

Research

Horizons

Pioneering research from the University of Cambridge

Issue 21

Spotlight
**Digital
humanities**

Feature
**Climate change:
can nature help us?**

Feature
**Oral
vaccines**



**UNIVERSITY OF
CAMBRIDGE**

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Welcome

With our smartphones, digital cameras, social media and more, mobile and digital technologies now pervade our lives to the extent that they are fundamentally, and almost unnoticeably, changing the way in which we interact. No less so for research. Being able to store, search, analyse and disseminate information at the touch of a button has become second nature.

In this issue, we take a look at how the digital revolution is offering new perspectives in humanities research: from GIS-enabled mapping of history and language change to cinematographic analysis of architecture and archaeology; and from creating vast searchable datasets to searching the vast dataset to be found in social media. To support the growing number of researchers working in this area, in 2011 the University created a Digital Humanities Network, which works across disciplines to bring together researchers for whom digital tools are transforming scholarship in the humanities and social sciences.

Looking more widely at technology, new possibilities for human-computer interactions are always just around the corner. In our feature section, we hear about scientists who are rethinking how computers can be trained to understand phrases, not just words.

Tying in with the recent launch of the Cambridge Conservation Campus, which will bring together more than 500 conservationists in Cambridge, another feature asks what we can learn from the natural world in how best to manage coastlines that are undergoing climate-related change.

And, among other fascinating research stories, we hope that readers will enjoy hearing about the moment in 1769 when a Maori canoe paddled out to Captain Cook's HMS *Endeavour* and bartered oars for cloth. The oars are in Cambridge's Museum of Archaeology and Anthropology, which is bringing them together virtually with other 'Artefacts of Encounter' worldwide through a new digital environment.



Professor Lynn Gladden
Pro-Vice-Chancellor for Research

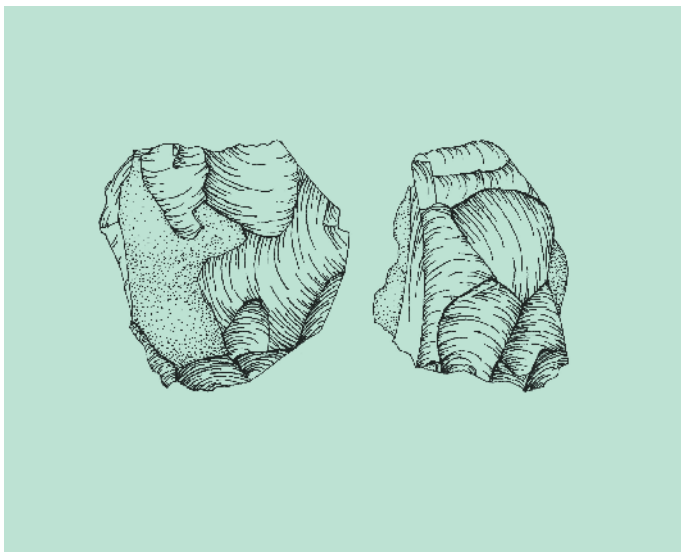
Editor
Dr Louise Walsh

Design
The District

Printers
Micropress

Contributors
Alex Buxton, Jacqueline Garget, Tom Kirk,
Sally Lewis, Fred Lewsey, Louise Walsh

T +44 (0)1223 765 443
E research.horizons@admin.cam.ac.uk
W www.cam.ac.uk/research



News



Credit: www.kalyanvarma.net

Cambridge Conservation Campus launched

A newly launched Conservation Campus will bring together more than 500 professional conservationists in Cambridge.

The Cambridge Conservation Initiative (CCI) – a pioneering partnership formed by the University of Cambridge and leading conservation organisations – has launched plans to create the Cambridge Conservation Campus, which will become a hub for researchers and practitioners working to protect and manage biodiversity worldwide.

The Conservation Campus will be co-located with the University's Museum of Zoology in central Cambridge. Plans are being considered for a £59 million refurbishment – with the generous support of the MAVA Fondation pour la Nature and the A.G. Leventis Foundation – to provide a series of shared spaces and facilities for the global conservation



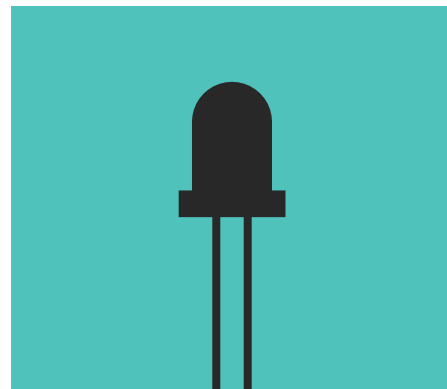
Image
Chameleon's tail

community, designed to encourage effective collaboration.

"The Campus will drive a massive step change in our collaborations and in our worldwide impacts. It will enhance our convening power and ability to engage new audiences worldwide, and perhaps offer a new model for conservation collaborations elsewhere," said CCI Executive Director Dr Mike Rands.

"Collaboration between organisations and institutions which are linked to a common cause has the potential to unleash synergies, spur innovation and come up with novel approaches to conservation," he added. "This in turn delivers stronger and better conservation solutions for the world's biodiversity and the natural capital it provides."

www.conservation.cam.ac.uk



Low-cost LEDs

A new £1 million facility will enable Cambridge researchers to reduce the cost and improve the efficiency of light-emitting diodes.

A new facility for growing gallium nitride – the key material needed to make energy-saving light-emitting diodes (LEDs) – has opened in Cambridge, enabling researchers to expand and accelerate their pioneering work in the field. The reactor, which is funded by EPSRC, was opened recently by David Willetts MP, the Minister for Universities and Science.

LED technology is already so energy-efficient that it's estimated that the overall demand for electricity would fall by at least 10% if every home and business in the UK switched to LED lighting. This would save the UK over £2 billion per year in electricity costs. Further developments planned in the new reactor would result in an additional £1 billion per year electricity savings.

The opening of the reactor marks the latest chapter in a decade-long research project to make LEDs the go-to technology for lighting, led by Professor Sir Colin Humphreys in the University's Department of Materials Science and Metallurgy.

Researchers are developing colour-tunable LED lighting, which would have the quality of natural sunlight and bring considerable health benefits to users, as well as the potential for using gallium nitride in electronics, which could have further significant energy-saving consequences.

News in brief

More information at
www.cam.ac.uk/research


18.04.13

A security solution that protects against the most serious threat to online banking is being rolled out by a Cambridge University spin-out.

27.03.13

A new study identifies over 80 regions of the genome that raise the risk of breast, prostate or ovarian cancer.



 Image
Summer school participant

On the fly

A programme created by Cambridge researchers is teaching African scientists how insects can be powerful yet inexpensive model systems in neuroscientific research.

When Cambridge PhD student Lucia Prieto Godino met Professor Sadiq Yusuf, a Nigerian scientist from the Kampala International University in Uganda, she learned that most neuroscientists in Africa use rats as a model system – and the seed of an idea was planted.

“Rats are expensive model organisms with very limited accessibility to genetic manipulation. *Drosophila*, however, are easy and inexpensive to breed and maintain in the lab, and the wealth of genetic tools available for the study of the brain makes fruit flies an attractive model organism used by many scientists in the West,” she explained. “But

without training, it can seem a major step for researchers to change to this approach.”

Now, Dr Prieto Godino (currently at the University of Lausanne) and scientists from several European universities are gearing up to hold their third three-week, hands-on summer school in Uganda to help early career scientists learn how to work with flies.

The courses have been so successful that Yusuf, Prieto Godino and Dr Tom Baden (also previously a PhD student in the Department of Zoology) founded an NGO, Teaching and Research in Neuroscience for Development in Africa (TReND in Africa), to channel future efforts in improving higher education and research in Africa. The initiative is now furnishing labs in Africa and supporting the development of the first MSc course in Neuroscience in Uganda in collaboration with the Kampala International University.

The next summer school runs from 19 August until 8 September 2013.

trendinafrica.org/activities/summer-schools

Big ideas in small packages

A video project demonstrates how academic research can be communicated in an engaging format that puts across complex ideas in a nutshell.

Anyone immersed in their subject will know how hard it is to step back and explain it in simple terms without losing the central ideas. Now, a project to make academic research in the arts and humanities more readily accessible to the public has brought together early career academics with social media practitioners in academia, museums, archives, libraries and the voluntary sector.

The result is the Digital Research Video Project. Each video uses engaging drawings and an explanatory voice-over to encapsulate an aspect of the original work undertaken by a Cambridge PhD student or postdoctoral researcher. Four videos have

so far been produced and are available on YouTube.

“It can be really hard work to know how to distill your ideas into concepts that the public can grasp without much prior knowledge of your subject... having to explain your work in fairly simple language is a useful exercise and there’s huge enthusiasm among early career academics to reach out to the public,” said project-organiser Dr Suzanne Pilaar Birch, who was a PhD student in the Department of Archaeology and Anthropology. “What particularly attracted the researchers to the project was the chance to be actively involved in the process of making their work accessible.”

The project is part of the Social Media Knowledge Exchange, a collaborative programme funded by the AHRC and led by the University of Cambridge Digital Humanities Network and the Centre for Research in the Arts, Social Sciences and Humanities, with partner institutions.

www.smke.org

Take a look...



at our new-look website, which automatically re-sizes to fit your desktop, laptop, tablet or smartphone.

www.cam.ac.uk/research

21.03.13

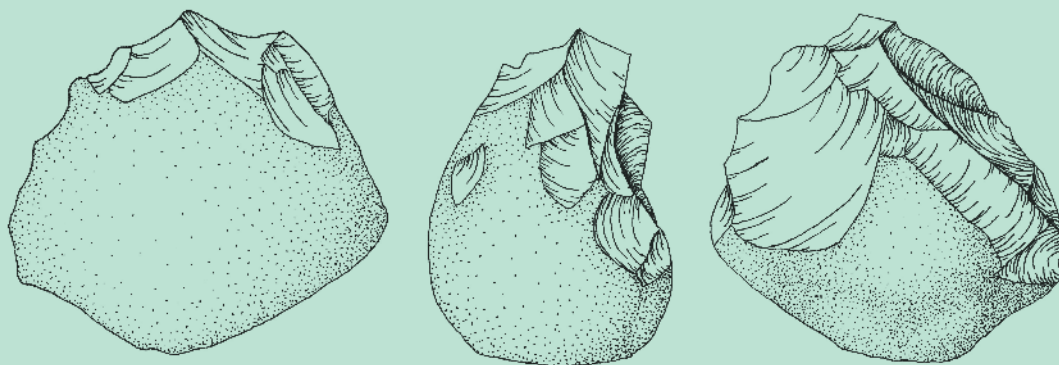
The Planck satellite reveals the Universe’s earliest light, imprinted on the sky when the Universe was just 380,000 years old.

11.03.13

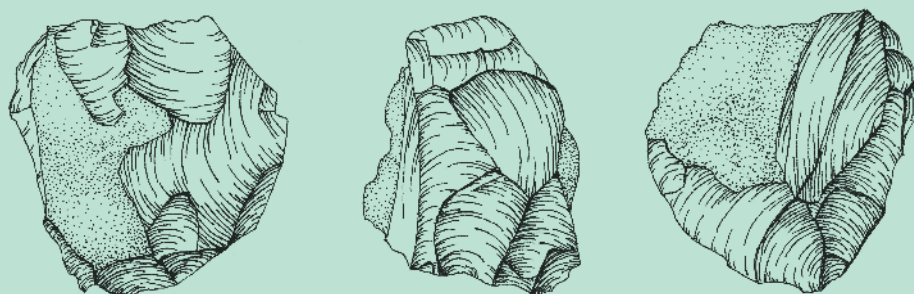
Research shows that digital records, such as Facebook Likes, could expose intimate details and personality traits of millions.

11.02.13

Cambridge is named a Wellcome Trust Centre for Global Health Research, supporting researchers working in public health and tropical medicine.



BEACHCOMBING FOR EARLY HUMANS IN AFRICA



From the earliest modern humans to the present day, our species has evolved dramatically in both biological and behavioural terms. What forces prompted these momentous changes?

In the middle of an African desert, with no water to be found for miles, scattered shells, fishing harpoons, fossilised plants and stone tools reveal signs of life from the water's edge of another era. In 40°C heat, anthropologists Dr Marta Mirazón Lahr and Professor Robert Foley from Cambridge's Leverhulme Centre for Human Evolutionary Studies (LCHES) are painstakingly searching for clues to the origin and diversification of modern humans, from the artefacts they left behind to the remains of the people themselves.

Kenya, East Africa, has long been known as the 'cradle of mankind' following the discovery of fossils thought to be of the first members of the human family, which arose in Africa around 6–7 million years ago. Various distinct species evolved from these ancestors over millions of years, including our own –

Homo sapiens – around 250,000 years ago.

"A lot of the research on the origins of modern humans has focused on defining their point of origin, then understanding why humans left Africa about 60,000 years ago to colonise the rest of the world – known as the Out of Africa model," said Mirazón Lahr. "But we have no idea what happened between 200,000 years and 60,000 years ago. We also have very little information on what occurred inside Africa after 60,000 years, when the different population groups and languages we see today evolved. The genetics suggest that the expansion out of Africa is just the tip of a massive population expansion inside the continent."

Mirazón Lahr's In Africa project, recently awarded five-year funding from the European Research Council, is investigating the evolutionary history of modern human populations. "The challenge is to find the sites where evidence of these early people can be recovered – their stone tools, the animals they hunted, their ornaments and, ultimately, the fossils of the people themselves," she said.



