Subtext 12

Summer 2010

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Nature plus nurture

It's complicated
On living and working with complexity

Frame and fortune
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University of BRISTOL

Subtext 12

Welcome

In mid-May, just as spring was getting into its stride, the news came that Richard Gregory, CBE, DSc, FRSE, FRS and Emeritus Professor of Neuropsychology here at Bristol, had died at the age of 86. A scientist and, just as importantly, a communicator, he revelled in combining enjoyment with enlightenment; this city's hands-on science centre, At-Bristol, owes its existence to Professor Gregory's imagination and tenacity.

Not all academics can be like the late Professor Gregory. Any institution hoping to thrive needs diversity of character: the mild-mannered as well as the slightly fierce, the cranky along with the unfailingly amenable, the solemn just as much as the jocular. The format of *Subtext* leaves a bit of room for character to emerge in our profiles: this issue features a driven social economist (p4), an anthropologist with a more than usually fluid sense of self (p7) and a biologist whose stubborn pursuit of her hunches took her to the forefront of a new field of science (p10).

We've been fortunate, as editors, to have encountered people whose personalities animate their work and give *Subtext* an extra dimension. We hope you enjoy the results in the pages that follow.

Nick Riddle
n.riddle@bristol.ac.uk

PS. You can read a heartfelt appreciation of Professor Gregory's achievements by his friend and colleague (and past Subtext *participant), Professor Tom Troscianko, at www.bristol.ac.uk/news/2010/7023.html.*

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DAVE PRATT

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Subtext No 12, June 2010

JEFFREY HENDERSON

Jeffrey Henderson, Leverhulme Research Professor in the Centre for East Asian Studies, has pursued his passion for ideas across several continents. He talks to Nick Riddle.

My ancestors were coal-miners in County Durham and Yorkshire. I was brought up in County Durham until I was about nine years old, then near Doncaster in what was then the West Riding of Yorkshire.

We weren't a typical coal-mining family. My mother had won a grammar school scholarship in the 1920s, but her father pulled her out at 14 because she had to contribute to the household income. I think it left her with a sense of the strong relationship between education and social mobility. My father worked every hour he could, then he'd come home knackered and fall asleep in front of the TV. He didn't drink or smoke, but he died of a heart attack when I was 21. I had almost no emotional reaction as I barely knew who he was; we'd hardly ever had a conversation.

After I started at a state grammar school, I lost my primary school friends, because they mostly went on to secondary modern schools. My elder brother had left home, so I was rather isolated. I suppose I compensated by spending lots of time in the library, getting involved in the world of ideas.

I was brought up in the Church of England – I was first boy soprano in my church choir. But as a teenager I started seriously questioning religion. My economics teacher introduced us to the work of the neo-Hegelian philosopher, Ludwig Feuerbach, who critiqued the idea of a supernatural creator. I understood enough to realise that this was a devastatingly logical demolition of the possibility of God. For me, it was the intellectual *coup de grâce*: I've been an atheist ever since. My mother was concerned about this, but there were lots of things we didn't talk about, and religion was one of them.

I had no idea how to tell one university from another – I just wanted to move far away from my parents. Several friends had chosen Birmingham University, so I did too. I took a general social science programme and planned to concentrate on economics, but the introductory economics course included very little on how actual economies worked. But part of the introductory sociology course was taught by an amazing guy who had fled Hitler's Germany, and he told us much more about how *actual* economies worked than the economics lecturers. So I realised that if I wanted to understand economies, I needed to study sociology.

During my first year at university, I realised that there was a job, other than school-teaching, where you could read books, talk about them and get paid for it. That was for me! I did a Master's and immediately after that I was a beneficiary of one of the unwritten laws of British academe at that time: if you hung around long enough, they'd give you a job.

At Birmingham I started hanging out with exchange students from the University of California (UC). To me, California seemed like the centre of the world. I got very interested in living there. So I got admitted to the sociology graduate programme at UC Santa Barbara (UCSB).

I thought California was bizarre. UCSB is stunning: it's on a narrow coastal plain between the mountains and the Pacific. You hop over the campus fence and you're on the beach. A lot of undergraduates were surfers who came because the waves were good in winter. They'd wander into class with their surfboards, and often their dogs. I was a teaching assistant for a social psychology class – a spaced-out audience of 400 students, many just in from the beach, with surfboards propped against the wall and dogs running around. It was a madhouse.

I never got into surfing. If you're serious about intellectual work, you can't hang out in the sun all day – it fries your brains. I liked partying, but I was pretty serious. One summer a bunch of us decided to study Hegel's *Phenomenology of Mind*, so we reordered our lives around it. We'd catch the rays and party now and then, but several evenings a week we'd repair to a 24-hour restaurant to work on Hegel – sometimes right through the night.

Disillusioned with Californian sociology and US politics, I returned to London. I kept life together by teaching A-level sociology at Catford Tech, but studied informally with Eric Hobsbawm. Being a brash young man, I'd sent him one of my papers. Spending time with him was an astonishing experience – he's probably the world's greatest living historian. Eric put me in touch with Ralph Miliband (David and Ed's dad), whom I studied with at Leeds.

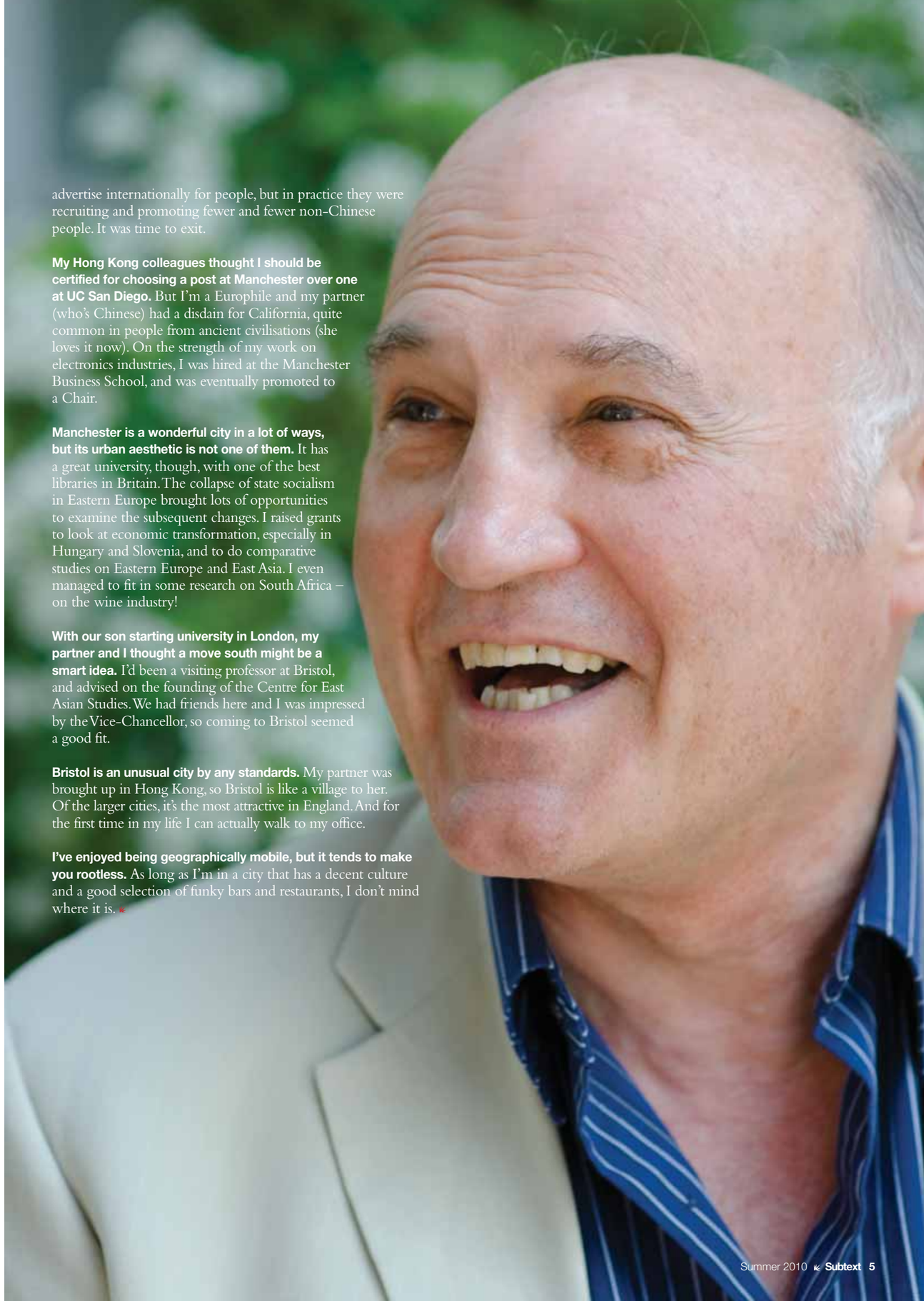
Some of the turning points in my life have been when I've tried for something and failed. By the early 1980s, I was on a fixed-term contract at Birmingham and university budgets were being slashed. I interviewed for the few academic jobs on offer, but got nowhere. Wanting to communicate with more than just students and academics, I made a serious attempt to get into broadcast journalism. I applied for training programmes with Granada TV and the BBC, but I didn't get through the interview process. Then I got a job offer from the University of Hong Kong.

