UNIVERSITY OF Southampton

NB

New Boundaries | Issue 10 | May 2010

Protecting against global diseases.

Research on life-saving vaccines

The power of information
Innovation through sharing data

Training tomorrow's technical experts
Revolutionary new Doctoral Training Centres

Harnessing life-changing energy
Providing electricity to African villages

In this issue

Over many years, the University of Southampton has distinguished itself as a hub of invention and creativity. Looking ahead, through our world-leading research, innovation and enterprise, we aspire to change the world for the better.

This issue of *New Boundaries* gives a flavour of our broad range of research, which crosses the boundaries separating the traditional disciplines. With our innovative and entrepreneurial approach, coupled with our global partnerships with businesses and the public sector, our researchers are tackling the most pressing challenges facing society today.

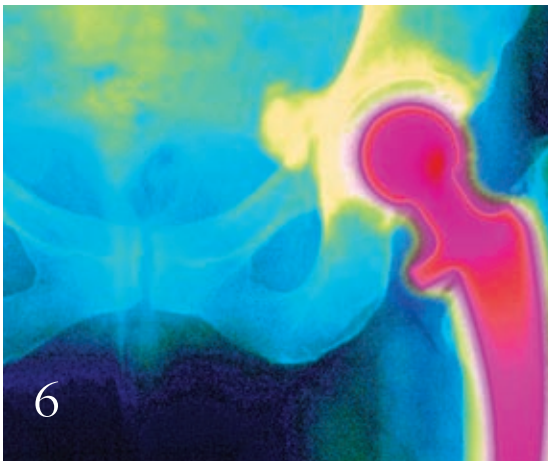
On page 4, we feature Dr Stuart Clarke's research on pneumonia and meningitis vaccines, which help protect millions of people around the world from these diseases every year.

Professors Nigel Shadbolt and Sir Tim Berners-Lee have transformed public access to UK government data through an innovative new website. On page 10, you will find out how sharing data in this way could be the key to finding answers to the world's most important questions.

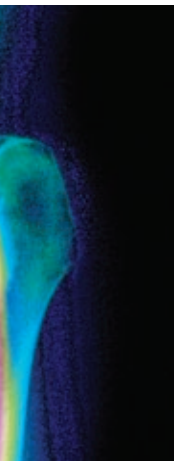
Looking further afield, how can developing countries improve the health and wellbeing of their inhabitants without repeating the mistakes we have made in the developed world? Professor AbuBakr Bahaj is leading a multidisciplinary consortium to introduce sustainable energy to Africa's most remote villages, giving life-changing benefits without damaging the planet. Find out more on page 16.

These are just a few of the groundbreaking stories from around the University; I hope you enjoy reading about them. If you have any comments or suggestions about the magazine, please send them to me at newboundaries@southampton.ac.uk.

Claire Roberts
Editor, *New Boundaries*


6


5



1

2

4

3

1 **Protecting against global diseases**
How one Southampton team is researching life-saving vaccines.
Page 4

2 **The power of information**
Transforming public access to government information.
Page 10

3 **Training tomorrow's technical experts**
Discover our revolutionary new Doctoral Training Centres.
Page 14

4 **Harnessing life-changing energy**
Sustainable electricity solutions for remote African villages.
Page 16

5 **Providing for an ageing population**
Vital research on how the supply and demand for healthcare is changing.
Page 22

6 **Innovation through business partnerships**
Links with the University have a positive impact on companies – and the wider world.
Page 24

Protecting against global diseases

More than 1.6 million people die every year from meningitis, blood poisoning (sepsis) and pneumonia caused by the bacterium *Streptococcus pneumoniae*. Dr Stuart Clarke, based in the School of Medicine, leads a team doing vital research on vaccines to protect us from these diseases.

"When a new vaccine is introduced, the concern is that it will exert a selection pressure on the bacteria. This means the strains of bacteria the vaccine protects against are replaced by those it doesn't, so disease still spreads in spite of the vaccine. This is what we need to look out for."

Dr Stuart Clarke, School of Medicine

Streptococcus pneumoniae was first isolated in 1881, independently by two researchers: the French chemist Louis Pasteur and US Army physician George Sternberg. It was given the name 'pneumococcus' because of its link with pneumonia.

Stuart's team has been monitoring the performance of the pneumococcal conjugate vaccine (PCV7; Prevenar) that was introduced into the UK childhood immunisation schedule in 2006. They have been monitoring how the vaccine is performing by detecting any changes to the nature of *Streptococcus pneumoniae* bacteria, known as the pneumococcus, before and after the vaccine was introduced.