Images

Stone tools (above), a bone chisel (top right) and a bone point (bottom right) used by *Homo sapiens* around 10,000 years ago

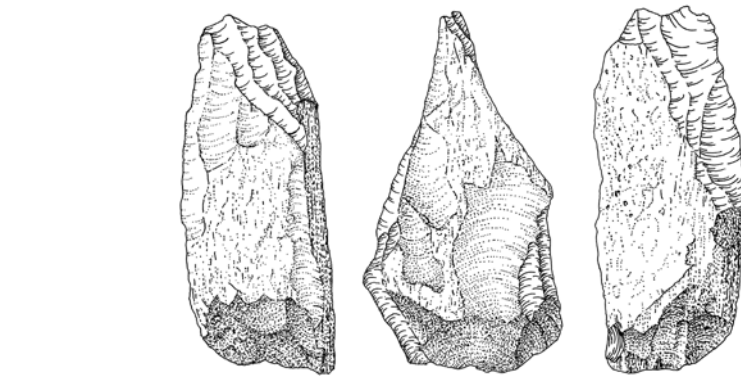
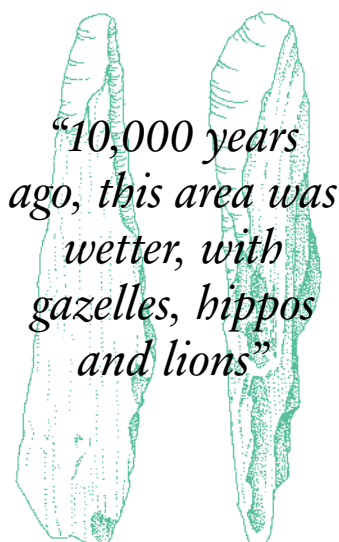
East Africa has played a central role in all earlier phases of human evolution. She has chosen to focus on this region based on the theory that its past environment was suitable for sustained occupation over time. But East Africa is huge, and finding the right place to look is absolutely crucial. Mirazón Lahr used satellite technology to find the first clues.

“In the past there were periods of enormous rainfall in the tropics. When glaciers melted in the northern hemisphere, due to climate change, the water evaporated and then fell in the tropics as monsoon rains,” she said. “The lakes were much higher and their margins were wider. We are using satellite images of the region to reconstruct where the ancient lake margins would have been when the lakes were last high, and that’s where we look.”

Mirazón Lahr and Foley have already carried out three field expeditions, in 2009, 2010 and 2011, to investigate their two chosen sites: the Turkana and the Nakuru-Naivasha basins of the Rift Valley in Kenya, and have made some spectacular finds on the ancient Turkana beaches.

“Ten thousand years ago, this area was wetter, with gazelles, hippos and lions, and the beaches are still there even though the water is long gone. We’ve found shells on the surface, and harpoons the people used to fish with. We go there and we just walk,” said Mirazón Lahr. “A lot has already been exposed by the wind, and occasionally we find sites where things are buried, and then we dig.”

“We’re looking at the lithics – stone tools – and how these relate to times of particularly high lake levels,” said Mirazón Lahr. “Then we’re looking at the fauna and, if we’re lucky, we find actual human fossils. The oldest fossil ever found that looks like a modern human is 200,000 years old, and comes from the basin of Lake Turkana. We’re trying to find the fossils that mark the origin of *Homo sapiens*. The ancient Turkana beach is an incredibly fossil-rich site, and we’ve already found such exciting things!



“We have many human remains – about 700 fragments – mostly dating from between 12,000 and 7,000 years ago, which match the age of this beach. To do the population biology and answer the questions about diversity we need these large numbers. This is already the biggest collection of this age in Africa.”

The primitive technologies that our early ancestors left behind change over time, and comparing finds dated to different times can advance understanding of our evolutionary trajectory. “We think the evolution to modern humans is associated with changes in behaviour and in technology, for example in their tool use,” said Mirazón Lahr. “We’ve already found evidence that they started using animal bones to make tools, which was rare in earlier populations.”

“The people who lived around this lake 10,000 years ago used microliths – a form of miniaturised stone tool technology,” said Foley. “Instead of producing one or two big flakes like the earliest modern humans, they produced lots of very small flakes to make composite tools. This is a sign of the flexibility of the way modern humans adapted to different conditions. We’ve also found a beach in the Turkana Basin from about 200,000 years ago and that has its own very different fossilised fauna, and very different stone tools. The technology and the people changed a lot over the past 200,000 years.”

Mirazón Lahr emphasises that geography and climate played a critical role in the origins and diversification of modern humans. “The times when the lakes were high were periods of plenty in East Africa,” she said. “When it was very wet there were lots of animals, the vegetation could grow, and you can imagine that the people would have thrived.” East Africa had a unique mosaic environment with lake basins, highlands and plains that provided alternative niches for foraging populations over this period. Mirazón Lahr believes that these complex conditions were shaped by varying local responses to global climate change.

“We think that early modern humans could live in the region throughout these

long periods, even if they had to move between basins.” With a network of habitable zones, human populations survived by expanding, contracting and shifting ranges according to the changing conditions. By comparing the fossil records from different basins over time, Mirazón Lahr hopes to establish a spatial and temporal pattern of human occupation over the past 200,000 years.

Her approach is a multidisciplinary one, combining genetic, fossil, archaeological and palaeoclimatic information to form an accurate picture of events. Drawing on her wide-ranging interests from molecular genetics to lithics and prehistory, she believes that the way to find novel insights is to consider each problem from various angles.

This approach is intrinsic to the In Africa project, in which she and Foley are not just searching for new fossils, but also trying to build a complete picture of our early ancestors’ lives and the external forces that shaped their evolution, both biological and behavioural. “The project will be one of the first investigations into humans of this date in East Africa,” said Foley. “Given Africa is where we all come from, that’s critical.”



I Dr Marta Mirazón Lahr
mbml1@cam.ac.uk
Professor Robert Foley
raf10@cam.ac.uk
Leverhulme Centre for Human
Evolutionary Studies

www.human-evol.cam.ac.uk



Image
Saltmarshes starting to
be inundated by the tide at
Abbots Hall, Cumbria, UK

Credit: Iris Möller

A wide-angle photograph of a saltmarsh landscape. The foreground is dominated by dense, brownish-tan grasses. In the middle ground, a body of water reflects the sky, with several small islands of marsh vegetation. The background shows a distant shoreline under a pale, overcast sky.

Climate change

Can nature help us?

Hard-engineered sea walls have a limited life span. Could saltmarshes and mangroves offer a different approach to buffering against storm surges and coastal erosion?

Flooding, landslides, crop failure, water shortages. Across the globe, the frequency with which humans are suffering the ill effects of climatic variability and extreme weather events is on the increase. Can natural environments be used effectively to help people adapt to the effects of climate change? The first systematic review of this question – facilitated by the Cambridge Conservation Initiative (CCI) Collaborative Fund for Conservation – finds much evidence of their effectiveness.

“The delays in international agreements on ways to reduce global greenhouse gas emissions mean that planning to counter the impacts of climate change is a necessity,” said Robert Munroe, Climate Change Officer at BirdLife International. “Governments of all countries should be making plans to protect us against these impacts.”

One adaptation option is to invest in costly, large-scale structures such as sea walls, irrigation systems and dams. But while their short-term impact is clear, these solutions lead to ever-increasing maintenance costs and often have negative impacts on local ecosystems and biodiversity.

“International policy makers are having to think about the different approaches they could take, but the problem is that they don’t have enough information to make informed decisions,” said Munroe.

“Hard-engineered sea walls have a limited life span, and we know that they change wave and tidal currents, often to the detriment of saltmarshes or mangroves that act as a natural buffer to storm surges and coastal erosion. Do we really want to lose these buffers and face increasing costs of sea wall maintenance?” asked Dr Iris Möller, Deputy Director of the Cambridge Coastal Research Unit in the Department of Geography.

“There’s anecdotal evidence from events like the 2004 Indian Ocean tsunami that villages surrounded by mangroves were significantly less affected by the tsunami than more exposed areas,” she added. The mangroves may have saved thousands of lives and properties by absorbing a large proportion of the energy in the waves.

But local anecdotal evidence is not enough to provide a reliable measurement of the effectiveness of an approach. Now a review has been completed of the effectiveness of natural approaches to buffering the effects of climate change. Termed Ecosystem-based approaches for Adaptation (EbA), this relatively new concept incorporates approaches that have been used for a long time to address climatic variability, but not necessarily in the context of adaptation to climate change.

“We wanted to understand what the research evidence tells us, in terms of the relative importance of ecosystems as opposed to hard-engineering solutions to the same problem,” said Dr Bhaskar Vira in the Department of Geography. Vira, Möller,

Dr Tom Spencer (Director of the Cambridge Coastal Research Unit) and Dr Andreas Kontoleon (Department of Land Economy) worked with climate change policy expert Munroe at BirdLife and climate change expert Dr Nathalie Doswald at the United Nations Environment Programme World Conservation Monitoring Centre, as well as with the International Institute for Environment and Development in London. They looked at published studies from around the world in which a wide range of EbA had been assessed. The step-by-step detail of their systematic review method was published in *Experimental Evidence* in 2012, which will enable it to be replicated for consistency in future studies.

“The systematic review is very specific: we sifted out the most relevant published studies and compiled evidence from them on the different interventions being used and how effective they have been,” said Vira. The team found that activities related to EbA have been used across the globe to address a broad range of climatic hazards and impacts.

“Do we really want to lose these buffers?”

Interventions include the sustainable management of wetlands and floodplains to act as floodwater reservoirs and provide important water stores for times of drought, and the conservation and restoration of forests and natural vegetation to stabilise slopes and regulate water flows, preventing flash floods and landslides due to increased rainfall. Most of the approaches were reported by the studies to be effective in reducing human vulnerability to the effects of climate change, climatic variability or natural hazards.

“The results are providing general guidance on the circumstances in which an EbA may be useful,” said Vira. “There are cases where it isn’t necessarily going to be helpful – if you live in Gloucestershire and you’re about to get flooded, you can’t start planting trees, you have to use sandbags. These interventions take time, and there are limitations to their effectiveness.”

“It’s important to work towards fully informed decision-making between alternative adaptation approaches,” said Munroe. “Large-scale infrastructural solutions may tend to be pursued because the financial costs are clear and their short-term effectiveness at buffering hazards has been tested by engineers. But by constraining natural ecological cycles, they may increase social vulnerability in the medium to long term. We found some discussions on the comparison between ecosystem-based and other kinds of approaches to adaptation, which are valuable for policy makers.”

“We also realised there are some real knowledge gaps,” added Möller. “We need information on the costs as well as the benefits, and on whether monitoring systems have been put in place to assess the long-term effectiveness of these approaches. With respect to ecosystems as coastal protection, for example, we need to know exactly how much energy mangroves and marshes absorb and what we can do to maximise and maintain the effect.”

The project collaborators recognise that the divide between scientific research and policy making must be bridged if governments are to make the best decisions for long-term adaptation to climate change. “Our partnership with NGO colleagues meant the project has both academic rigour and a built-in pathway to impact,” said Vira. The Collaborative Fund for Conservation, which was established with the generous support of the Arcadia Fund, was set up explicitly to foster these innovative partnerships.

The team’s collective range of contacts has enabled them to disseminate their results and recommendations. Their presentations at the United Nations Climate Change Conference in Durban in December 2012, and the distribution of briefing papers and guidance documents, have drawn the attention of decision-makers at the highest levels to the possibilities of ecosystem-based approaches.

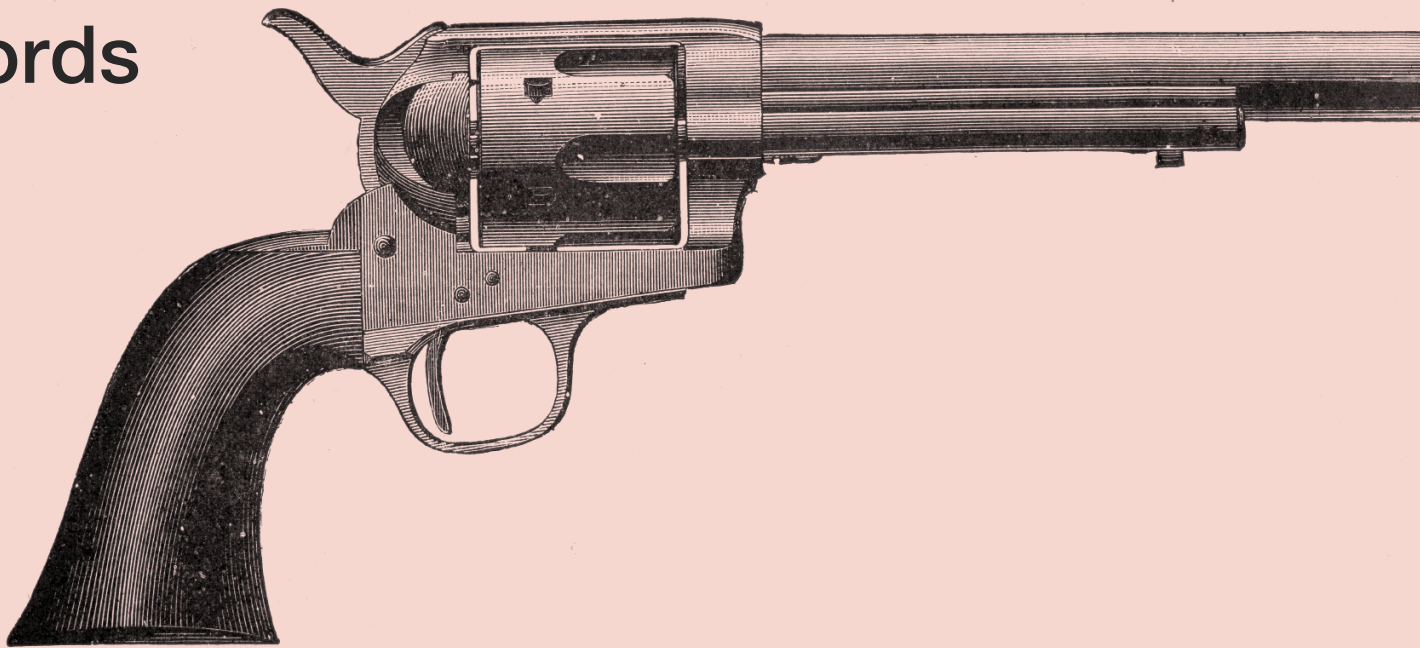
“A technical workshop on EbA, likely to involve 70 countries, was recently convened by the Climate Change Convention,” said Munroe. “Our work contributed to the momentum that resulted in this decision. It’s really exciting as it’s the first time the Convention has met to discuss this approach.”