Hong Kong had the highest average academic salaries in the world – they made me an offer I couldn't refuse. We had undemanding students and subsidised, palatial apartments. Employment terms were geared to those of the Colonial Civil Service: you did a 'tour of duty' for two-and-a-half years, then got six months' paid leave. In the old days you had to come back to Britain, because the authorities were concerned that if you stayed too long, you'd either go crazy from the heat or 'go native'. By the time I got there, you could take leave anywhere, with full airfares paid. You could sit on a beach in Hawaii for six months if you wanted to. It was easy to get waylaid by the lifestyle, and many colleagues did.

Hong Kong was another strange environment – very materialistic, with massive inequality. There were around 6.5 million people, in extremely high densities. There were too many people for the pavements, so you had to jump in and out of the traffic. It's now horribly polluted by car exhausts which combine with 95% humidity for half the year. But working there was an enormous help to my career: I met Manuel Castells and other extraordinary people who were hugely important to the development of my ideas and my life. The university had lots of funds, so I was able to do research on the electronics industry in East Asia, California and Scotland.

By the end of the 1980s, Hong Kong was beginning to feel like exile. The Cantonese – the predominant population in Hong Kong – have a reputation, even in China, for not being overly friendly to outsiders. It took me several years of hard work before I could relate to a few of them as friends. Doing so was very important, though, not least because many of the expats (with the exception of most academics and some journalists) were pretty obnoxious characters.

Eventually I saw the writing on the wall. After Mrs Thatcher had done the deal with Deng Xiaoping to transfer the territory back to China, the Hong Kong government had quite logically introduced an affirmative-action policy in recruitment and promotion. The university continued to advertise internationally for people, but in practice they were recruiting and promoting fewer and fewer non-Chinese people. It was time to exit.



JASON INGRAM

My Hong Kong colleagues thought I should be certified for choosing a post at Manchester over one at UC San Diego. But I'm a Europhile and my partner (who's Chinese) had a disdain for California, quite common in people from ancient civilisations (she loves it now). On the strength of my work on electronics industries, I was hired at the Manchester Business School, and was eventually promoted to a Chair.

Manchester is a wonderful city in a lot of ways, but its urban aesthetic is not one of them. It has a great university, though, with one of the best libraries in Britain. The collapse of state socialism in Eastern Europe brought lots of opportunities to examine the subsequent changes. I raised grants to look at economic transformation, especially in Hungary and Slovenia, and to do comparative studies on Eastern Europe and East Asia. I even managed to fit in some research on South Africa – on the wine industry!

With our son starting university in London, my partner and I thought a move south might be a smart idea. I'd been a visiting professor at Bristol, and advised on the founding of the Centre for East Asian Studies. We had friends here and I was impressed by the Vice-Chancellor, so coming to Bristol seemed a good fit.

Bristol is an unusual city by any standards. My partner was brought up in Hong Kong, so Bristol is like a village to her. Of the larger cities, it's the most attractive in England. And for the first time in my life I can actually walk to my office.

I've enjoyed being geographically mobile, but it tends to make you rootless. As long as I'm in a city that has a decent culture and a good selection of funky bars and restaurants, I don't mind where it is.

Bristol in pieces

NICK RIDDLE

TWENTY QUESTIONS

The Reverend Ed Davis is Anglican and Co-ordinating Chaplain at the University of Bristol Multifaith Chaplaincy.

What's your favourite meal? Since living in Spain, I've found it hard to resist anything with chorizo in it.

Cat or dog? Or neither? Definitely cats – and for the last couple of years, the Chaplaincy Centre has had a much-loved visiting feline, Tilly.

What do you sing in the shower? Probably something by Belle & Sebastian, but I'm terrible at remembering lyrics so it would be more likely to be humming.

Favourite smell? Lapsang souchong.

Your greatest character flaw? My wife tells me it's the incessant tapping out of rhythms with my fingers on any available surface, as a substitute for my drum kit.

What other historical period would you like to have lived in? I realise that from a Christian chaplain this may sound a bit textbook, but it would have to be 1st-century Palestine.

What keeps you awake at night? My kids (aged five and two), or a good episode of *Spooks*.

Native Americans believe we all have a Spirit Animal. What would yours be? An elephant – I've got a pretty good long-term memory, and I'm told that I resemble one coming down the stairs.

Favourite spot in the world? The Iguazu Falls, which I visited on a gap year in South America, while travelling by bus from Buenos Aires to Cochabamba.

What winds you up? As the philospher Daniel Dennett has said, 'There's nothing I like less than bad arguments for a view I hold dear'.

One book, one piece of music, one film. *Cloud Atlas* by David Mitchell, 'One of these things first' by Nick Drake, *Ferris Bueller's Day Off*.

What one possession would you save from a fire? The piano. My mother, who's a musician, learnt on it and played it for many years, and passed it on to us.

You can invite three people from any era to dinner. Who would you choose? Oscar Wilde, Elizabeth I, Rowan Williams.

Who would you like to banish to a desert island? Myself and my family – have you seen the price of a beach holiday during school holidays?

You can make one new law. What would it be? A ban on super-injunctions, as used in the recent Trafigura case.

If someone met you for the first time, what could they ask you to break the ice? How is this year's crop of purple sprouting broccoli coming on?

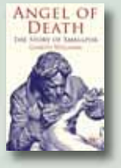
Your biggest life-changing experience (so far)? The week in April 2000 when I both started going out with my (now) wife, and discovered that I had been accepted for ordination training.

'My philosophy is this …' If everybody's thinking the same thing, then nobody's thinking.

How would you sum yourself up in one line? Open to suggestions.

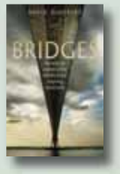
Is there a question you'd like to be asked? Anyone for tennis?

THE PLUG



Angel of Death: The Story of Smallpox **edited by Gareth Williams** (Palgrave Macmillan)

Smallpox is the only disease that mankind has successfully eradicated from the planet. This powerful history, by Gareth Williams, Professor of Medicine at Bristol, recounts one of the most exciting success stories in the history of medicine. Accounts of colourful historical figures such as Lady Mary Wortley Montagu and Edward Jenner appear alongside newly discovered material to provide insights into the anti-vaccination campaigns that remain active today, and into the many unlearned lessons of smallpox.

