it falls into the quasar, and in so doing emits radiation intense enough that astronomers can detect it on Earth tens of billions of years after it was emitted.

'The light that quasars emit provides a backdrop against which any gas cloud in the path of their light – whether in galaxies or in between galaxies – can be measured,' says Pettini. What interests Pettini and his collaborators is the gas that is closest to the primordial composition. Such gas may still bear traces of the first chemical elements manufactured by the first stars and released into their surroundings when they exploded, in effect providing a fossil record of the earliest events in the chemical evolution of the universe.

Taking precision measurements with sufficient spectral resolution of the properties of this gas has required the use of the world's largest telescopes in Hawaii and Chile. Such instruments provide the means to measure accurately the relative proportions of hydrogen (created in the Big Bang) and elements assembled subsequently in the interiors of stars.

From among the different types of gas clouds that can produce absorption lines in quasar spectra, the team have learnt to recognise clouds called 'damped Lyman alpha systems' (DLAs) that are most likely to be associated with galaxies that are still at an early stage of evolution. And they can now identify, from among the thousands of DLAs known, the rare few that have undergone a very small amount of star formation.

Cosmic clouds

The latest results of this five-year programme have just been published in the journal *Monthly Notices of the Royal Astronomical Society* by Ryan Cooke, Max Pettini and Regina Jorgenson working at the IoA, together with Chuck Steidel and Gwen Rudie at the California Institute of Technology in Pasadena, USA.

The authors report the first analysis of the composition of a near-primordial gas cloud containing the elements made by a star that exploded perhaps as many as 13 billion years ago.

Specifically, the tiny amounts of elements present in the cloud are in very unusual proportions, very different from their relative proportions in normal stars today, like our Sun. Most significantly, the ratio of carbon to iron is 35 times greater than that measured in the Sun. Such an overabundance of carbon relative to iron – as well as the relative proportions of other elements including nitrogen, oxygen, aluminium, silicon and sulphur – closely matches computer calculations of the elements synthesised and released by a star 25 times more massive than the Sun and originally consisting of only hydrogen and helium.

Weighing the universe

Moving towards a new understanding of the earliest stars isn't the only outcome of the research. 'In my view, one of the most exciting opportunities offered by these observations is the possibility to go even further back in time than the epoch of reionisation, to a few minutes after the Big Bang, when the whole universe resembled a star and was hot enough to create elements such as deuterium (a heavier form of hydrogen) and helium out of pure hydrogen,' says Pettini.

It turns out that the amount of deuterium manufactured in the Big Bang depends sensitively on the total amount of ordinary matter present in the universe. As a result, Pettini has been able to 'weigh' the mass of the entire universe by measuring the ratio of deuterium to hydrogen in the most pristine DLAs. The answer, which agrees beautifully with other, independent, measures, is that the universe is 4% ordinary matter, 22% dark matter and 74% dark energy.

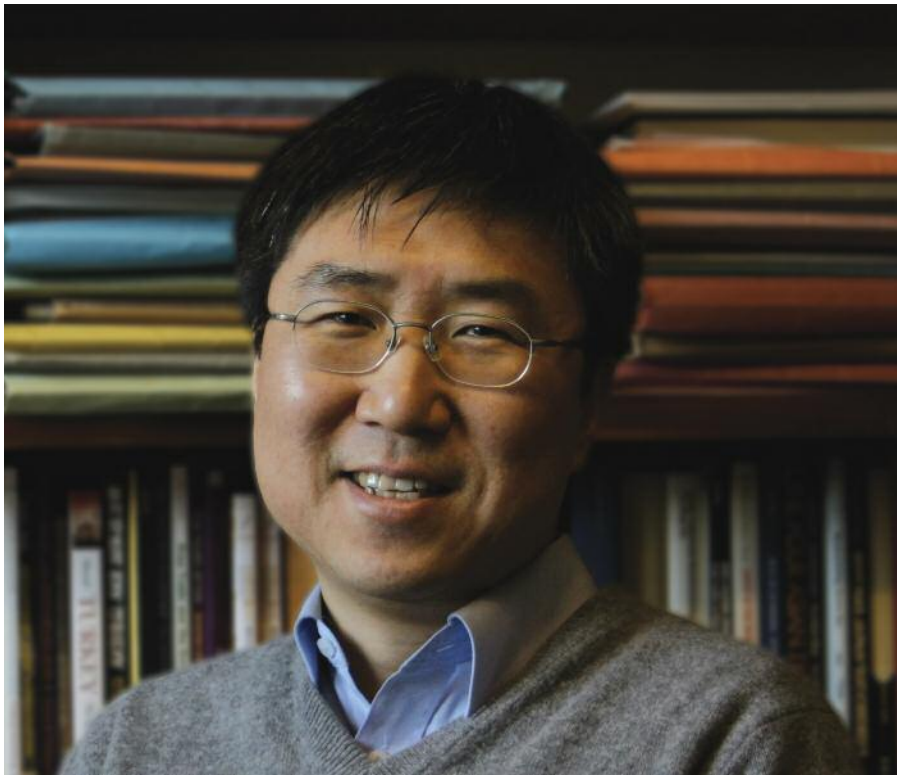
'For the first time in the history of mankind, scientists are able to determine fundamental cosmological numbers that describe our universe with precision,' comments Pettini. 'But we have yet to understand why these proportions are as they are and, most fundamentally, the underlying physics that determines these fractions.'