“EbA is an important tool in the adaptation toolkit, which has often been ignored because the evidence base had not been made clear,” said Munroe. “Employing it alongside other adaptation options will result in much more sustainable responses to the effects of climate change in both developed and developing countries.”



I Left to right
Dr Iris Möller
 iris.moeller@geog.cam.ac.uk
 Department of Geography
Dr Nathalie Doswald
 United Nations Environment
 Programme World Conservation
 Monitoring Centre
Robert Munroe
 BirdLife International
Dr Bhaskar Vira
 Department of Geography

Our ambiguous world of words



*“drawing a gun
could mean pulling
out a firearm or
illustrating a
weapon”*



Ambiguity in language poses the greatest challenge when it comes to training a computer to understand the written word. Now, new research aims to help computers find meaning.

Run has 645 different meanings. It's the largest single entry in the *Oxford English Dictionary*, placing it ahead of *set*, at 579 meanings.

Although words with multiple meanings give English a linguistic richness, they can also create ambiguity: *putting money in the bank* could mean depositing it in a financial institution or burying it by the riverside; *drawing a gun* could mean pulling out a firearm or illustrating a weapon.

We can navigate through this potential confusion because our brain takes into account the context surrounding words and sentences. So, if *putting money in the bank* occurs in a context that includes words like

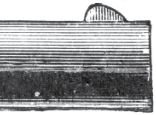
savings and *investment*, we can guess the meaning of the phrase. But, for computers, so-called lexical ambiguity poses a major challenge.

“Ambiguity is the greatest bottleneck to computational knowledge acquisition, the killer problem of all natural language processing,” explained Dr Stephen Clark. “Computers are hopeless at disambiguation – at understanding which of multiple meanings is correct – because they don't have our world knowledge.”

Clark leads two large-scale research projects – recently funded by the Engineering and Physical Sciences Research Council and the European Research Council – that hope to overcome this bottleneck. Applications of the research include improved internet searching, machine translation, and automated essay marking and summarisation.

“Many of the recent successes in language processing such as online

*“Computers
are hopeless at
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because they don’t
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knowledge”*



translation tools are based on statistical models that ‘learn’ the relationship between words in different languages. But if we want the computer to really understand text, a new way of processing language is needed,” said Clark.

As Eric Schmidt, Executive Chairman of Google, said in 2009: “Wouldn’t it be nice if Google understood the meaning of your phrase rather than just the words that are in that phrase?”

Clark has turned to quantum mechanics and a longstanding collaboration with Bob Coecke, Professor of Quantum Foundations, Logics and Structures at the University of Oxford, and Dr Mehrnoosh Sadrzadeh, Queen Mary (University of London), who works on the applications of logic to computer science and linguistics.

“It turns out that there are interesting links between quantum physics, quantum computing and linguistics,” said Clark. “The high-level maths that Bob was using to describe quantum mechanics, which also applied to some areas of computer science, was surprisingly similar to the maths that I and Mehrnoosh were using to describe the grammatical structure of sentences.

“In the same way that quantum mechanics seeks to explain what happens when two quantum entities combine, Mehrnoosh and I wanted to understand what happens to the meaning of a phrase or sentence when two words or phrases combine.”

Until now, two main approaches have been taken by computer scientists to model the meaning of language. The first is based on the principle in philosophy that the meaning of a phrase can be determined from the meanings of its parts and how those parts are combined. For example, even if you have never heard the sentence *the anteater sleeps*, you know what it means because you know the meaning of *anteater* and the meaning of *sleeps*, and crucially you know how to put the two meanings together.

“This compositional approach addresses a fundamental problem in linguistics – how it is that humans are able to generate an unlimited number of sentences using a limited vocabulary,” said Clark. “We would like computers to have a similar capacity to humans.”

The second, more recent, ‘distributional’ approach focuses on the meanings of the words themselves, and the principle that meanings of words can be worked out by considering the contexts in which words appear in text. “We build up a geometric space, or a cloud, in which the meanings of words sit. Their position in the cloud is determined by the sorts of words you find in their context. So, if you were to do this for *dog* and *cat*, you would see many of the same words in the cloud – *pet*, *vet*, *food* – because *dog* and *cat* often occur in similar contexts.”

Working with researchers at the Universities of Edinburgh, Oxford, Sussex and York, Clark plans to exploit the strengths of the two approaches through a single mathematical model: “The compositional approach is concerned with how meanings combine, but has little to say about the individual meanings of words; the distributional approach is concerned with word meanings, but has little to say about how those meanings combine.”

By drawing on the mathematics of quantum mechanics, the researchers now have a framework for how these approaches can be combined; the aim over the next five years is to develop this to the stage that a computer can use. Clark has spent the past decade developing a sophisticated parser – a program that takes a sentence of English and works out what the grammatical relationships are between the words. The next step is to add meaning to the grammar.

“To solve disambiguation and build meaning representations of phrases and sentences that computers can use, you need lots of semantic and world knowledge. The idea is to take the parser and combine it with the word clouds to provide a new meaning representation that has never been available to a computer before, which will help solve the ambiguity problem.

“The claim is that language technology based on ‘shallow’ approaches is reaching its performance limit, and the next generation of language technology will require a more sophisticated model of meaning. In the longer term, the aim is to introduce additional modalities into the meaning representation, so that computers can extract meaning from images, for example, as well as text. It’s ambitious but we hope that our innovative way of tackling the problem will finally help computers to understand our ambiguous world.”



I Dr Stephen Clark
stephen.clark@cl.cam.ac.uk
Computer Laboratory

What is English?

Computers are not alone in finding context a barrier to understanding English. Learners of English as a foreign language can also be held back. To help, Cambridge University Press has built a huge collection of examples of how English is really being used.

The multibillion word Cambridge English Corpus contains examples of spoken and written English in all its forms. Amassed over two decades, the electronic database draws on sources that range from the more expected (books, newspapers, journals, radio, television) to the more surprising (song lyrics, junk mail, voicemail messages and recordings from flight control).

As a constantly updated record of how English is being used today, the Corpus informs researchers at Cambridge University Press as to the most common words and grammatical patterns in English, and the results are being fed back into improving English language teaching books.

*“we analyse
patterns in language
and how English
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on context and
circumstances”*

“Context in English is important,” explained Dr Claire Demby, Language Research Manager, “we analyse patterns in language and how English changes depending on context and circumstances. For learners of English to become proficient, these sorts of subtle differences can be extremely important, and it is only by amassing a vast number of examples that our writers, lexicographers and researchers can determine how best to describe the patterns of English in our learning materials.”

I More information about the Corpus can be found at www.cambridge.org/corpus

O Feature article available online

Clearing the BAR to oral vaccines

Film available online

Credit: Jonathan Settle



A new technology under development by an academic–industry partnership protects oral vaccines from destruction by the digestive system.

From the mouth to the small intestine, the digestive system presents a series of challenges designed to protect us by killing ingested bacteria. If a microbe survives the digestive enzymes in saliva and the corrosive acid of the stomach, the toxic fat-emulsifying bile acids in the small intestine will probably kill it. As a first line of defence against disease and infection, the digestive system is an extremely efficient bactericide.

However, not all bacteria are pathogenic invaders intent on wreaking havoc. For ‘friendly’ bacteria – such as those used in oral vaccines or as probiotics – keeping them alive long enough to exert their benefits poses a significant challenge to biotechnologists.

Now, a new technology that can safely deliver friendly bacteria to the gut is under development by an academic–industry collaboration as an oral vaccine, and Phase

I clinical trials are now planned. Developed by Alexander Edwards, Krishnaa Mahubani and Professor Nigel Slater in the Department of Chemical Engineering and Biotechnology, the technology has been licensed by biotechnology company Prokarium through Cambridge Enterprise Ltd, the University’s commercialisation arm.

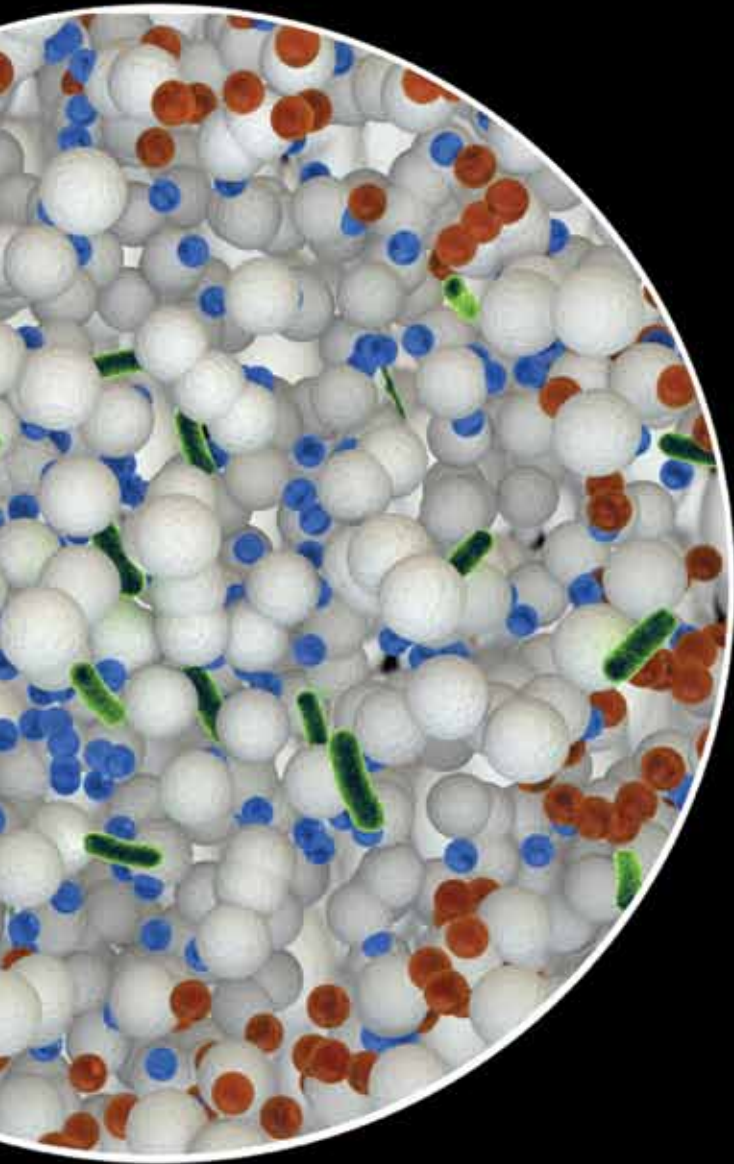
The oral vaccine is based on inactivated *Salmonella enterica* serovar Typhi – the pathogen responsible for typhoid fever – which has been engineered to carry proteins from the bacterium that causes traveller’s diarrhoea. When the body makes a strong protective immune response to *Salmonella*, it does so also to its hitchhiker, making it a powerful vaccine delivery platform for this and potentially any other disease-causing pathogen.

Salmonella is better able to survive the digestive system compared with other microbes and stimulates a strong immune response. This approach also reduces the cost and time of vaccine production, compared with the traditional methods of

purifying vaccine proteins from cultured cells.

Mahubani and Slater particularly wanted to create a vaccine that did not require injection. “Oral vaccines are part of a new generation of needle-free vaccination strategies,” explained Mahubani. “These strategies are especially suited for use in developing countries, where needle-based vaccination can pose logistical challenges due to the lack of a cold supply chain, hindering the roll out of vaccination programmes.”

Formulating the vaccine for ease of distribution and administration required the production of dried bacteria. However, simply administering dried microbes isn’t the answer. “Protection from saliva can be achieved by swallowing the dried bacteria in the form of a pill or capsule, and the digestive effects of the stomach can be protected against by using an enteric coating that dissolves once the capsule has moved out of the stomach into the more-alkaline small intestine,” said Mahubani. “In the assault course of the digestive system, the finish line for oral vaccines is the small intestine, where they must



Image

How the capsule works: as intestinal fluid hydrates the capsule, both bile (brown) and water (blue) enter; BARs (white) in the formulation hold back the progress of the bile long enough for the water to rehydrate the bacteria (green) before the capsule fully disintegrates and releases the vaccine into the intestine

With funding from the Technology Strategy Board (TSB) and the Biotechnology and Biological Sciences Research Council (BBSRC), the Cambridge scientists have been working with BioPharma Technology Ltd, Microbial Developments Ltd, Cobra Biologics Ltd, and now Prokarium Ltd, as well as Professor Simon Cutting at Royal Holloway College.