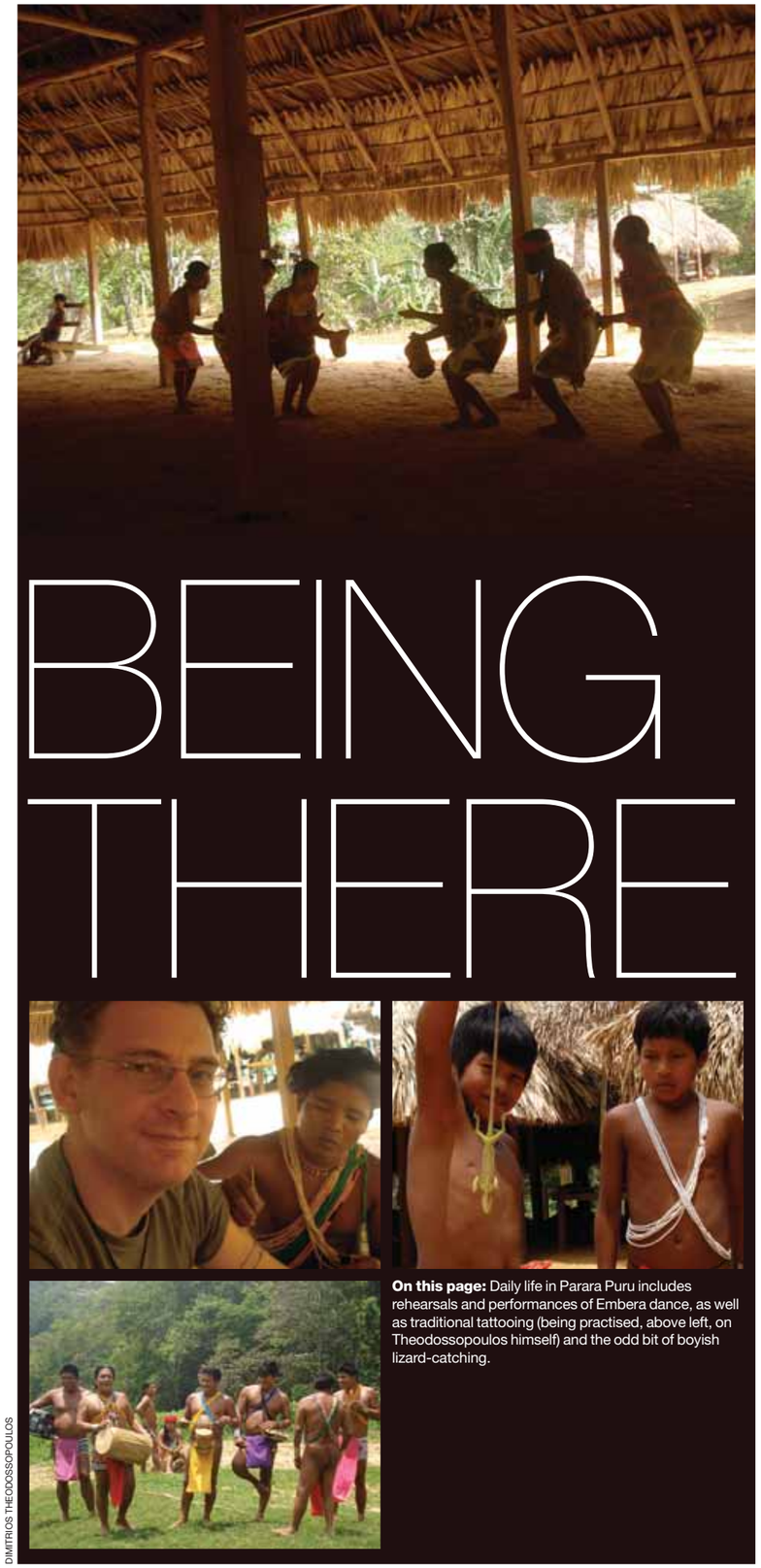


Bridges: The Science and Art of the World's Most Inspiring Structures **edited by David Blockley** (Oxford University Press)

David Blockley, Emeritus Professor of Civil Engineering, examines the scientific, artistic and cultural aspects of bridges. From design and construction to iconography and aesthetics, Blockley draws on examples from around the world to show how to 'read' a bridge. He also looks in detail at the risks engineers take when building bridges, and examines why things sometimes go wrong.

A History of Russian Thought **edited by William Leatherbarrow and Derek Offord** (Cambridge University Press)

This comprehensive new survey, co-edited by Derek Offord, Professor of Russian Intellectual History, charts the socio-political importance of Russian ideas from the 19th century through to the present day, and assesses the influence of its literary heritage. The book features contributions from eminent US and European scholars (including several from Bristol) on the quest of Russia's thinkers to arrive at a conception of 'the essence of the Russian nation'.



BEING THERE

Fieldwork in the world of anthropology is an up-close-and-personal matter. For Dr Dimitrios Theodossopoulos, it means living with an indigenous people in the forests of Panama, eating an awful lot of plantains and adding a new layer to his sense of self. He talks to Nick Riddle.

DIMITRIOS THEODOSSOPOULOS

On this page: Daily life in Parara Puru includes rehearsals and performances of Embera dance, as well as traditional tattooing (being practised, above left, on Theodossopoulos himself) and the odd bit of boyish lizard-catching.

It's become a stock opening for TV documentaries: an aerial shot of clouds that part to disclose a lush canopy of rainforest and a river threading through it. Then a montage of flora and fauna, and we cut to a forest clearing where an indigenous tribe dwell in picturesque isolation. The tribe are struggling to preserve their way of life; the outside world is encroaching on this idyll. If we weren't suckers for that kind of stuff, James Cameron's *Avatar* would have played to empty houses.

'There is a new interest worldwide in the predicament of indigenous people,' says Dr Dimitrios Theodossopoulos, Senior Lecturer in the Department of Archaeology and Anthropology, who has researched and written extensively on the subject. In particular, he has made a close study of the Embera, who live in an area of Panama called the Darién Gap (so called because it marks a break in the Pan-American Highway, which links North and South America).

The area's forests and swamps are relatively untouched, and the Embera have traditionally – and with good reason – been wary of the wider world. While having managed to preserve their language, customs and identity, the Embera have generally met with indifference or outright contempt from 'mainstream' Panamanian society. Such, at any rate, used to be the case.

But for the past few years, the Embera people have been opening up and engaging with the outside world – and Theodossopoulos has been witnessing this transformative period.

The sea-change in their outlook began when the land inhabited by some Embera communities became part of a new conservation area, the Chagres National Park, created by the Panamanian government. As a result, these Embera were only allowed to hunt once a month and could no longer clear any land for cultivation. How, then, were they to

DIMITRIOS THEODOSSOPOULOS

Top: 'For my first visits I didn't take a computer with me, but then I realised the Embera were very interested in technology. The children learned to use my camera, which was wonderful for me because they would take photos from their own point of view. Conversations in front of my laptop became valuable because they would see a photo from two years ago and I could say "That person doesn't live here – is that your cousin?" or whatever, and they could give me more information – about kinship for example. A Peace Corps volunteer taught some of the Embera to use Excel spreadsheets, and when she went home, she left them her laptop. So now they use Excel to work out how much each family should receive, according to the family's contribution to tourism, how many members of the family worked, and so on. They're very happy with this. So far, they're the only Embera community I know of to do that – although news travels fast, of course.'

Above left: 'I would say that I work *with* the Embera. I have to be useful. If people are digging a big hole to build a new house, I have to go and dig with the men. But when I'm relaxing in my house, very tired, trying to find time to write my notes, the children come in and I have to give them something. So I teach them English, show them the computer, teach them how to type their names and think of games that are educational.'

Above right: The house Theodossopoulos usually stays in has no solar panel or electricity. It's built on stilts, and has a roof but no walls. Privacy, therefore, is not a feature. 'On the other hand, I never feel lonely,' he says. 'I'm surrounded by my friends, and I hear their conversations and the crying of their children. I'm part of the same soundscape.' The open-plan arrangement also lets in the breeze, which affords some relief from the heat.

survive? The park's managers suggested indigenous tourism.

Several Embera communities were interested in the idea, and with the help of local non-governmental organisations, three of them developed plans for receiving tourists – plans that covered everything from managing money to creating a tourist-friendly toilet. That done, they opened for business.

Hello world

Theodossopoulos arrived to find the experiment working very well. 'The communities in the park started to receive regular groups of tourists from affluent countries,' he says. 'It was fascinating: ever since the Spanish Conquest, they'd been told that, in effect, there was something wrong with them; the rest of Panamanian society wanted them to become "civilised", to wear western clothes and speak Spanish. Now, they have a stream of visitors who come to take photos and express their admiration and tell them "Your culture is great", and leave with tears in their eyes.'

He has visited the Embera every year since 2005, staying for periods of up to four months depending on study leave. He spends most of his time in Parara Puru, a community of around 100 people established in 1998 specifically to receive visitors and to present and explain Embera culture in an accessible way: there are spaces designed for dance presentations and showing artefacts, and the thatched-roof houses were constructed with particular attention to detail. But this is no museum exhibit frozen in time; it's a genuine community, lived in year-round.

Naturally, there can be some exotic stereotypes at work here. But Theodossopoulos argues that, in this case, the effects are overwhelmingly positive. 'Many friends of mine, when they see some film or hear about what the Embera are doing, conclude that it's all about money, or they say "Look how the Westerners encourage the Embera to reproduce stereotypes about indigenous people". But in this case it's helping the people to recover from negative stereotyping in the past. At the local level, people campaigning for land rights and so on will be much more likely to succeed as a result.'

'The Embera have a stream of visitors who leave with tears in their eyes.'

Neighbourhood watch

Through his regular visits, Theodossopoulos has been able to chart the changes in Parara Puru. He recalls arriving one year to find a number of solar panels set up on tall wooden poles. 'They'd had some visitors from Finland and Austria who went home and persuaded their governments to donate the panels,' he says. 'Previously they'd relied on an inefficient generator that would only work for two hours a day, and only when there was money for the gasoline; now families have light until late into the evening, and they can use radios or small televisions. It changed their lives.'

Having become the focus of so much interest from visitors, the Embera began to want to learn more about their own history. And who better to ask than an anthropologist? 'They saw that I had books about Embera culture, with detailed accounts of their rituals and practices – some written over 90 years ago,' says Theodossopoulos. 'They were surprised to find out that I knew things about their history and culture that they didn't. So they began to ask "Are we doing this correctly? Is it what our ancestors used to practice?" They're also interested to see how I describe them, because they want to be able to articulate their own history.' As part of this process, he is collecting visual material for an 'Embera museum' in Parara Puru. 'All the knowledge generated by anthropologists over the years is now useful to the indigenous people they studied,' he says. Anthropology itself has now expanded its role as a result, and Theodossopoulos sees part of his job as helping the Embera to thrive in the modern world by developing a sustainable income.

Village idiom

'The whole discipline of anthropology is based on the idea that you have to go and live with the people you study for a long time,' he says, 'because that's how you move beyond stereotype and prejudice, and see the world from the other's point of view.' Thus, although he has visited the other Embera communities in the region, including some very remote settlements, Parara Puru is his base and the main focus of his work.