Nevertheless, the discovery of what Pettini and colleagues consider the missing link between the oldest stars still in existence in the Milky Way and the first generation of stars after the Big Bang brings us closer to unlocking the dark ages of the cosmos. One day, Pettini hopes that a DLA may even be discovered that has no metals – in other words, a cosmic cloud left over from a time even before the first stars.

Professor Max Pettini

For more information, please contact Professor Max Pettini (pettini@ast.cam.ac.uk) at the Institute of Astronomy (www.ast.cam.ac.uk/).

Professor Pettini has recently been elected a fellow of the Royal Society and awarded the Royal Astronomical Society Herschel Medal for his seminal contributions to extragalactic astronomy.



MARK MNISZKO

Dr Ha-Joon Chang

Author of the recently published *23 Things They Don't Tell You About Capitalism*, Dr Ha-Joon Chang studies how international markets succeed and fail, asking what steps might be taken to rebuild the world economy.

Born in Seoul, South Korea, Dr Chang left his homeland for the first time when he moved to Cambridge as a graduate student in the 1980s. His time in Korea had coincided with an economic miracle, when the country transformed itself from being one of the poorest countries to one of the richest by the late 1980s. It was an economic transition that he now looks back on with academic interest: 'Of course when you are living through it you don't realise the enormity of the change,' he says. 'But, as an economist today, I feel extremely fortunate to have witnessed this leap, rather like a historian of mediaeval England witnessing the Battle of Hastings.'

Dr Chang's research in the Faculty of Economics encompasses trade and industrial policy issues, foreign investment and intellectual policy rights, corporate governance and the stock market. Partly shaping his research agenda is his work with the many organisations he advises, from the World Bank to Oxfam, and the Ecuadorian Presidency to Shell.

'I don't wish to work on a permanent basis anywhere other than in academia but I have a lot of interactions with non-academic people – in government, business, international organisations, and NGOs – because much of my research is directly relevant to policies,' he says. 'These interactions help me to take a fresh look at economic theory and how it relates to the real world.'

He is also keen to bring economics to a new audience by communicating complicated ideas in plain language. His latest book *23 Things*… explains how capitalism really works by challenging such dogmas as the 'free' market, globalisation making the world richer, and rich countries being more entrepreneurial than poor ones, before concluding with his eight principles for rebuilding the world economy.

What might others be surprised to learn about you?
A few years ago, South Korea's Ministry of National Defense banned my book Bad Samaritans: The Myth of Free Trade and the Secret History of Capitalism *in the country's military barracks as 'seditious' literature. Funnily enough, the incident propelled me into something of a celebratory sphere in Korea – whenever the issue was discussed, somehow my book became representative of the list of 23 banned books. I suppose you could say it was the best kind of ban.* Bad Samaritans *had a certain aura and yet was available everywhere except in army bookshops, with the result that sales more than doubled!*

Who or what inspires you?
I'm inspired by people who have fought for a better world – the individuals we know about and also the countless, nameless people who have made sacrifices to change the world. I often get asked by my students whether, with so many things wrong with the world and so much resistance to change, it is realistic to expect any social and economic reform. But only 200 years ago people thought that abolishing slavery was totally unrealistic, and 100 years ago women were imprisoned for wanting the vote. These things were changed because people fought for them. So I tell them yes, although in the short run it's almost impossible to change anything, in the long run it is possible.

If you could wake up tomorrow with a new skill, what would it be?
I would love to wake up having learned another language overnight because knowing another language is like knowing another world. Spanish would be the best because some of my favourite writers are from Latin America, but even if it's a language with only three books I would gladly take it if it were given to me.