Now, as plans are put together for a Phase I clinical trial, work is ongoing to define the precise formulation of bile-adsorbing materials and dried bacterial vaccine, as well as to design the capsule that goes into the trial.

“It’s been very important during the development process that we’ve had the support of the TSB and BBSRC to progress the invention to the stage we’ve now reached,” explained Dr Rocky Cranenburgh, Prokarium’s Chief Scientific Officer. “The combination of BAR technology with the *Salmonella* vector will allow us to develop an advanced oral delivery platform that gives us the potential to revolutionise vaccinations.

“We are focusing on the development of a dual oral vaccine against typhoid and enterotoxigenic *Escherichia coli* (ETEC) – a major cause of diarrhoea – for travellers and developing country markets. There are 22 million cases of typhoid every year resulting in 200,000 deaths, so an effective oral vaccine could have a significant impact. Currently there is no dedicated vaccine against ETEC, considered responsible for 300,000–500,000 deaths per year, mostly of young children.”

“This is a great example of the University working with industry, interpreting needs to create a viable product using real science,” added Slater. “We think this formulation has the potential to be distributed to the four corners of the earth irrespective of supply chain considerations.”



Krishnaa Mahubani

ktam2@cam.ac.uk

Professor Nigel Slater

nkhs2@cam.ac.uk

Department of Chemical Engineering and Biotechnology

survive the detrimental effects of bile. After drying, bacteria lose their natural tolerance to bile. We needed to find a way of stabilising the bacterium in a dried form so that it could be brought back to life before the bile destroys it.”

Once rehydrated, and after the bacterium has reached the lining of the small intestine, it is intercepted by the immune system, eliciting a strong response to the multiplying pathogen. The next time the immune system encounters the same material, usually in the form of the disease-causing pathogen itself, it can react quickly to clear the invader.

The answer to overcoming the encounter with bile came when Edwards made a surprising discovery, as Slater explained: “Drying did not affect the bacteria permanently. On rehydration, they regain their natural protection to bile.

“When we started the project, this wasn’t known. But the finding opened a door to how we could create an oral vaccine that could survive in the digestive system and didn’t require cold storage. We realised that we needed a technology that would allow the bacteria to rehydrate before the bile reaches it.”

“This is a great example of the University working with industry”

The solution lay in a novel adaptation of a material called bile-acid adsorbing resins (BARs). Developed in the 1960s to lower cholesterol levels, BARs such as cholestyramine have a long track record of safe oral administration to patients.

The scientists reasoned that if the capsule contained dried bacteria mixed with BAR then, when the enteric coating dissolves and water and bile enter freely, the movement of bile would be held back by the resin long enough for water to rehydrate the bacteria, before the capsule finally breaks open. When she tested the theory, Mahubani found that this adsorption concept works, even at progressively smaller and smaller capsule sizes.

Development of a sophisticated artificial pancreas holds potential to transform the lives of patients with Type 1 diabetes.

Type 1 diabetes is a lifelong condition caused when the pancreas stops producing the insulin needed to control blood sugar levels. Patients must carry out frequent finger-prick tests and inject insulin to keep their blood sugar within safe limits. Left untreated, Type 1 diabetes is fatal; even suboptimal control increases the risk of heart disease, stroke, kidney failure, nerve damage and blindness.

Patients under the age of five are a particularly vulnerable group. Too young to recognise the shaking and dizziness that warn of a drop in their blood sugar, they are at high risk of developing overnight hypoglycaemia.

Now, a clinical trial with this age group is testing an 'artificial pancreas', developed by the group of Dr Roman Hovorka, Director of Research at the University's Metabolic Research Laboratories. "Using an off-the-shelf insulin pump and continuous glucose sensor, we've developed a computer algorithm to control their function in a closed-loop fashion, delivering the correct amount of insulin according to blood sugar levels," he said. "By maintaining tight control of blood sugar, this has the potential to revolutionise the treatment of patients with Type 1 diabetes and significantly improve their quality of life."

The glucose-responsive insulin delivery system has been trialled in adolescents, adults and pregnant women with Type 1 diabetes at the Cambridge Clinical Research Facility (CRF), and follow-on studies are ongoing with these groups at home.

Hovorka has now turned his focus towards using the system to help the very youngest patients. This year, 78,000 children worldwide were diagnosed with Type 1 diabetes, and the incidence in under-fives is rising annually by 3% in many countries.

"Insulin is a hormone that is powerful enough to kill people, so we need to be very careful"

"The risk of these children developing overnight hypoglycaemia, when blood glucose levels drop dangerously low and can lead to a coma, is a major concern for parents," said Hovorka. "The tiring routine of getting up several times every night to check their child's blood sugar is disruptive for the whole family."

The artificial pancreas that keeps tabs on sugar



In the new trial, running until July 2013, children stay overnight at the CRF with their parents. "Insulin is a hormone that is powerful enough to kill people, so we need to be very careful," said Hovorka, whose research is funded by the Juvenile Diabetes Research Foundation, US National Institutes of Health, Diabetes Research Network, National Institute for Health Research (NIHR), Diabetes UK and European Commission. "Our trials at the CRF are an essential step, enabling us to document safety and reliability with different groups before we let them test it at home. Our controlled conditions, and proximity to the hospital, provide reassurance that, if there is a problem, we can help."

"Our trials at the CRF are an essential step, enabling us to document safety and reliability"

The CRF is a joint venture between the University's School of Clinical Medicine, the NIHR and the Wellcome Trust. It provides facilities for investigators from across the Cambridge Biomedical Campus to carry out clinical trials in patients and healthy volunteers, but is now greatly oversubscribed. Fundraising is currently under way to enable an extension to be built next year, to accelerate the development of effective new treatments and interventions to benefit patients across a wide range of conditions, including obesity and diabetes, immune and inflammatory disorders, and cancer.

For Hovorka, various other trials of the artificial pancreas system are also in progress, including in the control of blood sugar in patients in the Neurosciences Critical Care Unit at Cambridge University Hospitals NHS Foundation Trust, and his prototype devices are being commercialised by Cambridge Enterprise, the University's commercialisation arm. "We hope to make the overnight closed-loop system widely available in the next three to five years," he said.



I Dr Roman Hovorka
rh347@cam.ac.uk
Metabolic Research Laboratories

As health services strive to improve quality and reduce costs, researchers report on the benefits – and the pitfalls – of ‘pay for performance’ in hospitals.

Hospital performance has rarely been out of the news in recent months, following the conclusion of a public inquiry into Mid Staffordshire NHS Foundation Trust that argued for “fundamental change” in the culture of the NHS to make sure patients are put first. The news casts a spotlight on what measures the government might take to combat poor care.

One emerging movement in hospital health services is the adoption of pay-for-performance (P4P) schemes to reward better-performing hospitals with cash incentives. In the USA, for instance, the government’s social insurance programme Medicare has launched P4P in efforts to encourage better and more standardised care, and to penalise hospitals with high re-admission rates.

However, it remains unclear as to whether P4P schemes improve patient outcomes, explained Professor Martin Roland, Director of the Cambridge Centre for Health Services Research (CCHSR): “P4P is being widely implemented, especially in the United States despite a scant evidence base.”

The idea behind P4P is to reward healthcare providers based on how well they perform against a set of pre-agreed criteria, such as whether anti-clotting medication has been given within 30 minutes following a heart attack and how quickly antibiotics are given for patients with pneumonia.

Now, the first evaluation of a P4P scheme (Advancing Quality) in the UK has suggested that 890 lives were saved across 24 hospitals in the northwest of England over an 18-month period. The analysis of the NHS scheme was carried out by a team of researchers at CCHSR, the University of Manchester and Nottingham University Business School, and was published in the *New England Journal of Medicine*.

The Advancing Quality scheme used a ‘tournament’ system, in which only the top performers received a bonus. The researchers evaluated the number of in-hospital deaths due to pneumonia, heart failure and heart attack within 30 days of admission following the scheme’s introduction, compared with the 18 months preceding it, among a total of 134,435 patients admitted for these conditions and controls across the country.

**890
LIVES
SAVED IN
24
HOSPITALS**

A scheme similar to Advancing Quality had failed to show any improvement in outcomes in the USA. Speculating on reasons for the difference, Roland said: “The context is really important – the level of the incentives, how they are structured and whether clinicians from different hospitals meet together to discuss how they were improving care face to face as they did in the UK, or through ‘webinars’ as in the US.”

Extensive work by CCHSR evaluating P4P programmes has shown that these incentives can have benefits, but also unintended consequences. For instance, care for non-incentivised health problems may be neglected if there are powerful incentives to concentrate time on other conditions.

The CCHSR is a collaboration between the Health Services Research Group in the University’s Institute of Public Health and the

Health and Healthcare Policy Programme at the independent and not-for-profit research institution RAND Europe. The centre was recently placed second in a world ranking of health policy think tanks. “The collaboration between the University and RAND Europe has been a great success,” said Roland, “bringing together expertise from two complementary organisations as well as bringing in experts from the US to collaborate on our research.”

“As new ways of delivering health services develop, and public expectations change, it becomes ever more important to evaluate how effectively organisations in primary, secondary, community and social care are performing,” he added. “These are significant contributions to the healthcare debate because only then will policy makers have the knowledge to determine where best to place limited resources.”



I Professor Martin Roland
mr108@cam.ac.uk
Cambridge Centre for
Health Services Research

**Can you put a
price on health?**



Things Artefacts of Encounter



Images

Tahitian barkcloth, woven Maori belt,
Tahitian warrior's gorget



Feature article
available online

Maori artefacts presented to Captain Cook's crew on their first voyage of discovery capture the spirit of a first encounter between two cultures.

Living in a multicultural, globalised world, it's hard to imagine the moment when different cultures first meet, or a time when people's knowledge of each other's worlds was nonexistent.

Yet, on 12 October 1769, Maori canoes paddled out from the east coast of New Zealand to investigate a large ship. The vessel was HMS *Endeavour*, captained by Captain James Cook, and this was the first time the Maori people had encountered a European.

According to the diary of ship's surgeon William Monkhouse, they "enter'd into a traffick with our people for [Tahitian] cloth... giving in exchange their paddles (having little else to dispose of) and hardly left themselves sufficient number to paddle a shore."

Almost 250 years later, the paddles and other artefacts are housed in the University of Cambridge's Museum of Archaeology and Anthropology. Now, an innovative research project, *Artefacts of Encounter*, has been working with Polynesian communities to understand what the earliest Europeans to

visit the Pacific Islands made of the people they met, and what those people made of them.

Rather than turning to the written evidence of Europeans, the researchers have placed at the heart of their investigation the objects the Polynesians gave in exchange for goods. For the Polynesians, the feathered cloaks and woven helmets, nose whistles and shell horns are often the only surviving evidence of early contact with other cultures.

"Artefacts help us to study what parties on either side of the encounters were trying to achieve through these transactions," explained researcher Dr Julie Adams. The team, which includes Dr Amiria Salmund and Carl Hogsden, has been funded by the Economic and Social Research Council to create a digital environment that for the first time brings together over 1,000 objects from 40 voyages held in 30 museums worldwide.

The Museum of Archaeology and Anthropology holds a world-class collection of Oceanic, Asian, African and Native American artefacts and has been shortlisted for the Art Fund's Museum of the Year 2013.

www.maa.cam.ac.uk



Maori paddles collected on
Captain Cook's first voyage
(1768–1771)



Forging connections: *digital humanities in Cambridge and beyond*

John Rink and Simon Goldhill, Co-Directors of Cambridge's Digital Humanities Network, explain how digital tools are transforming scholarship in Cambridge.

Humanities research and the questions underlying it are being radically reshaped by new digital technologies and the connections and insights that they afford.

Digital tools have been used for decades to browse library catalogues and to access, collate and disseminate primary and secondary research materials. Many of these tools were produced by 'humanities computing' teams that basically offered support services to academic researchers. But during the past 10 years or so, the field of digital humanities has developed into "a genuinely intellectual endeavour with its own professional practices, rigorous standards, and exciting theoretical explorations," as noted by the literary theorist Katherine Hayles (Duke University).

Cambridge is well placed to exploit and enhance the transformative potential of digital technologies in the arts and humanities, and to make a major contribution to the ongoing development of the emergent discipline.

Significant research clusters using digital mapping tools (such as GIS) can be found in Archaeology, Geography, History, the Computer Laboratory, and Asian and Middle Eastern Studies. Several departments have a well-established profile in social network and social media research. In addition, clusters of expertise in digital editions can be found in Music, English, History and Philosophy of Science, Classics and the University Library.

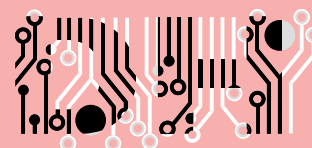
Further attributes of the Cambridge DH 'scene' include the longstanding role of the Centre for Research in the Arts, Social Sciences and Humanities (CRASSH) in fostering crossdisciplinary interaction between digital humanities researchers. E-research and e-learning tools have been developed at the Centre for Applied Research in Educational Technologies (CARET). The University Library has become a centre for digitisation and digital project management, as well as home to the e-repository DSpace@Cambridge. Across the spectrum of humanities disciplines, expertise in digital research is flourishing.

The Digital Humanities Network was established in 2011 to enhance

Cambridge's potential in this area, and to foster collaboration and synergy across an extraordinarily rich research environment. It aims to engage leading scholars across the University in developing a shared agenda for digital humanities research throughout the next decade. This involves setting current and future research themes, helping to plan future IT infrastructure needs, and encouraging the University to support staff training and recruitment policies that will provide the people needed to realise the Network's vision.