The day-to-day practicalities of living with the Embera do present a few challenges for a European. 'Their diet is not very varied,' says Theodossopoulos. 'The staple food is plantain, which they fry for breakfast, lunch and dinner, sometimes with fish or chicken – but no vegetables. So I have to take vitamin supplements.' Washing is a task that has to be performed in the river ('I usually swim in the river every day anyway, to refresh myself'), and since he isn't a tourist, the toilet purpose-built for paying visitors is out of bounds. Every three weeks or so, Theodossopoulos makes the three-hour river journey to Panama City 'to wash my clothes properly, stock up on vitamins, enjoy a warm shower and eat meals with vegetables'.

Such excursions are probably also a necessary break from what he describes as 'a very intense level of interaction'. Nevertheless, having done fieldwork in other remote places, he has no hesitation in calling his time with the Embera 'much more rewarding than any other experience'.

Two-way anthropology

The Embera are getting something out of it, too, besides a clearer sense of identity and a better livelihood. 'They're studying me too,' says Theodossopoulos. 'When I ask them about their life history, they ask me about mine. They ask whether there are any rivers in Great Britain, how big they are, whether they have good fish. They ask what sort of houses we live in, how much money we make, why we have so much of it. And they want to know about where the tourists come from: "What is Italy? What is France? Are they big countries, are they small? Is it hot or cold there? Tell us more."'

With so many nationalities passing through, the Embera have become very aware of the notion of stereotypes, and it didn't take them long to notice a few national traits. 'They know that the North Americans will buy more goods than the Europeans. And they've found that the Germans tend to wander away from the group and get lost, so they have to send a boy to find them and bring them back. They've also noticed that Italian men are especially keen on posing for photos with the Embera women.'

Na'vi, c'est moi

Just as the Embera's sense of themselves is changing, people everywhere are discovering a more complex identity, thanks to globalisation. Take Theodossopoulos, for example, born in Greece but now travelling with a British passport. He commonly refers to the Embera as 'my people', which is mostly shorthand but does suggest (and he admits as much) that another layer of identity is incubating inside him.

The Embera, meanwhile, are likely to find plenty to identify with as they continue to engage with the rest of the planet and come into contact with other 'peripheralised' communities. Another notable event, thinks Theodossopoulos, will occur when the DVD of *Avatar* arrives in Parara Puru, as it inevitably will. 'They do watch films,' he says, 'and often they ask me clarification questions afterwards: Can superheroes really fly? What's real and what's imagined?'

And what sort of questions might they have for him after watching *Avatar*? 'I wonder. Perhaps they'll ask me whether I'm really a spy for the logging companies. Or maybe "Can you bring us weapons to fight them with?" I imagine they will recognise the situation that the Na'vi are in, and the younger Embera will have a sense of revitalised pride.'

But he stresses that the message he brings to the debate is a positive one. 'I've seen indigenous groups benefit from globalisation,' he says. 'Peripheralised communities across the world are becoming aware of each other. They're realising that they aren't alone, and that they can come together and change things for the better.'

Watched pots

Funding from the Economic and Social Research Council has enabled Theodossopoulos to spend five months in Darién in 2010, during which he has been visiting some more remote Embera communities (with Bristol colleague Professor Mark Horton) in search of their ceramic tradition. 'They used to make beautiful pots that looked very pre-Colombian, until plastic and metal replaced them in the early 20th century,' he writes in an email from Panama City. 'I have just discovered an old Embera couple who remember how to make the clay pots – very exciting. I hope that they will teach the young people their secrets. If not (they are really quite old), I will teach the Embera myself!'

IT'S COMPLICATED

Simple things can end up creating systems that are alarmingly complex. The Bristol Centre for Complexity Sciences (BCCS) was launched in 2007 to provide a focal point for the many disciplines involved in this emerging field. Two early champions of complexity – Professor Claire Grierson in the School of Biological Sciences and Professor Mario di Bernardo in the Department of Engineering Mathematics – discuss this strange and exciting new world of research. Nick Riddle tries to keep up.

JASON INGRAM

Left: Grierson and di Bernardo first met as members of the team that set up BCCS. They now meet regularly on Skype to co-supervise two of the Centre's PhD students – and to have this conversation.

Fish gotta swim, birds gotta fly

MdB: For me, complexity science is about trying to explain the behaviour of systems made of many interacting parts – systems whose behaviour can't be explained by studying the individual agents in it. Take a flock of starlings: they can fly in intricate formations of many hundreds of birds, and the flock's patterns change when, for example, a predator comes along. How do they make those incredible manoeuvres? It's something we call self-organisation: the ability of a complex system to direct itself, react to external stimuli and form something new. What I try to do is model this mathematically, to see if we can replicate it in, for example, robotics, by building a swarm of robots that can behave in a very smart and flexible way.

CG: For a biologist like me, complexity science exists to generate the tools in computing and maths that we need to tackle these questions about biological systems. Mathematicians and engineers used to look at systems with lots of bits and say, 'Let's assume all the bits are the same, or if they're different, it's random differences'. That made the maths easier. But in a biological system the components are all different and all *behaving* differently, and yet over and over again you'll get the same things coming out: human beings have five fingers on each hand most of the time, even though the way each person grew can vary in some important respects.

Simpler times

CG: My Dad's also a biologist, and I was determined not to do the same thing. I gave up biology at school as soon as I could. I wanted to be a physicist, but I got the message that girls didn't do that. I was one of three girls in the physics class, and the teacher always confused our names; for practical experiments he paired us each with a boy because he thought we wouldn't be able to do it otherwise. Every time he was near a girl teaching, he'd get into a state and drop things. It was a very uncomfortable experience. I found a degree course at Warwick University where I could study maths, chemistry and biology in the first year and then specialise. And I enjoyed the biology so much, particularly genetics, that I chose the most genetics-related degree I could. I had to go to my Dad and eat a lot of humble pie and say, 'Actually, Dad, what you do is really interesting'.

MdB: As one of my university professors once said, if you're born in Naples, you can't help wanting to study chaos: the traffic systems here are a miracle of complexity. I've always been keen on science. My parents were both lawyers ...

CG: But your brother is a scientist as well, Mario.

MdB: Yes – clearly we didn't like law very much. My father was also very keen on science, so we were always taken to science talks and science museums. The turning point was 1982 when I was given a ZX Spectrum computer for my 12th birthday. I became really keen on all those home computers – I also had a Commodore VIC-20, which really excited me because you could write little programmes on it in BASIC. I decided then that this was what I wanted to do. My first degree was in Electronic Engineering, then I did a PhD in Applied Maths, then I moved into control engineering, which is more mathematically oriented.

Mixing it up

CG: When I was at Warwick, the biology and maths departments shared a building and a dining room, and we walked up and down the hill together – it was a mile away from campus – so we got to know the maths students. We ended up having conversations about maths and biology, and I think being thrown together like that had a big influence on the kind of scientist I became.

MdB: I had a similar experience here in Naples, where I did my first degree. Electronic engineers, physicists and mathematicians had five-year degrees, and for the first three years we all studied together. That makes you interdisciplinary from the beginning. It's also what we're trying to do at BCCS – bring together students from different disciplines to look at things from slightly different aspects. The problem you want to solve is the same, so it's better to join efforts than work separately.

CG: Early in my career, I thought that we could use some kind of maths to find out how biological systems work, but I didn't know where to start. Biologists had been collecting the components – individual genes, proteins, and so on – but to me that was like taking a car apart: you needed to work out how one bit turns and makes another bit turn, and how they all fit together to give you a car that can move and steer. At the time, being interested in mathematically modelling a biological system was considered a kind of madness; it had been tried in the '70s and was seen as a dead end. So I bided my time, collected papers that I liked and tucked them away in a secret file. Luckily, I wasn't the only one thinking along these lines.

Communication and competition

MdB: The biggest challenge in my area is how to develop the mathematical tools to understand the behaviour of these large, extended systems. The answer lies in the fact that the individual agents – animals, robots, bacteria, whatever – communicate with each other and make decisions. Each bird in a flock senses the distance between itself and its neighbours, and their velocity. That's an implicit form of communication.

CG: In the case of bacteria, they all secrete a substance, and by sensing how much of the substance there is around them, they can measure how dense their population is.

MdB: At BCCS we've been able to bring together biologists, mathematicians, biochemists and statisticians to understand some of

'Complexity has taken me to places I never expected.'

these mechanisms, and now we're beginning to use them. For instance, Claire and I have been working with a team of undergraduates and postgraduates on a project to investigate how to engineer a population of bacteria that can perform co-ordinated tasks, like oscillate in unison to produce certain chemicals. We entered that project in a competition at MIT, where it won the Best Model Prize two years in a row.

Doing the maths

MdB: Our approach of looking at mathematical models of things before doing the experiment has generated a completely new way of doing science. For example, biologists are now talking about doing 'in silico' experiments – building mathematical models, then using a computer to run simulations. There's a project involving many teams around the world to create a virtual model of the human brain on an IBM supercomputer. That's incredible – it's like science fiction! But computer modelling means that we can now create a large, extended model with many agents and observe what they do.