What is your favourite research tool?
It's more a research methodology than a tool, but I've learned much from looking at the economics of real societies and comparing them across time and space. The real world does not operate in a way that economic models would predict – life is often stranger than fiction. My favourite example is Singapore. It's famous for its free trade and welcoming attitude towards foreign investors but in many ways it's a socialist country, with all the land publicly owned, 85% of housing provided by the government-owned housing corporation, and more than 20% of national output produced by state-owned enterprise. It is a perfect example of both the limitations of economic theory and the pragmatic mixture that is needed in the real world – anyone trying to invent an economic system on the basis of a particular theory would not invent Singapore's economy. Real-word analysis wakes you up from your hidden assumptions and helps sharpen your theory.

What will the future look like in 2050?
In contrast to what is often hyped, over the past 30 years the world economy has grown more slowly and has become more unstable and more unequal than it was during the preceding 30-year period. On top of this, we are in the middle of a financial crisis the end of which is not yet in sight. Unless we reform this system we could continue to have these problems over the next 50 years. I see the challenge as restoring the balance between the market and the government, finance and the real economy, and material prosperity and environmental sustainability. Economists will need to do their bit to help find solutions.

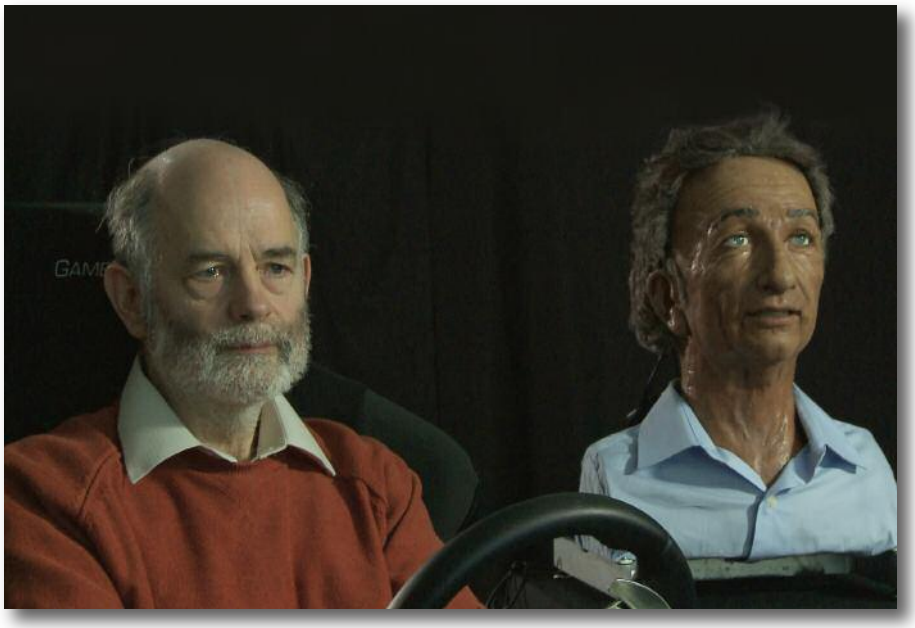
For more information, please contact Dr Ha-Joon Chang (hjc1001@cam.ac.uk) at the Faculty of Economics or visit www.hajoonchang.net/

Find us on YouTube EDU

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

Cambridge Ideas: This icy world

University of Cambridge glaciologist and Director of the Scott Polar Research Institute Professor Julian Dowdeswell has spent three years of his life in the polar regions. This film follows him to Greenland and the Antarctic as his research reveals the challenges we all face from climate change.
http://bit.ly/h9Ogey



Cambridge Ideas: The emotional computer

Can computers understand emotions? Can computers express emotions? Can they feel emotions? This video visits Professor Peter Robinson's research team at the Computer Laboratory to show how emotions can be used to improve interaction between humans and computers.
http://bit.ly/fWYL09

Cambridge Ideas: Forgotten heroes

Cambridge University archaeologist Dr Gilly Carr, along with two other researchers in Guernsey, has uncovered a previously unseen archive featuring the testimonies of people who were deported to German prison camps during World War II. Their project aims to document the history of protest and resistance in the Channel Islands.
http://bit.ly/fpCTtt

Archaic Greek in a modern world

An endangered Greek dialect which is spoken in a remote part of north-eastern Turkey has been identified by researchers as a 'linguistic goldmine' because of its startling closeness to the ancient language. Hear speakers of Romeyka, as Cambridge researcher Dr Ioanna Sitaridou explains the significance of the endangered language.
http://bit.ly/eO0wnD

Preventing HIV transmission in breastfeeding

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

To view videos, please visit www.youtube.com/cambridgeuniversity or www.youtube.com/edu and select the University of Cambridge.

Your way into Cambridge

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