Among other activities, the Network has already helped to generate major external funding, supported a transferable digital skills project for early career researchers, and led a social media knowledge exchange project.

The great strengths and distinctive contribution of digital humanities at Cambridge derive from the wealth of ideas that inform and underpin the research in this area. The fact that Cambridge researchers are uniquely skilled in analysis, critique and interpretation gives them an edge in developing what Todd Presner (University of California, Los Angeles) has called the "entirely new disciplinary paradigms, convergent fields, hybrid methodologies, and ... publication models" that now characterise digital humanities, thereby paving the way for future developments of signal importance to those working in the field and well beyond.



I Left to right
Professor Simon Goldhill
sdg1001@cam.ac.uk
CRASSH
Professor John Rink
jrs50@cam.ac.uk
Faculty of Music

*Dr Anne Alexander coordinates
the Digital Humanities Network
www.digitalhumanities.cam.ac.uk*

 **Image**
blackeye, Joseph Nechvatal;
 2010 computer-robotic-assisted
 acrylic on canvas and screen with
 digital animation

CREATIVITY THAT COUNTS



Credit: © Joseph Nechvatal; courtesy of Galerie Richard, New York & Paris

In a digital world, literature, art and music are often the result of collaborative efforts. But who owns what, and can copyright law cope? New research aims to find out.

An apocalypse unfolds before the viewer's eyes, as microscopic dots appear, combine and 'consume' a work of art: digital artist Joseph Nechvatal destroys digital representations of his paintings by unleashing a computer virus that 'gnaws away' at his creation in real-time and, to do so, he collaborates with programmer Stéphane Sikora.

Many artists like Nechvatal have embraced the benefits of working both digitally and collaboratively to create innovative pieces. The 52-member Intercontinental Music Lab, for instance, creates music that is inspired, arranged and written by different band members without them ever having to meet. "We all understand that the completed song can't exist without this collective creative input," explained founding partner Barney Brown.

But what are the implications of collaboration when it comes to deciding who the author of the work is, and who owns the rights to control its use? "The premise is that the digital world is changing both the way people create works and what they create," explained Professor Lionel Bently from Cambridge's Faculty of Law. "While there have been many responses from copyright law to the possibility for copyright infringement, there has been very little in terms of rethinking the fundamental concepts – who is the author and what constitutes the work they have created?"

A team of researchers from the Universities of Cambridge (led by Bently), Amsterdam and Bergen is now reaching the

completion of a three-year research project that is scrutinising these notions.

Funded with €1 million by HERA, the study is drawing on insights from humanities disciplines to offer a new understanding of copyright norms that can support the continuation of creative collaboration in the digital environment.

"Copyright is often criticised for being rooted in a solitary notion of authorship," explained lawyer Dr Elena Cooper, who has interviewed 18 digital artists and poets, including Joseph Nechvatal, as part of the project. "The assumption is that creative practices using digital technology radically challenge that concept. The interviews revealed that authorship remains an important concept in the digital age, though there is a real diversity in its meaning, spanning not just collaborative notions, but also solitary ones.

"Moreover, we often think of large-scale multi-author ventures like Wikipedia as being newly enabled by digital technology. But the 70-year process of compiling the *Oxford English Dictionary*, instigated by the Philological Society in 1857, reveals that large-scale collaborations also existed in the 19th century. This was a process that involved the contribution of thousands of volunteer readers, sub-editors and assistants, alongside the salaried editors."

Cooper's research in the archives of Oxford University Press and the University of Oxford's Bodleian Library is revealing a treasure-trove of correspondence that documents what lawyers, unpaid contributors and Philological Society members understood about the copyright implications of the involvement of masses of contributors. Looking at the solutions proposed in the 19th

century, she commented: "we may well be able to learn from this experience today."

Cooper and philosopher Dr Laura Biron are also asking whether ideas about the philosophy of art can help copyright identify the author in cases where many have contributed. "We are examining what institutional theories of the late 20th century say about authorship," Cooper explained, "and how a new definition based on the role, authority and intent of the artist could help copyright lawyers navigate their way through the competing claims of multiple contributors. This is an intersection between philosophy and law that has not been previously considered."



I **Left to right**
Dr Elena Cooper
 Faculty of Law
Dr Laura Biron
 Faculty of Philosophy
Professor Lionel Bently
 lb329@cam.ac.uk
 Faculty of Law

www.creativitythatcounts.org



Research on Egypt is looking at how to read revolution and grass roots opposition through social media.

25 January 2011 was the day Egypt's revolt began. People flooded the streets of cities across the country, calling for an end to the Mubarak regime. Two days later – in a moment unprecedented in history – the government turned off Egypt's internet, in the hope of quelling massive civil unrest.

It didn't work. Two weeks later Mubarak stepped down.

The Western media relished portraying the Egyptian uprising as the 'Facebook revolution', a digital epoch securing social media's place in history as a vehicle for political change – an unstoppable galvanising force.

Such views were clearly oversimplistic, especially as the revolution continued apace despite – even because of – the loss of the internet. As one activist stated on his blog, losing the internet at the hands of his own government served as a powerful reminder of "why we're doing any of this."

So in what ways did social media influence Egyptian revolution, and how do opposition movements continue to use it? Can researchers capture these digital datasets to analyse social turbulence?

Dr Anne Alexander, a research fellow at the Centre for Research in the Arts, Social Sciences and Humanities (CRASSH), is investigating the digital fingerprints left by

Egyptian people on Facebook, Twitter and other social sites during civil unrest.

"I found myself thrown into a huge amount of social media data in my research as a political scientist working on Egypt. The work I'm able to do, the kind of access I have to sources previously inaccessible outside the country – or in many cases full stop – has changed enormously."

More than 600,000 Egyptians joined Facebook between January and February 2011. On 2 February, the day the internet switched back on, it was the most accessed website in the country. There were 1.5 million Egypt-related tweets in just the first week of the uprising.

The statistics are startling, and it's perhaps easy to see why the Western media leapt on them. But, as Alexander points out, "it's not Twitter that overthrew Mubarak, but mass mobilisation and burning down police stations – that's what makes revolutions."

Communication technologies were certainly important for Egypt's uprising, and not just social media. Smartphones enabled protesters to capture footage of events, which were manually relayed – as networks were down – back to 'media camps' set up by activists in touch with outside journalists.

These clips were reported by global news agencies such as the BBC, CNN and – critically for Egyptians – Al Jazeera, the Arabic news network that was the most influential source of information for the nation, far outweighing social media.



Images

A selection of images from Egypt's revolution in January 2011

WORKERS' STRIKES AND FACEBOOK LIKES



“You have social change colliding with technology”

The remote access to often thousands of viewpoints, tracking development of events seemingly in ‘real time’ from people on the ground, has unquestionably transformed the ability to research political movements, as well as the movements themselves.

But analysis of social media raises important questions about truth and identity that Alexander finds “disconcerting”.

“The multiplicity of viewpoints, this sense of a godlike panoptical vision that social media seems to provide – offering near-instantaneous presence to events on the other side of the world – can be deceptive.”

As Alexander highlighted, most people who have tried to tweet while evading tear gas will tell you “it’s not instantaneous at all!” and what they choose to share – the viewpoint expressed to the world as fact – is highly selective.

“The digital self has an inevitable aspect of performance, something you’re ‘putting on’ for the outside world, as I’ve discovered through interviews.”

For Alexander, it is critical to ‘triangulate’ when using social media as a source by combining it with interviews both remotely and face to face.

As emerging fields of digital anthropology and ethnography become increasingly valuable for researchers, tools and approaches will need to be developed – as well as ethical boundaries. “I’m not convinced people understand the extent to which what they say is public, and may put them in harm’s way – now or in a few years,” said Alexander.

“Social media allows access to datasets with an unprecedented range of detail, but presents a host of new challenges for researchers. It’s possible to ask questions in new ways but whether social media data can really transform our understanding of society remains to be seen.”



I Dr Anne Alexander
raa43@cam.ac.uk
CRASSH

While Twitter and Facebook contributed to initial online mobilisation, Alexander found that people she interviewed following the uprising said it was large-scale physical gatherings, rallying cries at Friday prayer and traditional activism that led to revolution.

“People attribute agency to technologies when it should be attributed to people. Facebook did not cause a ‘tipping point’. When the stakes are very high – arrest, torture, death – it takes multiple tipping points to reach crucial moments, showing enormous endurance on the part of the people,” said Alexander in a paper co-authored with Dr Miriyam Aouragh of the University of Oxford.

“You have social change colliding with technology. New media played a part as one of a number of tools used by the people, leaving a remarkable rendering of a moment in history that researchers can interrogate.”

Recently, Alexander has been studying the ways in which Facebook in particular has been used during industrial action in post-Mubarak Egypt, to both gather and disseminate information.

“Twitter and Facebook are not the social network, we are the social network”

Amr Gharbeia
Egyptian activist

Last year, public sector workers striking at many of the country’s sugar refineries used Facebook as an “online newspaper” – uploading interviews with strike committee members, media reports for comment and encouraging debate on the ‘wall’.

A common trait in online labour activism is to use Facebook’s capacity for ‘sharing’ to be transparent about contact with management. Posting all output from meetings lends credibility to industrial action.

“The process of making available all dealings with management – from documents to photos of a meeting – reflects peoples raised expectations for democratic accountability post-revolution, and social media can be a platform for this,” said Alexander.

This is particularly important for emerging independent unions as, before the revolution, the trade union federation was – and to some extent still is – an arm of the state.

Striking doctors used social media to gather reports from different provinces, setting up national Facebook pages to channel information, but also to lobby – both the government for increased funding and the wider public for support.

Explanatory videos and leaflets for doctors to distribute among patients were circulated via Facebook, using social media as “essentially a form of PR.”

Some of the most intense debate Alexander encountered in her research has been on constitutional reform in Egypt, as the Muslim Brotherhood – who use a “well-developed ecosystem” of social media – have risen to prominence in the country.

Those opposed have taken to the streets but also to “every social media platform going” and Alexander is able to access voices and opinions that would have been difficult 10 years ago, with “extremely rich” content attached.

For Alexander, social media offers huge opportunities but also challenges. “You have to maintain critical detachment, know the questions and approaches that will help unpick what’s presented – as with any source material.”

Major motion pictures from our prehistoric past

Cambridge archaeologists are illuminating some of the oldest graphic art of the past, by applying some of the most advanced graphic technology of the present.

We tend to think of archaeological investigation as getting down and dirty with the physical evidence of vanished people – skeletal remains, submerged foundations, the charred detritus of daily life. This is evidence with substance that can be analysed, dated, pieced together. But what do archaeologists do with sculptures that are made of air? In the case of the 150,000-plus engravings of the Valcamonica valley in the Italian Alps, the images have been carved out of the sandstone rock. They are a subtraction from it.

From about 4,000 BC up to medieval times, with activity concentrated in the 1st millennium BC, the peoples of the valley have hewn pictures out of the rocks with stones or tools. Dr Christopher Chippindale, rock art expert and Curator at the Museum of Archaeology and Anthropology, and Dr Frederick Baker, film-maker and Senior Research Associate at the McDonald Institute for Archaeological Research, use the local dialect term for these engravings: *pitoti*, or ‘little puppets’.



Images
Pitoti engraving hewn into the sandstone of the Valcamonica valley, Italy

Baker describes the *pitoti* as “Giacometti meets landscape artist Richard Long, by way of Paul Klee.” Human figures – ‘orants’ – with arms raised as if in angular attitudes of worship, weapon-clad warriors sparring in pairs, priests and priestesses with halo-like headdresses, jiving dancers, grazing animals, wagons, wheels, houses and symbols form a communal autobiography of mankind.

Examining and analysing such ephemeral images in the absence of any formal knowledge of the circumstances that produced them, let alone interpreting the curious clustering of the *pitoti* on around 2,000 rock faces across a 70-km-long valley, has challenged archaeologists since the *pitoti* were discovered as an archaeological phenomenon over a century ago.

The response of Baker and Chippindale has been to approach the *pitoti* as pictures, with particular respect to what distinguishes them from paintings: their depth. Using digital imaging technologies such as laser-scanning, graphic animation and ambient cinematic techniques, they have formulated a new research methodology based on ‘visual excavation’ of these images as 3D entities.

This approach has thrown new light on the *pitoti*. “The first thing that struck me,” said Baker, “was that the pictures look like stills out of an animation. As a film-maker, my response was, ‘What happened next?’. When you take into account their depth this question becomes even more interesting, because the *pitoti* appear and vanish according to the angle of the sun. When it hits the rock obliquely, the image casts a shadow, and that is what makes the art visible to us. It is a natural 3D effect.”

Baker specialises in film projection. “So watching the sun arc and fall over one of these panels,” he recalled, “and seeing the individual figures leap out then disappear was revelatory. They form a landscape-based proto-cinema.”

The proto-cinematic metaphor is applicable to individual *pitoti*, some of which appear inexorably in transit to another action: the thrust of a spear; the parry of a shield; the flight of a startled deer. By laser-scanning then animating the engravings, Baker, Chippindale and Andreas Wappel (St Pölten University of Applied Science, Austria) found that our ancestors did record them in motion. “We animated an image of a bird,” explained Baker, “and not only got it to fly in an absolutely naturalistic sense, but found that concentric arcs inside its body were not plumage but follow the graphic logic of a bird’s beating wings.”

With rock faces as screens and the sun as a projector, the valley forms a natural amphitheatre. This begs the question of whether it also worked acoustically. Together with musicians playing instruments including a natural cow-horn, Baker and Chippindale tested the hypothesis that auditory performance was an aspect of a multi-sensory experience.