CG: And see how far away we are from understanding it all.

From maths to medicine

MdB: The trouble with mathematical models is that they're set in stone: they're equations, with parameters that you have to set. But living organisms adapt and evolve, so how do we embed that feature in our models?

CG: And can there be self-organisation in a network that somehow directs its evolution or restricts where the network can go next? Could we even, in the long run, identify things that we could change that might produce a different kind of variation or open up more potential? Those kinds of questions are scary but really fascinating, I think.

MdB: One thing we are studying at Bristol is whether we can *control* this kind of complexity. Can we make all the individuals in a network behave in a synchronous manner? To give a medical example, insulin production is one of the big problems in diabetes: pancreatic cells in healthy people all follow the same pattern of producing insulin at the right times. In diabetic people this doesn't happen. If we could understand how to engineer the cells so as to restore the proper pattern, perhaps we could cure diabetes. Similarly with epilepsy: it's thought that seizures are often caused by synchronous firing of the neurons in the brain. So can we find ways to enable individual cells in a network to reorganise themselves and their connections to maintain or avoid synchronisation, even in the presence of some disturbances or faults in the network itself?

Vive la différence

MdB: Bridging the gaps between disciplines means you have to deal with each other's terminology. Scientists are very good at defining the same thing in many different ways. I've been swearing a lot recently when reading biology books, because there so many different terms ...

CG: Well, in our defence, Mario, we biologists have had to invent names for thousands and thousands of things that you can't see with the naked eye, things that never had a name before.

MdB: No, no, it's absolutely true. But when Claire and I meet with our students I often find that I'll describe something typical of engineering and Claire will nod and say, 'This sounds so much like biology'.

CG: Yes, and vice versa for me. Complexity and self-organisation raise questions right across science and beyond – into sociology as well. Look at networks of people on the web or on Twitter. And economics – why did we have the global crash? That's a complexity question.

MdB: The more people in different disciplines talk to each other, the more links emerge – that's complexity at work. When I was doing my PhD, getting my two supervisors to talk to one another was a challenge. If you'd told me that in ten years' time I'd be talking to a biologist, I'd have said, 'Wait – it's been hard enough to make a couple of engineers talk to each other, I'd never be able to talk to a biologist'. But it's happening.

A question of character

MdB: I'm very enthusiastic about things I like: I get quite obsessed. I also have an ability to see connections, particularly between seemingly different things – an electrical circuit and a mechanical system, for example, which I discovered could both be modelled using the same mathematics. And in this work, being able to see connections between a biological system and a network of robots has helped me a lot. But that enthusiasm means that I try right away to tackle very complicated problems, huge mathematical models, rather than start with something simple and build the complexity up. But over the years I think I've learned to control myself!

CG: I'm completely open-minded and very resistant to dogma. That's great, because I'm not frightened of going in any direction, but the downside is that it's harder for me to communicate my results to the outside world because I don't take enough account of what everyone is expecting. If the field's going in a direction, I almost deliberately resist that, and ask, 'How might this direction be wrong?' Maybe I'm just naturally stubborn and difficult!

More from less

MdB: Complexity is a very new field, but it's already taken me to places I never expected, to work on problems I didn't ever think I would come across.

CG: For me, it's like a dream come true.

MdB: It has made me think differently about a lot of things. Self-organisation in networks was one of the biggest challenges to my religious upbringing – I'm almost an atheist now. So much can happen in biological networks because of interactions between agents that aren't aware of being part of something bigger. The question of consciousness has always fascinated me, and we still don't know completely how it arises, but it's entirely reasonable to me that neurons, which are not conscious, can give rise to the most amazing behaviour when billions of them are firing and communicating with each other.

CG: Complexity has helped me to see that you can get more and more interesting things from less and less – you don't have to invoke as many mysterious processes as I used to think. I might get in trouble for saying this, but most of the biologists I know are not very religious. That could be because biologists are already used to the idea that we could all be here without anyone having put us here, and that things that seem very designed might be 'self-assembled'. Having said that, I do know some biologists who *are* religious. But of course, faith really has nothing to do with science.

HOLMES FROM HOME

Left to their own devices, plants find the conditions that best allow them to thrive. So it was that Penny Harms, a native of the Isles of Scilly, came to put down roots in Bristol. She talks to Hilary Brown about her job as Glasshouse Co-ordinator at the University's Botanic Garden.

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It's a clammy 30°C in the tropical glasshouse at the University's Botanic Garden and the *Subtext* photographer's lens has steamed up. Despite being clad in foot-to-chest neoprene waders for a demonstration of how to prune *Pistia stratioides* (a spongy, free-floating acquatic plant, commonly known as water lettuce), Penny Harms has barely broken into a sweat. 'You get used to the temperature,' she says. 'People look at me as if I'm crazy when I wear a fleece in here, but the heat doesn't bother me.'

The water lettuce drifts around on the surface of a raised stone pool in the centre of the tropical zone. It's too early in the year to see the pond's star attraction, the giant Amazon water lily, *Victoria amazonica*, which was grown from seed at the Royal Botanic Gardens in Kew and was first transplanted to Bristol's Botanic Garden in spring 2007. This huge plant has vibrant green leaves of up to three metres in diameter that turn upwards at the edge. 'Children love it when you tell them that the lily pads are strong enough for them to sit on,' says Harms.

New beginnings

This year, for the first time, Harms is trying to grow a batch of *Victoria cruziana* from seed donated from Oxford Botanic Garden to complement the *Victoria amazonica* in the pool's second planter. 'The *Victoria cruziana* leaves are smaller, but have a deeper rim, and the underside of the leaves is purple rather than red, so it should be quite a sight,' says Harms. 'The *Victorias* are annuals, so the idea is to pollinate them by hand, collect our own seed and store it through the winter so we've got a constant supply of plants.' Provided the seeds germinate, of course. 'I've sown about a dozen, so fingers crossed,' she says. 'I don't know what I'll do if they all germinate – there's only room for one plant in the pool.'

Plants can be unpredictable, but for Harms that's part of their attraction. Take *Amborella trichopoda*, for example, the most primitive flowering plant in the world. The garden's Director, Professor Simon Hiscock, brought some seeds back from New Caledonia, and Harms was responsible for their germination. 'Months went by with no sign of life and I'd almost given up on them,' confesses Harms. 'Then, after six months, whoomph, they were off.' The Botanic Garden is the only garden in Britain to have the plant, and Harms is one of just a handful of individuals worldwide to have grown it from seed to flowering.

Patience, it seems, is the key to good gardening. And inevitably, if you're a good gardener, people are going to ask you for advice. The most common question asked of Harms is, 'Is it dead?' 'We're all in such a hurry these days and we expect plants to adhere to our own schedules. We want a lovely border and we want it now,' she says. 'I'm sure a lot of dormant plants get thrown out. Sometimes you just have to watch and wait, and they'll flourish in their own good time.'

A change of scenery

Harms has been casting a watchful eye over the Botanic Garden's tender species for 13 years. She started as a volunteer at the garden's former site at Bracken Hill, where one of her first tasks was to re-pot the ferns. 'There were three sections in the glasshouse where the ferns were kept,' she remembers, 'and the cool area contained a beautiful collection of *Cymbidiums*,

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a type of evergreen orchid. When I was asked to re-pot those as well, I was in heaven.'

Before she came to Bristol, Harms had been working in a commercial horticultural nursery in London, growing plants for hotel displays or for sale at Covent Garden market. 'It was exciting in a way, but it bothered me that you never got to grow anything to maturity,' she says. Working in a botanic garden appealed because of the variety of (often unusual) specimens housed, and 'because you're responsible for them throughout their life'.

Four years ago, the garden relocated to its current site at The Holmes in Stoke Bishop. It was no mean feat: as well as lifting many plants, the staff embarked on a huge propagation drive, planting seeds and taking hundreds of cuttings over two years with the aim of transferring around 70 per cent of the existing plant material to the new site. Harms is proud of the fact that they were largely successful and believes that the move strengthened the team's sense of ownership of the garden.

Small but perfectly formed

The current garden, although smaller, is more focused, and contains four distinct, but interconnected, collections: plant evolution; plants of Mediterranean climate regions; useful plants; and local flora and rare native plants. The new glasshouses – which, along with the potting shed and propagation house, form Harms' domain – hold tender plants from the core collections displayed in four climatic zones: tropical; sub-tropical; warm temperate; and cool temperate.

As well as caring for the plants (and there's a lot of watering to do), Harms oversees up to 40 volunteers and supervises a succession of horticultural students on year-long work placements. She also receives a string of offbeat requests from staff and students from the University's own School of Biological Sciences. 'I was once asked to collect samples from plants at particular stages of flowering for a study about the various signals flowers send out to different pollinators to indicate they're ready for pollination,' she recalls. 'It makes you look at your plants in a different way.'

Appearances can indeed be deceptive: dozens of unremarkable-looking saplings, standing in neat rows on benches behind the glasshouses, turn out to comprise the world population of certain rare types of whitebeam and rowan. Harms is propagating them for a project led by Professor Simon Hiscock on the evolution and breeding systems of nine *Sorbus* species in the Avon Gorge, particularly the origins of two rare endemics, *Sorbus bristoliensis* and *Sorbus wilmottiana*, which have evolved in the gorge through hybridisation.

Career flourishes

If she hadn't been discouraged from studying botany at school ('teachers told me it was a dying subject'), Harms herself may have gone down the academic route. At any rate, plants have always featured large in her life. She was born on St Mary's in the Isles of Scilly and grew up in a family of keen gardeners. 'I had a great uncle who used to point at plants in the garden and expect me to know what they were,' she recalls. 'I was only about four, so the names usually came out wrong, and even when I'd learned them I would mix them up on purpose just to tease him.'

By the time her mother began taking her on trips to Tresco Abbey Gardens, she was familiar with botanical as well as common plant names. 'The garden is laid out on a series of terraces and the plants differ according to the altitude, from shady ferns at the bottom to South African *Protias* with their exotic pink blooms at the top,' she says. 'From the highest terrace, you can look out over the tops of the *Phoenix canariensis* palms to the sea and the white beaches of the other islands beyond.'

She started to paint the plants she saw and went on to study fine art after she left school. In retrospect, she says, this wasn't such an odd choice for someone who has ended up in horticulture, since both painting and gardening combine practical and creative elements. Her first job was back on the Scillies, picking and bunching daffodils throughout the winter and planting bulbs in the spring and summer. Four years later, she moved to London and completed a National Certificate in Horticulture, specialising in nursery practice and cultivating a passion for propagation that she is able to indulge in her current job.

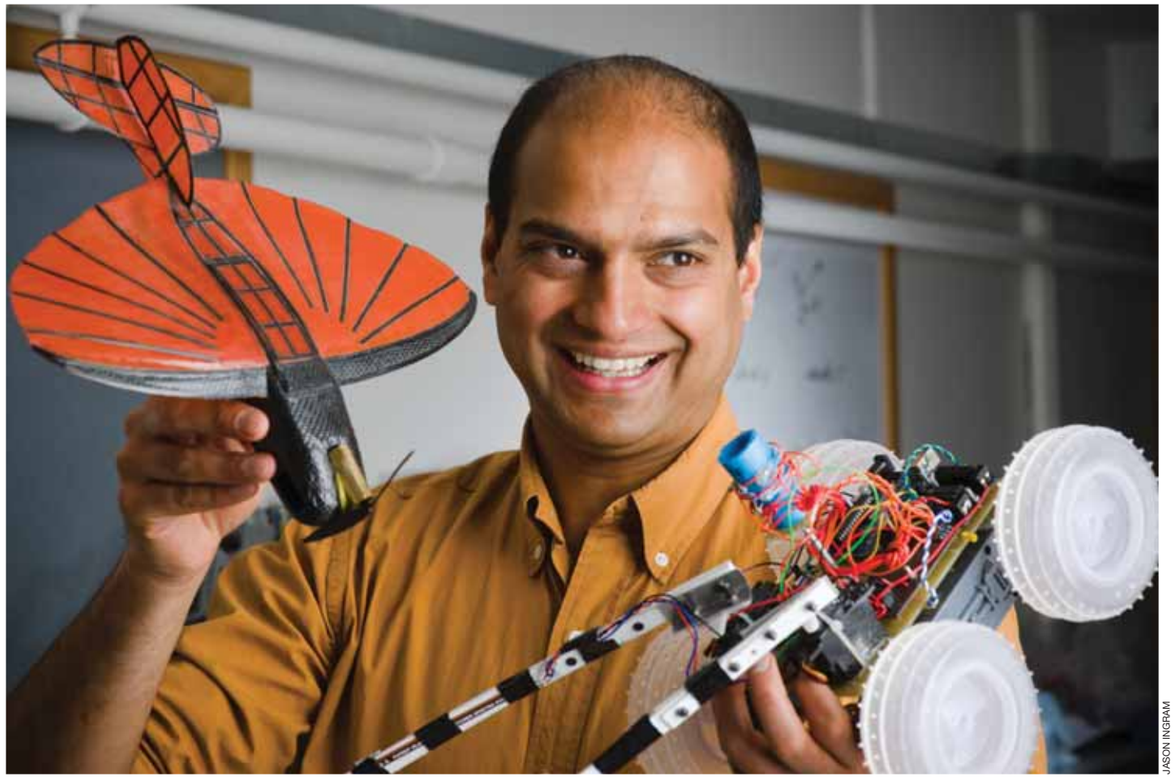
Firmly planted

Harms relishes the sense of continuity that comes with working in the Botanic Garden. There's a wealth of historical information attached to each plant – where the seed originated, who collected it, when it was sown, when it first flowered, and so on. These accession details are important for conservation and research purposes and Harms records them meticulously. 'It's like being in a living museum – you want to preserve your collections for future generations,' she says.

The garden is part of a national network of botanic gardens that provides opportunities for swapping plants and knowledge. Bristol's Botanic Garden has an exchange programme with Tresco Abbey Gardens and Harms has just returned from a week's visit. 'There's a world of difference between the two gardens, even though geographically they're not that far apart,' she says. For a start, everything grows outside on the Scillies, which means it's impossible to stop plants hybridising because the wind is constantly blowing the seeds around. 'You get *Aeoniums* all over the place, but it's unusual to see the black variety, beloved of garden designers, because you can't keep the species separate,' explains Harms. 'We're able to keep our own collections pure just because we grow them in a greenhouse.'

As Harms puts the finishing touches to a package of plants she's sending back to Tresco, she makes a mental list of things she might request in exchange. She's reluctant to choose a favourite plant, but admits to a fondness for the early-blooming *Narcissus papyraceus*, or paper white. 'They're the quintessential spring flower – they come out in September on the Scillies and have the most intoxicating scent,' she says wistfully. 'They'd be just right for the Mediterranean bank in the main garden.'

For more information about the Botanic Garden, including opening times and forthcoming events, please visit www.bristol.ac.uk/Depts/BotanicGardens.



JASON INGRAM

A LIFE IN MOTION

There's a lot you can learn from a cockroach, according to Dr Ravi Vaidyanathan, Senior Lecturer in Biodynamics in the Department of Mechanical Engineering. Hilary Brown hears how one of the world's most despised bugs helped launch a career in biologically inspired systems engineering.

Science fiction has promised us housekeeper robots for decades, and we still don't have them. But, as was widely reported in the media in April this year, we do have surgeons performing pioneering heart surgery using a remote-controlled robotic arm. The remote catheter manipulation system attaches to the patient's bed and is operated from a separate room, saving clinicians from exposure to X-rays.

Why has it taken so long to invent a device that allows surgeons to control a catheter unencumbered by a heavy lead apron? After all, the birth of automation technology can be traced to the Ancient Greeks, and Leonardo da Vinci was sketching plans for a humanoid robot around 1495.

Well, it's complicated, says Dr Ravi Vaidyanathan, whose research centres on biologically inspired engineering systems – using animal movement as inspiration for constructing mobile and medical robotic devices. Animals have evolved over billions of years, and imitating Nature's methods, designs and processes requires significant advances in many different areas of science and technology.

Early moves

Despite having a high profile in robotics, Vaidyanathan doesn't think of himself as a robotics engineer or even a mechanical engineer. 'I use biology as the basis for designing new engineering techniques,' he says. 'Living organisms are complex systems that are difficult to replicate using traditional engineering methods, and robotics just happens to be one of a range of new technologies that has been successfully applied to biodynamic engineering design.'

Vaidyanathan became curious about the mechanics of body movements after suffering a series of sporting injuries. He grew up in the US and played a variety of sports, including American football. 'Over the years, I managed to break both my arms and legs, and fracture my wrist and skull,' he says. 'I spent a long time in plaster, pondering the forces that caused the breaks and how the bones healed.'

He might have followed his Indian-born parents into medicine if he hadn't been put off by the thought of being on call. 'The layout of our house meant that you had to go through my bedroom to get to the front door,' says Vaidyanathan. 'I was often woken up in the middle of the night when my Mum, who was a surgeon, was summoned to hospital.' Instead, he went into mechanical engineering, 'on the basis of

Above: Dr Ravi Vaidyanathan with (left) a prototype multi-modal robot capable of flying, landing and crawling and (right) a mobile robot with cockroach-inspired antennae for navigation by touch.

having an aptitude for maths, science and making paper airplanes'.

During his undergraduate degree, he realised that there was an entire field of science – biomechanics – that brought all these interests together. This inspired his final-year project on sensors for detecting tongue movement in stroke patients. His first foray into the world of robotics, for his Master's, was to devise a robot based on a tongue-like, muscular system – a sea slug, to be precise. 'Most robotics systems around at the time were based on skeletal systems, so this was one of the first attempts to build a soft-bodied robot,' says Vaidyanathan. 'If you can combine the two body types into one model, you get even greater functionality.'