“We found that three key *pitoti* sites with distinctive iconography had extraordinary echoes, clearly audible to those standing in front of the art,” explained Baker. “You get a lot of echoes in mountains,” he continued, “but these sites had another common denominator:

they are amongst the earliest rock art sites. Archaeologists have long wondered why they were chosen. Now we know that it is the echoes that matter.”

By using performance to explore a hypothesis about performance, the Cambridge team has opened up a new line of archaeo-acoustical research. It took just a day, but it was one that Chippindale will never forget. “This discovery was thrilling,” he said. “It was the most exciting day of my research life.”

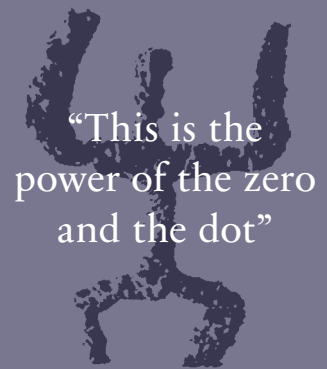
3D realisation has thrown up a further indication that some of the *pitoti* are, literally, in suspended animation. A researcher from one of the partner institutions working with Baker and Chippindale, Marcel Karnapke from the Bauhaus University Weimar, converted a distinctive orant into a sculpture for an exhibition held in Milan and then in Cambridge’s Museum of Archaeology and Anthropology. “Far from being roughly symmetrical as had been assumed,” said Chippindale, “the figures stand, perfectly balanced, on their toes.”

“This is the power of the zero and the dot,” said Baker of these insights. “The digital level has enabled us to record more exactly, look more closely and, because the digital world is all about mutability and metamorphosis, to test hypotheses.”

Now, this research is being scaled up through an ambitious, pan-European project – 3D Pitoti – which began in March 2013 and is funded by the European Union. With Cambridge’s contribution led from the McDonald Institute, the project will use autonomous micro-aerial vehicles and develop portable robotic scanners to build on the lines of enquiry opened up by Chippindale and Baker, who will be joined by Cambridge archaeologists Professor Charly French and Dr Craig Alexander. The project will present the resulting resources and research in novel graphic, interactive and universally accessible digital forms.

The research will analyse the *pitoti* from multiple but inter-related perspectives, from the bird’s-eye view (their distribution and classification across the valley) to the human scale (their clustering within one site, and on individual rock panels). While ostensibly random, there are, in fact, significant patterns to the clustering. “These are agglomerations of images rather than compositions,” explained Chippindale. “We know that they were created over the course of centuries. But they are not placed in an unstructured way. There are affinities in terms of the type of image and its size. We can see, too, that artists typically avoided superimposing their images on their predecessors’ art.”

The research will zoom in to analyse whether the arrays of images have narrative meaning. It will examine individual *pitoti* to address the longstanding debate about the balance in prehistoric art between communal and individual expression. “The prevailing thinking is that the *pitoti* work on the communal level of, say, Arsenal fans spraying ‘AFC’ on the lampposts of Highbury. But perhaps we’re dealing with individuals like London street artist Banksy, leaving his message to posterity.”



“This is the power of the zero and the dot”

Film available online



Left to right
Dr Frederick Baker
 fb346@cam.ac.uk
 McDonald Institute for
 Archaeological Research
Dr Christopher Chippindale
 cc43@cam.ac.uk
 Museum of Archaeology
 and Anthropology

www.pitoti.org



Credit: wikimedia

Clickable history

Geographic information systems – once limited to the domain of physical geographers – are emerging as a promising tool to study the past, as researchers are discovering for medieval history.

Almost nothing persists to reveal the existence of Jews in the Byzantine Empire – no buildings or synagogues, coins or seals, pots or pans, charms or amulets. Such evidence of everyday life simply hasn't survived for this now-vanished people, despite their living in a region that stretched from the southern Balkans, across Turkey to Crete and Cyprus for almost a millennium until the late 15th century.

Yet, evidence there is – if you look hard enough: inscribed on toppling tombstones, referenced in medieval travelogues and documented in fragments of Hebrew manuscripts that have only recently been deciphered. But because these threads are scattered so widely, often inaccessibly or in fragments, Byzantine Jewry has been largely neglected in histories both of the Empire and of the faith.

Now, new research is not only filling these gaps – and, in so doing, showing how the Jewish population had a distinctive identity and unique culture – but is also breathing new life into the sources. The key to the approach is the use of a geographic information system (GIS).



Image

GIS is being used to map the Jewish presence in the Byzantine Empire, a region that stretched from the southern Balkans, across Turkey to Crete and Cyprus; detail of the area from a 14th-century world atlas (created by Abraham and Judah Cresques)

Similar to the advanced technology that underpins Google Maps and the global positioning systems now used in millions of cars, GIS combines a relational database with an interactive map. Like these tools, the map is dynamic – when a question is asked of it, the system pulls data from the database to produce a map that gives specific information about a specific location at a specific time.

Although GIS has been around for some 50 years, its use in research had largely been restricted to the geographical sciences. Today, however, the tool is increasingly being used by researchers to map behaviours and events onto the landscape, whether it's the relationship between the built environment and obesity, or emergency planning for terrorist attacks and natural disasters.

And now, historians such as Professor Nicholas de Lange, who leads the study Mapping the Jewish Communities of the Byzantine Empire in the Faculty of Divinity, are turning to GIS as a means of managing and interrogating complex collections of data that relate to a defined location, and disseminating the information via the internet.

Maps have always been a linchpin of historical study but, as de Lange explained, GIS and the advent of web maps are providing new scope for visualising trends in historical data: "What's exciting about GIS is it allows us to move into a different dimension. Conventional maps are two dimensional – they show the situation in a geographical area at a given point in time. We are adding a third dimension that frees maps from being static snapshots – it can be viewed backwards and forwards in time, instantly revealing changes."

“What’s exciting about GIS is it allows us to move into a different dimension that frees maps from being static snapshots”

"The interactive nature of GIS is ideal for allowing researchers to investigate varied types of information quickly," added Dr Gethin Rees, who built the GIS-enabled database in collaboration with colleagues at the University of Umeå in Sweden. "Users can assess the relevance of particular places to particular Jewish individuals or communities, and compare the data over whatever time period best suits them." The resulting website was launched in March 2013 and is freely available to specialists and nonspecialists alike.

"We are trying to tell an historical story through the medium of a searchable map," said de Lange. "In a history book, the author will inevitably have made judgements about the data they decide to show on a map, and this information can become outdated. GIS circumvents this – our database aims to have all of the data that are currently available, and that becomes available in the future. Inclusivity is important because the relatively unexplored nature of the subject means that it's impossible to predict all the uses to which historians and other researchers will put the data."

To this end, research associate Dr Alexander Panayotov, with the assistance of three researchers based in Italy, Greece and Turkey, has been painstakingly assembling data that can be dated and located relating to the presence of Jewish communities in the Empire from 650 until the end of the 15th century.

One of the richest sources of information is the writings of the Jewish traveller Benjamin of Tudela, who passed through Byzantium on his way to the Holy Land in the mid-12th century. His travelogue describes the location of Jewish communities, the number of Jews or Jewish households in each place, their communal leaders, social status, religious schools and sects.

Other sources of knowledge about Byzantine Jewish life include Hebrew inscriptions on tombstones that help to place individuals in specific locations at specific times; deeds, personal correspondence and legal documents, such as the marriage settlement and dowry in 1022 between Namer son of Elkanah and Eudokia daughter of Caleb, which provide social and economic history; and Hebrew manuscripts that contain the date and place of their writing. All the information these provide is being added to the growing database.

To date, around 1,000 separate sources have been analysed, describing over 1,000 individuals living at 150 locations and participating in 100 different occupations.

One of the greatest challenges the researchers have faced is the fact that GIS was designed for use with empirical data – facts and figures that are assured. "When you consider the age-related damage and fragility of many of the medieval sources, precision and reliability are sometimes compromised," explained Rees. "Given the scarcity of information, even such problematic data cannot be overlooked in a project of this type. Luckily GIS is capable of handling 'imperfect data' much better than conventional maps and it's possible to

provide a digital indication of the uncertainty surrounding an event. That way, the user can judge whether to accept the evidence or not."

The Byzantine Empire is held by scholars to be an important historical link between the ancient empires of Greece and Rome – with their rich cultural and intellectual traditions – and the modern world. Some have suggested that, without this link, the nature of European civilisation would have been very different.

"The Jewish population was a very interesting minority group in this time period," explained de Lange, whose research was funded by the European Research Council. "We have learned through this project that Jews were engaged not only in a wide range of trades, but also in farming, and even owned property and lands, unlike Jews in much of Latin Europe."

Thanks to the new digital resource, fresh insights can be gained into the involvement of Jews in trade, the effect of political change on their lives, the movement of Jewish communities around the Mediterranean and the factors that influenced the development of Jewish residential quarters in cities.

"Past scholarship tells us that historians have not been able to see some of these relationships clearly," Rees added. "For instance, the importance of silk has been over-emphasised, probably based on Benjamin of Tudela's interest in writing about this occupation. We now know that silk production makes up only a tiny fraction of the overall references to Jewish occupations."

Acknowledging that the use of GIS for historical research is still in comparative infancy, the researchers are aware that it's not easy to predict how the technology will develop. But by taking steps to ensure that their data are available in formats that allow others to link to the dataset and re-use it in the future, their hope is that it will interlock with other digital projects, to provide a seamless historical resource that criss-crosses time and place.



I **Left to right**
Dr Alexander Panayotov
 aap41@cam.ac.uk
Professor Nicholas de Lange
 nrml1@cam.ac.uk
Dr Gethin Rees
 gpr26@cam.ac.uk
 Faculty of Divinity

www.byzantinejewry.net

Digital editing, unconstrained by the spatial limitations of the printed page, is about giving readers access to the material in all its multiplicity. It offers the prospect of ‘un-editing’



Film available online
Featuring the Online Chopin
Variorum Edition

Emerging new digital editions at Cambridge are effecting a sea-change in the nature of the scholarly edition, radicalising access to vital source materials and opening up new possibilities for research.

Much work in the humanities could not be done without scholarly editions, and producing such editions consumes vast amounts of time and energy. Apocryphal stories abound about academics whose editorial labours have consumed their careers.

“Scholarly editing has traditionally been about coming up with a stable, pristine text,” explained Dr Jason Scott-Warren, Director of the Cambridge Centre for Material Texts in the Faculty of English. “The greater the cultural significance of a work, the more important it becomes to identify distortions and to correct those distortions, so as to produce a single, perfected version for modern readers.”

Where conventional editing seeks to reconcile conflicting versions for the reader, digital editing, unconstrained by the spatial limitations of the printed page, is about “giving readers access to the material in all its multiplicity,” he continued. “It offers the prospect of ‘un-editing’.”

New digital projects at Cambridge are making what Scott-Warren refers to as the true “mess of history” available in ways hitherto impossible, and are creating opportunities to explore the past lives of texts in ways previously unimaginable.

The medieval and early modern ‘commonplace book’ exemplifies the multiplicity of the raw materials that inform our literary histories. These domestic journals – scrapbooks, essentially, dating from the 15th to the 18th centuries – form the basis of Scriptorium, a digital archive produced by the Faculty of English with funding from the Arts and Humanities Research Council. These volumes bring together disparate texts, such as household accounts, sonnets, prayers and jokes, in unexpected and illuminating ways. “In this rich mulch of materials,” said Scott-Warren, “we might find the scaffold speeches of convicted traitors juxtaposed with contemporary political satires, or medical instructions mingled with proverbs and drinking songs. We begin to understand some of the interactions between genres, and to sense the import of a text in its moment.”



It is the connections across the texts as much as the messages they individually convey that enable Scriptorium’s users to shine a light onto the past. The same principles of deep and lateral connectivity characterise the array of digital editions emerging at Cambridge today, materials ranging from cardinal religious texts to foundational scientific treatises; from the music of Fryderyk Chopin to the plays of Arthur Schnitzler. These new editions feature analytical tools as well as annotations and contextual information that enable users to draw connections between – and so forge new paths of enquiry through – disparate parts of our cultural heritage.

The Cambridge Digital Library, a powerful platform being developed by Cambridge University Library (with funding from the Polonsky Foundation), is further enriching its digital editions by re-presenting their content in innovative ways that transcend boundaries between archive and edition, between traditional roles (librarian, editor, publisher, reader) and between institutions.

A new digital edition of the Board of Longitude archive, for instance, charting the development of science and technology in the 18th century, will incorporate objects – telescopes, clocks, chronometers – from the National Maritime Museum along with abstracts, biographies and essays from experts in the Department of History and Philosophy of Science.

The University Library is amalgamating its online Newton Papers with the fruits of the University of Sussex’s Newton edition and is beginning to link its own Darwin Correspondence edition with the digital archive. It is also employing text-mining techniques to enrich the descriptions of its Genizah collection of 190,000 medieval manuscript fragments documenting the lives of Mediterranean Jews, Arabs and Christians. This will enable the mapping of new relationships between the documents.

“Our next step,” said Digital Library Manager Grant Young, “is to empower readers themselves to annotate, tag,

The un-Limited Edition

Images

Left: Isaac Newton's revisions to his first edition of *Philosophiæ naturalis principia mathematica*; right: Fryderyk Chopin's manuscripts of the Nocturne Op. 62 No. 1 and Ballade Op. 38 showing his amendments

converse with and challenge each other – and us. It's about leveraging information that will augment the content and establish new connections, building in feedback mechanisms, interactivity and a recommendation facility."