'The trouble starts when you take a robot out of a controlled environment.'

The great escape

Depending on your definition of robot (and there's disagreement among experts about whether the term can be applied to remotely operated mechanisms or solely to devices that are controlled by their software without human intervention), we've been living with them for years; industrial robots, for example, have been commonly used in manufacturing since the 1970s.

But the real challenge, says Vaidyanathan, is adaptability – getting robots to sense and react as quickly as humans and animals to different circumstances or changes in their physical environment. 'In manufacturing, you build a robot to perform a certain function and then you construct a space around it that is ideally suited to carrying out that task,' he says. 'The trouble starts when you take the robot out of that controlled setting.'

Vaidyanathan had a first attempt at building a robot that can operate autonomously in dynamic environments when studying for a PhD in Biologically Inspired Systems at Case Western Reserve University, in Cleveland, Ohio. Here he worked on modifying a mathematical model of a cockroach's nervous system – in particular, its escape mechanism – for robotic systems.

'If you've ever tried stomping on a cockroach, you'll know that it's faster than we are. It's neurologically hard-wired for escape,' says Vaidyanathan. Cockroaches are equipped with sensors capable of detecting the slightest disturbance in the surrounding air and ground vibrations. The bug's nervous system can transmit that sensory warning in a few thousandths of a second directly to its legs, while instantly analysing its surroundings and choosing the right way to move. 'Cut off its head and it will walk,' says Vaidyanathan. 'It's more likely to die of starvation than be caught by a predator.'

The lab at Case Western, where Vaidyanathan was a student under the supervision of Professor Roger Quinn, successfully applied the model to a collision-avoidance system in a small radio-controlled car fitted with ultrasonic sensors. When the car approached an obstacle, the cockroach-inspired escape-response circuit would take control to avoid a crash. The fact that there was no way of predicting how the car would respond – it might slow down, speed up, or turn left or right – was a plus, explains Vaidyanathan. A cockroach avoids capture by being unpredictable as well as fast.

Trial and error

Vaidyanathan was hired by a US-based engineering firm to translate the model into a collision-avoidance system for aircraft. 'We crashed quite a lot of radio-controlled airplanes during this period,' he admits, 'but we eventually succeeded in getting the models to make evasive manoeuvres to avoid computer-simulated obstacles in the sky.' The results were even better when the avoidance system was turned around, so that instead of avoiding an obstruction, the airplane targeted it.

The next step was to try to apply another cockroach attribute – locomotion – to create mechanical muscles and legs that could be used with unmanned vehicles popular with the military, for surveillance, reconnaissance, and search and rescue purposes. This led to Vaidyanathan experimenting with 'morphing multi-modal robots' – devices that mimic the ability of many animals to move in more than one medium, in this case to fly and to crawl.

One of the challenges was to capture the flight control mechanism of birds, bats and some flying insects. 'Birds can fly smoothly in gusty conditions because their wings change shape to adapt to variations in airflow,' says Vaidyanathan. As the airflow over the wing stabilises, the wing returns to its original shape in a process called passive adaptive washout.

Mother Nature, however, proved a hard act to follow, and when it came to testing his early robots, Vaidyanathan came up against various problems. For example, he might find he'd used batteries that were far too powerful, because he'd underestimated the amount of energy absorbed by a bird's wing muscles in flight. This would result in the model overheating, or, in some cases, literally flying off into the sunset. He remembers flight-testing a robot with a 14-inch wingspan on a day when bigger, conventional, airplanes were grounded because it was so windy: 'The first flight, over two kilometers, worked fine, and the robot came back. I guess my colleagues and I got a bit cocky, because we decided to do a re-run, but this time the robot just kept going. We never saw it again.'

The research finally came to fruition in 2008. The Bristol Robotics Laboratory, in collaboration with Case, the University of Florida and the US Naval Postgraduate School in Monterey, where Vaidyanathan had taught systems engineering before coming to the UK, successfully completed a series of experiments with the first autonomous, portable robot capable of flying, landing and crawling in a continuous sequence of actions.

Moving with the times

Since taking up his post at Bristol in 2008, Vaidyanathan has turned his attention to the use of robotics in medical applications. One of his projects has been to design an assistive control device for people who are paralysed in all four limbs. This comprises a sensor that fits into the ear and responds to changes in ear canal pressure caused by tongue movements, thus avoiding the need for the kind of physical mouthpieces that have been popular in the past.

'It's not until you talk to the people who use these aids that you properly understand their needs,' says Vaidyanathan. 'When I was developing the earpiece, I corresponded with a man whose disabled son used a mouth brace fitted with various control buttons that he could operate with his tongue. It worked fine, but what if he wanted to take the brace out so he could eat or chew a piece of gum? He'd need a carer on hand to remove it and put it back in; there would be hygiene issues associated with that, and, more importantly, a continuing lack of independence.'

Rehabilitation after injury is another area he is exploring. 'I came to work one day with a sprained ankle from playing basketball, which led to two of my students devising a kind of bionic ankle – a strap-on mechanical brace that helps you walk without crutches,' says Vaidyanathan, convinced that this is an area where the use robotics is becoming increasingly viable.

Vaidyanathan has devised an undergraduate course on Biologically Inspired Systems, based on his research interests, and acknowledges the role the University and the Bristol Robotics Laboratory have played in supporting his work. 'The interplay between biological and artificial systems represents a whole new area of teaching and Bristol is foremost among institutions worldwide to recognise the importance of this,' he says.

He's quick to admit that so far we've only succeeded in reproducing a minute fraction of what a biological system is capable of. 'There are so many synergies within living organisms – the exoskeleton, the nervous system, the muscle groups, and so on – that it's impossible to replicate them by looking at any one system in isolation,' he explains. 'When I watch an elite athlete performing or see a cat leaping over a fence, I'm amazed by how all these systems come together in such a seamless way.'

The question is whether this appreciation extends to cockroaches. 'Well, I did think twice about squishing them when I lived in an insect-infested apartment as an undergraduate,' he says, 'but there were so many of them …' His voice tails off, leaving the rest to the imagination.

FOUND IN TRANSLATION

Dr Birgit Beumers, Reader in Russian, has made a career of studying cultural transitions: from Soviet to post-Soviet, from Russian to English, and from frame to frame of early Russian cinema. She talks to Hannah Johnson.

Learning languages is all about crossing borders – literally so, in the case of the young Birgit Beumers, growing up in Aachen in what was then West Germany. Having added English and French to her native German, she wanted to tackle a fourth language: Russian. But this proved a challenge in the days of the Cold War. 'Russian wasn't really an option in West German schools,' she says, 'so I had to cross the Dutch border, about 20 minutes' drive away, to attend classes.'

Such crossing of boundaries has informed Beumers' work ever since. She clearly enjoys roving between different disciplines: from theatre to cinema to the wider Russian culture that developed in the great period of upheaval following the collapse of Soviet Communism.

Beumers considers herself privileged to have had a front-row seat during this time of historic change. She spent the pivotal year 1986-87 in Moscow and now finds it a little strange to be teaching her current students, who were only just born then, about that momentous era. 'It's purely history to them, so sometimes talking about it does tend to make me feel like my own grandmother,' she admits.

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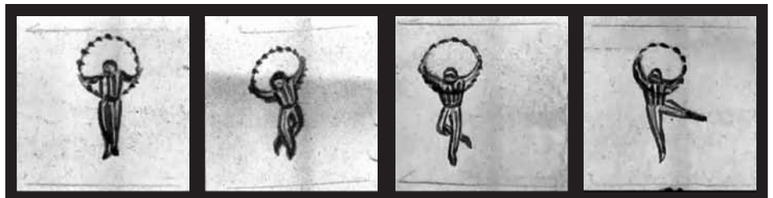
Chaos à la Russe

It was during this time that Gorbachev's reforms, *glasnost* and *perestroika*, were beginning to kick in, and exiled artists and writers were starting to return. Among them was Yuri Lyubimov, legendary director of Moscow's Taganka Theatre and the subject of Beumers' PhD thesis. Productions from his theatre that had been banned for ideological reasons were being reinstated in the repertoire, and Lyubimov himself, stripped of his Soviet citizenship in 1984, was one of the first Russian artists to return. Beumers had the 'extraordinary honour' of passing on the letter from his ensemble of actors, inviting him back to the company which he still leads today at the age of 93.

During the 1990s, she got to know several young experimental writers, artists and other creative people. 'In the post-Soviet era, the country was left in complete turmoil,' she says, 'but it was also really exciting to witness these young artists developing.' Although richly rewarding, visiting the country at this time had its dramas: there were political coups, inflation and currency fluctuations. 'We only ever changed small amounts of money,' Beumers remembers. 'It was safer to hold on to your dollars than to have roubles which were worth one loaf of bread one day and half a loaf the next.'

The transition to the free market at the end of 1991 was a particularly difficult time. 'There were panic purchases, nothing left in the shops,' she recalls. 'People stocked up because they didn't know what was going to happen. It was as if everyone was expecting some kind of food apocalypse. There had been voucher systems and rationing before, so people had this real sense of insecurity about what the free market would bring. It was a very strange situation, especially for a foreigner like me who knew that the free market was nothing to fear.'

But there were many lighter moments, too. Visiting in the mid-'90s, she asked a friend whether a bank note from her last visit some



Above: Frames from Alexander Shiryaev's animated study of a hoop dance from the ballet *Casse-noisette* (*The Nutcracker*), drawn on paper sometime between 1902 and 1905.

eight months previously were still valid. 'No,' her friend replied dismissively, 'it's got a picture of Lenin on it.' The renaming of streets and metro stations also caused much confusion for Beumers and her Russian friends: 'For a time, no-one ever had any idea where we'd arranged to meet,' she laughs.

New scenarios

The late '90s were a fascinating time for Russian drama. Something similar to the UK's 'In-yer-face Theatre' (pioneered by writers such as Mark Ravenhill and Patrick Marber) emerged, with many companies staging highly experimental plays not based on a linear, coherent plot. The influence of this new Russian drama spread to the world of cinema, and Beumers' research soon widened into film too.

Since then, she's become passionately committed to the cause of spreading culture through cinema – an aim that still informs her work today. As well as organising Russian film events with the Watershed in Bristol, she has set up *Kino Kultura*, an online journal which features news, reviews and articles about the current state of Russian cinema.

Beumers also has a sideline subtitling recent Russian films, an activity she finds both challenging and rewarding. 'If you're translating a book, you can add a footnote, but with a subtitle you can't,' she says. 'You only have ten seconds of the viewer's attention. Often there's something that can be said in one language but not in another, or it doesn't come out as beautifully or as poignantly as in the original. That's one of the great conundrums of translation.'

While her enjoyment of the process is obvious, she's keen to stress that there's no real substitute for mastering another language: 'I hope this country will continue to support language learning. In the past few years, we've seen numerous cuts at school level and beyond. I think that's a huge loss – if you don't speak a person's language, you'll never fully understand them.'

As an example, she cites her experience helping with a film about the Mari, an ethnic group in the Urals, who preserve many of their local traditions and rituals. 'Knowing their language helps you to understand how they do things, what their beliefs are and how they're likely to behave in an everyday situation. It's important to know this so you can respond adequately without causing offence. We're increasingly in danger of simplifying our level of communication; you can't truly learn a culture without learning the language.'

Frame to frame

While her subtitling work helps to bring contemporary Russian films to a wider audience, Beumers' recent research project is helping to rewrite the history of early Russian cinema. It focuses on a previously unseen archive of animated films which appear to predate both the official birth of Russian cinema in 1908 and the work of Ladislas Starevich, believed to be the world's first puppet animator, who began making films in 1911.

Beumers describes with palpable excitement her visit to St Petersburg to see the archive and meet its owner: 'He opened a huge cupboard and there were all these old film containers – not large canisters but little tins that looked like powder compacts – with handwritten labels dating them to between 1906 and 1909. Fragments of a camera had also survived and a number of animations drawn on paper which could be shown using a special optical device.'

These films – stop-frame animations of puppets dancing – were made by Alexander Shiryaev, assistant choreographer at the Mariinsky Theatre. Shiryaev worked alongside Marius Petipa, who is generally regarded as the world's most influential choreographer and was famous for his definitive productions of *The Nutcracker*, *Swan Lake*, *Coppélia* and many others.

His intimate knowledge of dance made Shiryaev a highly skilled animator who instinctively understood how to recreate human movement. The artistry in his work, not to mention his dedication to the time-consuming process of animation, left Beumers marvelling: 'He had a little toy theatre and these puppets which he made himself and an old camera, not electric but with a hand cranker. He'd move each puppet – not just one or two but as many as eight – so that all the positions were harmonised, then he'd go to the camera – *crank* – then back to the puppets, change their positions slightly, then back to the camera – *crank* – and so on.

'The old man who saved the films from destruction was a photographer at the theatre during the Soviet era and knew Shiryaev. He told me that, in Shiryaev's room, there was a path on the wooden floorboards that had been hollowed out by this constant movement to and fro between the toy theatre and the camera.'

A remarkable achievement, in terms both of quality and of scope (one film consists of more than 8,000 frames), the animations, for Beumers, are testimony to Shiryaev's extraordinary strength of character: 'If he wasn't satisfied with the result, or thought he needed to do something differently, he would make the entire film again. He was utterly dedicated to what he was doing, always striving for perfection – and for whom? For his children and his students; they were his only audience.'

Explosive stuff

Actually getting to view the films also required dedication. Nitrate stock is very fragile and there's always the risk that it can spontaneously combust. To make matters worse, Shiryaev's films are not in the standard 35mm format and don't have sprockets, having been perforated by hand using a machine like a hole punch. Fortunately, there are now modern projection machines with so-called 'wet gates' which use liquid to soften and smooth out the brittle film, and then run it without touching the perforations.

Running old film is always risky, though. Digitising such precious pieces of cinema history is the only way to ensure their survival and should, Beumers believes, be an urgent priority. 'There are so many film fragments and visual documents that need to be preserved,' she says. 'Film is so fragile: all it takes is an accidental gesture such as an abrupt movement of the hand, and you can destroy a frame in an instant. The emulsion can snap and detach from the film, and the image is gone forever.'

Some of Shiryaev's films have already been preserved, but the process is expensive: one minute of footage costs about one thousand pounds to digitise. Beumers is currently seeking funding to save a further 30 minutes of film, but securing the money is a challenge. 'Sometimes it seems people today are only interested in things that are superficial and transitory,' she laments. 'We're in danger of losing a lot of important things forever. Where we now think "Well, it's just too expensive to digitise these films", in ten years' time we might be saying "Actually we should have done that", but by then it will be too late.

'That's partly why I got involved in the Shiryaev project: I could see that unless something was done, all his work was going to perish. One film combusted in front of our eyes – it just disappeared. Luckily we still have the original negative. But that goes to show how quickly such things can happen.'

Beumers refuses to be daunted. The desire to preserve cinema history clearly brings out a devotion in film scholars almost equal to that of an animator like Shiryaev – as one final example illustrates: 'I know a scholar who used a normal flatbed scanner to transfer images and save a very rare film showing the opening of the State Duma by the Tsar in 1909. He scanned every one of the 5,000 frames manually. I have no words for that kind of dedication.'

NICK RIDDLE

NICK RIDDLE

CHARACTER PARTS

Although most of the items held in the University of Bristol Theatre Collection are concerned with the history of the stage, its archives also include a small selection of artefacts from film and television. The Stephanie Cole Archive, for example, includes items donated by the actress from her long and distinguished career in theatre, television and radio.

Pictured here is a selection of props used by Cole in her portrayal of Dr Beatrice Mason in *Tenko*, the classic BBC/ABC drama about a group of women in a Japanese internment camp during the Second World War. The series ran between 1981 and 1984.

Cole, who donates material to the Archive every year, was awarded an honorary Master of Arts degree by the University in 2002. She was also awarded an OBE in 2005 for her services to drama, the elderly and mental health charities.

Endnotes

1

THE ROYAL SOCIETY

1 An engraving of Robert Ferguson FRS (1767-1840) by William Penny. The University Library's Special Collections has acquired a unique archive of material belonging to the mineral collector and MP, who is infamous for having run off with Mary Elgin, the wife of Lord Elgin (of the Elgin Marbles). Ferguson was a patron of science and a supporter of the Geological Society. The material, mostly from the early 19th century, sheds light on developments within the Society in its early years.

2 Red land crabs on Christmas Island. Researchers in the School of Biological Sciences have been investigating how the crabs manage to complete a five-kilometre breeding migration to the ocean during the monsoon after being relatively inactive during the dry season. They found that the crabs' muscles underwent a dramatic change over a short time, becoming aerobic and highly resistant to fatigue. The research was published in *The Journal of Experimental Biology*.

3 A giant penguin ice sculpture used to demonstrate how to make music by capturing sounds from the natural world. The exhibit, by the Department of Music, formed part of Discover, the University's biennial public celebration of research in March.

4 Probably Sir Robert Dudley (1574-1649), formerly known as Sir Thomas Overbury (1581-1613), by an unknown artist. Dudley was the illegitimate son of Queen Elizabeth I's favourite courtier, the Earl of Leicester. The 16th-century portrait was identified by History of Art MA students working on a display of paintings of mystery figures. The picture is on display until October at Montacute House, near Yeovil, as part of the *Imagined Lives: Mystery Portraits 1520-1640* exhibition.

5 Riley Joyce, the first newborn to receive xenon gas in a bid to prevent brain injury following a lack of oxygen at birth. The pioneering technique was developed by Professor Marianne Thoresen, who featured in *Subtext* 11, and was carried out at St Michael's Hospital, Bristol, in April. Riley's middle name is Xenon.

2

LUCY TURNER

3

BRISTOL EVENING POST

4

NATIONAL PORTRAIT GALLERY

5

MARIANNE THORESEN

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