Where the edition has traditionally been regarded as tantamount to a bible, now the reader can access materials that show that the Bible is, in fact, an edition. Young's team, in collaboration with the University of Birmingham, has recently released the first major edition in over 100 years of the 5th-century *Codez Bezae Cantabrigiensis*, one of the handful of manuscripts used to establish the text of the New Testament.

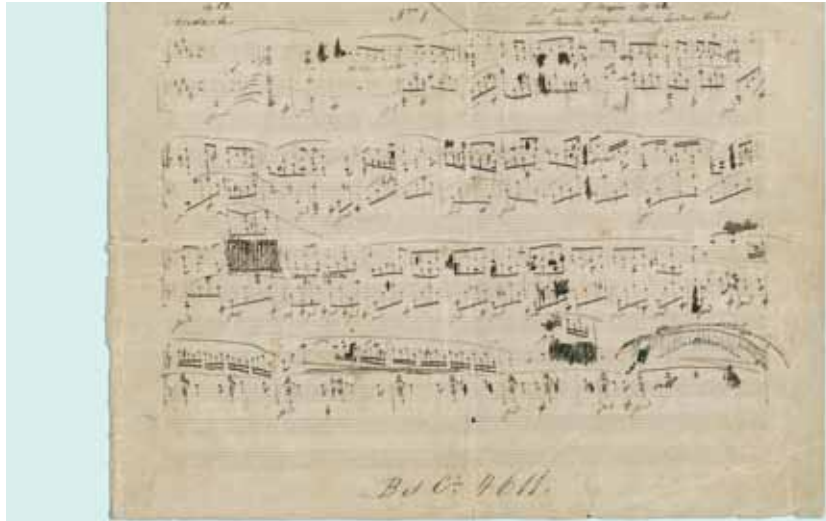
This plurality and the potential eclecticism that results – with fully personalised editions standing at one extreme – can be unsettling. "Perhaps print provides the stability that is necessary for intellectual life to proceed, so that we will need to work out compromises between print and digital media," suggested Scott-Warren. Through a Digital Humanities Network launched in 2011 by the University, academics, librarians and technicians are looking critically at digital editions in production, and exploring their implications for editorial theory.

The potential empowerment, however, in accessing what Scott-Warren described as "the instability that lies beneath the surface of the text" is clearly apparent in a project devoted to the flux at the heart of the creative process: the Online Chopin Variorum Edition (OCVE), funded by the Andrew W. Mellon Foundation.

Chopin's music is subject to the variations that occur when transmitting any text in musical notation or performances, but further variants arise from his own, perpetual revisions of his works. Not only is it impossible to determine a neat chronology across his versions: it is not valid to assume that Chopin was refining his work towards a point of perfection. Each version may be understood as definitive in its moment.

The OCVE enables users to compare and annotate passages across sources ranging from Chopin's manuscripts to revised impressions of the first editions. We can trace, for example, where an altered chord inflects the music with new meaning; or how the absence of a pedal release sign at the end of a piece, interpreted by many modern editors as an omission, can in fact be an instruction to keep the pedal down after the final cadence and allow the music to fade into silence, beyond the limits of the double bar-line.

While this project makes conventional editing far more straightforward, "the really exciting thing about the digital future," said Professor John Rink, Director of the OCVE, "is the creation of a new understanding of what an edition is, and what it can do. For a user of the OCVE to trace the creative evolution of an idea across sources results in an understanding that potentially is an edition, in and of itself."



Credit: The Newberry Library



Credit: Bibliothèque Nationale de France

Moreover, the form of an edition in the digital environment is fluid. Chopin's variants emerge from his experience of performing his music. The integration into these digital editions of material arising in performances, and of actual recordings of performances, is now being explored at Cambridge, along with the use of tools such as time-based mapping and visualisation.

"The edition itself will become a living entity," said Young – reflecting what Rink described as "the notion of contingency and re-creation at the heart of any work."

"What we're really talking about here," Rink continued, "is a parallel between the way the mind seeks and forms connections between ideas – some straightforward, some subtle – and the way the internet works by facilitating connections. In these emerging new editions a perpetual, kaleidoscopic process is enacted and opened out by virtue of new technologies. This is about nothing less than releasing and then harnessing the human imagination in ways that exploit its infinite creative potential."



I **Left to right**
Professor John Rink
 jsr50@cam.ac.uk
 Faculty of Music
Dr Jason Scott-Warren
 jes1003@cam.ac.uk
 Faculty of English
Grant Young
 gy219@cam.ac.uk
 Cambridge University Library



Images

Screenshots from the film *Villain* (1971) with Richard Burton, directed by Michael Tuchner



Cinematic geographies of Battersea

Research is combining film ‘archaeology’ with digital technology to create a new approach to ‘sites of memory’ for the London borough of Battersea.

In a disused railway arch, Richard Burton guns down the man who framed him before charging across overgrown scrubland with the law in pursuit.

Dereliction surrounds on all sides as the corrupt life of his character – gangster Vic Dakin – unravels. Residents peer over the balconies of grimy tower blocks to watch Dakin get cornered by police.

In 1971, the makers of *Villain* needed a suitably gritty location to shoot the dénouement of this now little remembered British thriller, so, as for a number of similar films of the era, they chose the urban decay of the borough of Battersea – which 50 years previously had been a thriving centre of industry.

Now, 40 years on from Burton’s foray into the crime genre, this very spot is about to become the site of one of the largest regeneration projects in London’s history, called Nine Elms, including an extension of the Northern Line on the London Underground.

Battersea is the subject of a new Arts and Humanities Research Council-funded research project from Cambridge’s Department of Architecture, looking at how film – fiction, documentary and amateur footage – has, often inadvertently, captured the changing fortunes of this part of south London.

Sifting through hundreds of hours of footage, the project team aims to create a cinematic ‘archaeology’ of Battersea, by building layers of scenes and clips from films that depict precise areas of the borough at different points of the 20th century.

Researchers are investigating a hugely diverse range of film, from Ealing Comedies to social realist drama, Pathé news, amateur super 8, right up to modern YouTube clips.

“The plan is to map for the first time a large number of movies onto a map of a city to chart its evolution in terms of the fabric, but also social change,” said Professor François Penz, who is leading the Cinematic Geographies of Battersea project with colleagues from the Universities of Liverpool and Edinburgh as well as English Heritage.

The project came about through discussions between Penz, Professor Richard Koeck from the University of Liverpool and his former Cambridge colleague Professor

Andrew Saint, who now heads up English Heritage’s Survey of London.

The Survey was created in 1894, a year before the advent of cinema, with a mission to record every parish in London – one it still pursues today, with each parish taking between three and four years to survey.

“I kept in touch with Andrew and, together with his team, we often talked about how film depicted sweeping changes in London, so we put together this pilot project,” said Penz.

“At the time, he was working on Battersea, so we decided to start there, which has been great as it’s a movie-rich area, as well as one that has been through – and about to go through – huge changes.”

Penz notes that Battersea is a space where “a lot of the cinematic crime in British films was committed,” and that south London in general is prone to dystopian depictions.

Key films, such as Ken Loach’s sixties ‘kitchen sink’ drama *Poor Cow*, also reveal battles between classes, and contain moments of high architectural significance.

“In addition to ‘longitudinal’ century-wide study, we also engage in detailed ‘cross-sectional’ study – taking a few films and studying them scene by scene, even frame by frame.”



Images

Screenshots from the film *Poor Cow* (1967) with Carol White, directed by Ken Loach

Penz highlights a single cut in *Poor Cow* that takes the main character from Victorian terrace to 'brutalist' concrete: "Suddenly she's in the Winstanley Estate – an icon of modernism – then shiny and new, now sadly run down and high in crime."

"Many of the Victorian backstreets seen in such films were cleared to make way for estates, and now only exist in films."

A key touchstone for the philosophy underpinning this research is the idea of the 'soft city', as set out by the writer Jonathan Raban in his 1974 book of the same name.

Raban describes "the city as we imagine it... soft city of illusion, myth, aspiration, and nightmare" to be "as real, maybe more real, than the hard city one can locate on maps."

For Penz, this is the essence of the Battersea project: "People experience space physically and emotionally, their perceptions influenced by representations in the culture they are exposed to."

"The 'soft city' of illusion is found in cinema. We aim to uncover this side of Battersea to complement the Survey of London's 'hard' documentation of streets, churches and so on – together providing a more holistic vision of what an area is and has been."

One of the main goals of the project is to use the layers of film history to provide a living 'lieu de mémoire' – or site of memory – that the community can both share in and contribute to.

To do this, the team are using digital techniques to 'triangulate' the locations these cinematic fragments were filmed in, then pin the historical layers of film to the site on modern digital maps using geo-tagging, technology familiar to most users of Google Maps.

All this information is being built into a smartphone app, along with the Survey of London records, so that the public can experience both the 'soft' and 'hard' sides of their neighbourhood 'in situ' and eventually even add footage themselves.

The team plans to launch the app later in the year, combining it with screenings of some of the films – in surprisingly relevant locations.

"We want to resurrect the ghost cinemas of Battersea," said Penz. "Can you believe that Battersea doesn't have any cinemas anymore! At one time, there were around 25 – as described in the Survey of London – often 'shopfront' cinemas, with back rooms holding maybe 40 seats."

"For example, one is now a bank, and its current manager remembers going to see movies there as a child. We hope to project films with key local scenes that were shown in some of these old cinemas."



Penz aims to combine the film clips in the app with details of former cinemas and even, when possible, the programmes of the day:

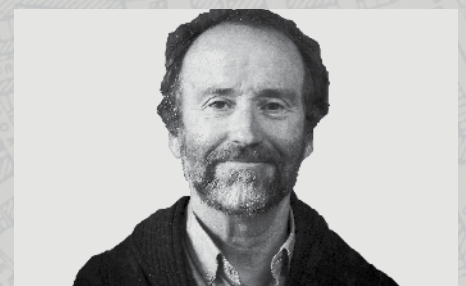
"The app could tell you that the scene of a certain film was shot where you stand, show you the clip, then tell you it was shown at this ghost cinema that stood a mile, say, in that direction, on this date and what else was on there at the time."

The team is working closely with the British Film Institute and other local organisations. Penz is confident that the level of detail of the research will "unlock moments in history, and help to crystallise common local memories that can connect communities."

While the Battersea project is a pilot, Penz can see the methodology being replicated, and is considering extending to further afield, and not just north of the Thames.

"We've created a research platform with Nanjing University in China. We want to look at how this translates to other cultures. How can this be applied in a Chinese context where differences in spatial understanding and variations in screen language may result in a double translation effect? The effects of globalisation on how 'sites of memory' form in localities is, I think, a fascinating possible direction for this research."

"We want to resurrect the ghost cinemas of Battersea"



I Professor François Penz
fp12@cam.ac.uk
Department of Architecture

www.cinematicbattersea.blogspot.co.uk



A newly launched digital resource provides the first ever oral history database of 20th-century Mongolia, as told by the Mongolians themselves.

History is more than the study of a past littered with significant dates and events, and peopled by prominent figures. It is also embodied in the experiences and memories of ordinary citizens living everyday lives, yet these types of observations are rarely documented.

Oral histories can help to fill this gap. Collections with recordings of people talking about their lives – how they have understood, reacted to and even ignored events – can add historical substance in a way that is impossible to impart through a few lines in a history book, especially where great changes have happened within living memory.

In Mongolia, for instance, the 20th century was one of turbulent upheaval, as the country moved from being a part of the Qing Empire, to an aristocratic Buddhist government, to Soviet-style

socialism and, finally, to democracy. How did people respond to these changes? What significance did these nation-wide transitions have in their own lives?

Questions such as these lie at the heart of a recently completed five-year research project at the Mongolia and Inner Asia Studies Unit to record individual conversations with hundreds of Mongolians as they look back over their past. The Oral History of Twentieth Century Mongolia project, which was funded by the Arts and Humanities Research Council, will provide a new way of interpreting a tumultuous century rooted in the real-life experiences of ordinary people.

Some of the contributors recount their personal experiences of the brutal Stalinist repressions of the 1920s and 1930s, during which at least 35,000 people (about 4% of Mongolia's population at the time) are believed to have been killed. Others speak of the effects of collectivised farming, life in Mongolia during World War II, and the impact of post-Soviet privatisation reforms.

Mongolia by mouth



Credit: All images, Oral History of Twentieth Century Mongolia project



Images

Images supplied by Mongolian interviewees as examples of important moments in their family's personal history

For Dr Chris Kaplonski, the project's manager, an early indication of the potential richness of the content came when he encountered the reflections of people remembering the democratic revolution in Mongolia in 1990: "I was struck by how some people viewed the protests and demonstrations as 'just something to do'. This is the sort of observation that very rarely, if ever, is recorded for posterity.

"Yet such a comment fundamentally changes the way we understand things. If the people I talked to are correct, and many people went to the demonstrations because it was something to do, not because they had a deep-rooted belief in democracy or foresaw what would happen, this fundamentally changes how we understand what happened. It doesn't change what the organisers thought they were doing, or how the government reacted, but it sheds new light on how other people saw the event. It fills in those blank spots, to expand a sentence or two of understanding, until it fills many pages."

**"Oral history...
lets us into knowing
things about people
that are too often
overlooked"**

Vitality for a project of this scope, it was important not only to collect in-depth oral accounts from Mongolians of all ages, and from different regions of the country and walks of life – from herders to prominent politicians – but also to create a digital resource that would allow the interviews to be readily searched.

Dr David Sneath, who leads the project, explained: "Five years ago, digital technology had moved to a point where we could combine two different sources of methodology in anthropology – the small-scale, time-intensive fieldwork that involves open-ended, richly in-depth interviews, and the broad sweep of surveying a very large number of people. By amassing transcripts of all of the interviews into a searchable database we could create a publicly accessible, dual-language resource that would allow easy comparisons across large datasets."

As technology has moved on since the beginning of the project, so too has the opportunity for widening the potential of the database. Kaplonski has already begun the task of extending its capabilities into supporting audio, video and documentary

assets. Alongside the searchable interview transcripts, users can view images of archival family photographs, personal records and paintings. Videos illustrate life in Mongolia and revisit the areas where some interviewees lived and worked.

One of the objectives was to allow as much of the narrative as possible to be informed by the Mongolian subjects themselves. Using a field research team made up of Mongolian researchers, several of whom were from the National University of Mongolia, the data collection process was able to incorporate Mongolian sensitivities and interests. "We felt that it was vital to design and offer a resource that would be of wide interest to Mongolian citizens, rather than a narrowly focused database driven purely by Western agendas," explained Sneath.

"From a social anthropologist's point of view, an important aspect of the interview process is the context of the interview, because this can help condition the outcome," he added. "So we also collected an unprecedented amount of data about what was happening at the time of the interview: who was the interviewer? Were family members of the interviewee present? Were they eating or drinking?"

Over 600 interviews have now been gathered, transcribed, translated and tagged, and are available on the newly launched online resource. The interviews can be searched as free text, through keywords and thematically – from family to funerals, privatisation to politics.

The project contributes not only to the academic understandings of history, memory and state transformations but, as importantly, also to the preservation of Mongolian history and cultural heritage, an area that Sneath says "has been downplayed, ignored or bent to overly political ends during most of the 20th century."

Now comes the task of discovering what the combined oral histories of 20th-century Mongolia can tell us. Sneath, Kaplonski and colleagues anticipate that the memories will reveal fascinating insights into events such as the impact of collectivisation in the 1950s – when the socialist regime consolidated land and labour into collective farms – and the disbanding of the collectives through privatisation in the 1990s.

Certainly, Perenlii, an 81-year-old retired shepherd, remembers how her parents were some of the first locally to join the collective. When she joined the collective farm herself, she struggled to fulfil her milk quota while looking after 500 sheep and mothering many children. What she remembers from that time is that she was always tired.

On the other hand, 61-year-old Pürevdorj has fond memories of socialism – a time, he felt, when people were hardworking, ethical and responsible, when the state paid attention to the family and supported population growth. He expressed his unhappiness with democracy, feeling that the reversal in the state's policy had negatively influenced the country's development.



"Reminiscences like these are why we think oral history is important. It lets us into knowing things about people and their lives that are too often overlooked or ignored," said Kaplonski. "We want to understand people and their world – their culture, society, religion, work, and so on – as real people, not just nameless ranks marching through events set in motion by a few people. To point out the obvious, this can only be done by actually talking to people."

"What we have here is the real history," added Sneath. "Because of the digital infrastructure, we can extract social, economic and political histories from this in a matter of minutes, yet the basis is simply people describing their own experiences, in their own pasts."



I Left to right
Dr David Sneath
ds114@cam.ac.uk
Dr Chris Kaplonski
ck227@cam.ac.uk
Mongolia and Inner Asia Studies Unit

amantuuh.socanth.cam.ac.uk

Welsh Twitter: *capturing language change in real time*

A database of Welsh tweets is being used to identify the characteristics of an evolving language.

Twitter keeps millions of people in touch, whether it's sharing their politics with followers or updating their mates with the trivia of everyday life. These tweets are in Welsh: 'loaaaads o gwaith i neud a di'r laptop 'cau gwithio!', 'dio cau dod on!! Mar bwtwm di tori.' Roughly translated, they read: 'loads of work to do and the laptop won't work' and 'it won't come on!! The button's broke.'

How do you capture changes as they take place in the language we use in everyday life – from buzz words such as 'sweet' to tags such as 'innit'? One answer is to look at tweets. Because they don't follow the conventions of written language, tweets provide an authentic snapshot of the spoken language. By analysing the content of the 140-character messages, linguists can get to grips with the dynamics of the language played out in real time.

Welsh is spoken by 562,000 people in

Wales; 8% of the country's children learn it at home as their first language and 22% are educated in Welsh.

Like all living languages, Welsh is constantly changing and new varieties are emerging. When Dr David Willis from Cambridge's Department of Theoretical and Applied Linguistics set out to research the shifts taking place in Welsh, he used a database of Welsh tweets as a means of identifying aspects of the language that were changing, and then used that information to devise the questionnaires used for oral interviews.

He explained: "When your intention is to capture everyday usage, one of the greatest challenges is to develop questions that don't lead the respondent towards a particular answer but give you answers that provide the material you need."

"If I want to find out whether a particular construction is emerging, and where the people who use it come from, I would normally have to conduct a time-consuming pilot study, but with Twitter I can get a rough

and ready answer in 30 minutes as people tweet much as they speak," he said. "My focus is on the syntax of language – the structure or grammar of sentences – and my long-term aim is to produce a syntactic atlas of Welsh dialects that will add to our understanding of current usage of the language and the multi-stranded influences on it. To do this relies on gathering spoken material from different sectors of the Welsh-speaking population to make comparisons across time and space."

In the late 17th century, the antiquarian Edward Lhuys conducted an investigation into the dialects of Wales. By the 19th century, Welsh was attracting the attention of European historical linguists such as Johann Kaspar Zeuss. Later, scholars all over Europe, realising that local dialects were receding in the face of industrialisation, sought to record variations in language. Large dialect atlases were undertaken in Germany and France, and speech archives were begun, such as the one that laid the foundations for the National History Museum at St Fagan's near Cardiff.

In the 1960s the attention moved away from rural areas to the cities where most people by then lived – and researchers started to look at sentence structure, an area of language that presents particular challenges for investigators. Willis's interest in syntax stemmed from his study of a wide range of minority languages, including Breton, which is, like Welsh, a Celtic language. To create the biggest possible picture of syntactic changes in Welsh as it's spoken today, he decided to take an inclusive approach and set out to investigate day-to-day speech patterns of a broad range of speakers, aged 18–80.



562,000

562,000 people in Wales speak Welsh; "people tweet much as they speak"

British Academy funding for a year-long study has enabled Willis and assistant researchers to interview around 160 people across Wales, beginning his analysis with North Wales where the language is thriving and a significant number of children use Welsh as their home language. The study included both those who had acquired Welsh at home and at school.

The spoken questionnaire asked interviewees to repeat in their own words sentences that were presented to them in deliberately 'odd' Welsh that mixed different dialects, inviting the interviewee to rephrase the awkwardly phrased sentence to sound more 'natural'. An example in English might be 'we've not to be there yet, don't we?' which a British speaker might be expected to rephrase as 'we haven't got to be there yet, have we?'

The data from these interviews are a treasure trove of information in terms of the light their content can shine on how and why the structure of language shifts over time – and give the researcher a valuable database not just for the present study but also for future research.

*loaaaads o gwaith i neud
a di'r laptop 'cau gwithio!
dio cau dod on!!*

Changes identified so far include use of pronouns and multiple negatives. An analysis of usage of the Welsh words for 'anyone', 'someone' and 'no-one' reveals that there are differences between those who learnt Welsh in the home (who are more likely to say the equivalent of 'did someone come to the meeting?' and 'I didn't see no-one') and those who learnt it at school (who are more likely to say 'did anyone come to the meeting?' and 'I didn't see anyone').

One example of multiple negatives reveals a shift in meaning of the Welsh word for refuse, 'cau'. "We knew that people in the north used the word 'cau' to mean 'won't', saying the equivalent of 'the door refuses to open' for 'the door won't open'. Negative concord – such as saying 'I haven't not seen no-one' for 'I haven't seen anyone' – is a strong feature of Welsh. We've now identified two groups in the north: one that still says 'the door refuses to open' and the other that have begun to say 'the door doesn't refuse to open'. The next step is to work out when and how this change occurred."

In tracking shifts in the language, GIS mapping is used to plot where interviewees were brought up and enables researchers to look at the geographical spread of particular aspects of syntax, making comparisons between age groups, gender and mode of acquisition.

The research has revealed that, while Welsh does not vary much by social class, there are interesting differences between the variety of Welsh spoken by those who learn it as their first language in the home and that spoken by those who are first exposed to it in nursery or primary school.

"Those who acquire Welsh once they reach school are more likely to use English sentence constructions, which are perfectly good Welsh but differ significantly from the constructions used by those who acquired Welsh at home. For example, they tend to prefer standard focus particles – words that correspond to a strong stress in English sentences like 'I know YOU'll be on time' – over the ones from their local dialect," said Willis.

With around 22% of the Welsh population educated in Welsh at school, and all children learning it as a second language, data on this aspect of language acquisition may prove valuable in developing Welsh teaching policy – for example, in determining which forms to teach second-language learners or in promoting both dialect and standard written Welsh in schools.



I Dr David Willis
dwew2@cam.ac.uk
Department of Theoretical
and Applied Linguistics



8% learn it at home



22% are educated in Welsh



Credit: Jacqueline Garget

Inside out

Meeting Professor Didier Queloz

Searching for answers to some of the most enduring questions of all time, astronomer Didier Queloz talks about his fascination with nature and how he finds inspiration in the most unusual of places.

World-leading scientist Didier Queloz discovered the first exoplanet – a planet outside our solar system – in 1995 as a PhD student, together with his supervisor Michel Mayor at the University of Geneva. “There are so many stars out there, and almost all of them have planets for sure. Demonstrating that it was actually possible to find exoplanets was a tremendous breakthrough – we blew the field wide open.” The search for, and study of, exoplanets has since grown rapidly into a mainstream scientific endeavour.

Swiss-born Queloz has just moved from Geneva to Cambridge’s Cavendish Laboratory in the Department of Physics to establish a Centre for Exoplanetary Research, which will be based in the new Battcock Centre for Experimental Astrophysics on its completion. Queloz will enable Cambridge to develop a

new strand of research in one of the most exciting areas of modern astronomy, drawing on existing expertise across instrument development, star and planet formation, atmospheric chemistry, planetary geophysics and climatology. Exoplanetary research holds the exciting possibility of discovering Earth-like planets able to support life, and of finally answering the age-old question, ‘are we alone?’

Q What’s the point of your research?

A I’m addressing our need to know how come we’re here on this planet, are there any other planets with life out there, is life rare or common – the same questions the ancient Greeks asked. It’s a very big agenda and I may not find any answers during my lifetime, but I will at least be part of the process. In 1995 we made the idea of searching for other planets and life outside the solar system a reality, and now there are teams all over the world doing it. We’re finally addressing these big questions in a systematic way.

Q Where do you have your best ideas?

A When I first wake up, in the shower, or when I’m gardening. I never have my best ideas at work because I’m not free enough to let my mind float around.

Q Have you ever had a Eureka moment?

A I have plenty of them! I think one of the definitions of being a physicist is to solve the problems that nature has given us. I get immense pleasure from solving problems, even very simple ones.

Q What might other people be surprised to learn about you?

A I am a very eclectic person, I like many different things. Sometimes I might spend a couple of days reading books about history and not doing science at all. I think it’s always good to read books outside your field – they can reveal how to solve problems and they provide stimulation for my work.

Q If you could wake up tomorrow with a new skill, what would it be?

A I would be gifted for learning languages – I am so bad at it [he says in perfect English]. I tried to learn Spanish and it's so difficult. Language gives you access to people, and to build good science you have to build good connections. The enjoyment of science is also about the pleasure of working with your colleagues.

Q How would you describe your childhood self?

A I was interested in everything. I was already into science but I didn't realise it – I loved mechanics, electronics, nature, and had a fascination for the night sky. I used to go to the Greek Islands to visit my grandfather – there was no electricity, and as a child it was fantastic. As soon as the sun set there was this beautiful night sky, and I would sleep outside and watch for shooting stars.

Q What's your favourite research tool?

A My brain. I can use it to figure out how to build other tools.

Q Who or what inspires you?

A Interactions with other people – I don't get inspired alone in my office.

Q What skills do you draw on to carry out your research?

A Maths and logic are the basic skills, and then you have to be creative. It's fine to do what everyone else is doing, but it can be even more fun if you do something a little bit different and think ahead of the others. I am aware I've been more successful than average, maybe for a series of reasons, but luck is certainly one of them.

Q How do you relax?

A When I feel completely stressed, I just decide to have a day doing nothing. Breakfast for two hours while talking with my wife, light the fire, read a nice book, and have a good sleep.

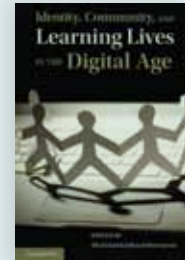
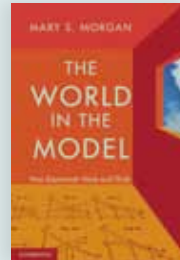
Q How would you like to be remembered?

A As a nice guy! I'm not doing science to be remembered, but because I think it's very important for society, and a lot of fun. I feel privileged to bring my stones to a big pyramid of knowledge. We inherit from what people have done in the past, and there will be other people after us who will benefit from the work we've been doing.

I Professor Didier Queloz
dq212@cam.ac.uk
Cavendish Laboratory,
Department of Physics



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Contact

Research Horizons
Office of External Affairs and Communications
The Pitt Building, Trumpington Street
Cambridge, CB2 1RP

Cover

Protesters try to march on the Interior Ministry's compound in Lazoughli Square, Cairo, during Egypt's revolution in 2011. Researchers are using social media to study grass roots opposition movements in Egypt. Find out more on p. 20.