Stuart, who holds the post of Clinical Senior Lecturer and Honorary Consultant in Health Protection, explains: "When a new vaccine is introduced, the concern is that it will exert a selection pressure on the bacteria. This means the strains of bacteria the vaccine protects against are replaced by those it doesn't, so disease still spreads in spite of the vaccine. This is what we need to look out for."

In 2006, Stuart's team started a study to find out how these bacteria are being carried in the nose and throat (an area known as the nasopharynx) in the population, how they are changing and how these variations may have occurred. Funded by pharmaceutical company Pfizer (Wyeth), this is thought to be the only study of its kind to be carried out in the UK during the introduction of the pneumococcal conjugate vaccines. Stuart was awarded the Bupa Foundation award category of 'best emerging medical researcher in the UK' in 2009 for leading this world-class research.

A complex disease

The pneumococcus is an important cause of invasive pneumococcal disease (IPD), including meningitis, sepsis and pneumonia. It also causes minor infections such as middle ear infection (otitis media), mainly in children. IPD is a complex disease: there are at least 91 different types (known as serotypes) of pneumococcus, depending on the characteristics of the protective capsule that surrounds the bacterium, shielding it from our immune system. The pneumococcus can also swap DNA between its own species and other *Streptococcus* species, which allows it to survive, spread and become resistant to antibiotics. This has led to debate among medical professionals about the effectiveness of vaccines against the pneumococcus.

Using molecular surveillance techniques, Stuart's team has monitored the epidemiology, or spread, of the different serotypes of pneumococcus in the population since 2001. "When the pneumococcal vaccine was licensed for infants and young children in the USA in 2000, we started monitoring the spread of pneumococcal bacteria, in preparation for the vaccine being introduced into the UK childhood immunisation schedule," says Stuart.

The new vaccine, Prevenar, protects against seven serotypes of the pneumococcus and stops these from being carried in the nose and throat, in theory preventing them from being passed between people. By the time Prevenar was introduced into the UK childhood immunisation schedule in 2006, Stuart's team had collected five years of valuable baseline data on the natural variations of the pneumococcal bacteria in the population. The results showed that even before the vaccine was introduced, there were fluctuations in the different serotypes of the pneumococcus circulating in the population.

Increasing public confidence

The pneumococcus can be carried in the nose and throat from an early age without causing any symptoms. Other studies have estimated that up to 40 per cent of people may be carriers of the pneumococcus, and could potentially be carrying IPD. The pneumococcus can enter the bloodstream from the nasopharynx to cause meningitis, sepsis or pneumonia.

The research supports pneumococcal vaccination policy and, importantly, the results give the public confidence that this is an effective vaccine for children. Stuart explains: "In theory, once the conjugate vaccine has been implemented in the childhood schedule, not only should it stop causing disease, but it should no longer be carried in the nose and throat. "This is vital in nurseries and schools, where these types of bugs can be spread by close contact, just like a common cold. Then, someone who is vulnerable to the bacteria will get a serious illness such as meningitis, sepsis or pneumonia. If all the children are vaccinated against the pneumococcus, then the spread will be significantly reduced."

Informing pandemic vaccine policy

Stuart's research could also be valuable for informing vaccine policy in a pandemic. No one knows what effect a pandemic, such as the recent H1N1 swine flu, has on the other bacteria that people carry in their nose and throat. Stuart's team hopes to do a large, community-based study to investigate the effects on the pneumococcus.

"We aim to look at how the pneumococcus is carried by people before, during and after a pandemic, over a three-year period," Stuart explains. "There are still a lot of questions around the interactions between viruses and bacteria and the nose and throat – for example, which one comes first: is it the flu that comes first and you get pneumococcal pneumonia, or is the pneumococcus already there and it's just waiting for the flu to come in and damage your respiratory tract to enable the pneumococcus to take effect?"

International partnerships

The team works in partnership with groups in Singapore and Kuala Lumpur in Malaysia. Stuart explains: "These countries have an interest in the pneumococcus and their vaccines aren't yet freely available to the public. This means that they are provided on a private basis to people who can afford it – but many people can't afford to have the vaccine.

"Our aim is to demonstrate that there is a real need for the vaccine to be added to the childhood schedule so everyone can access it. We will do this by improving the understanding of pneumococcal epidemiology in these countries using the same methods we're using here in the UK," says Stuart. ▸

"Vaccines in use today are generally based on the properties of single-celled bacteria. Our approach is new because we will target properties of the protective biofilms in order to design new vaccines."

Dr Jeremy Webb, School of Biological Sciences

"There are very few other places – if any – in the country that could provide all the links needed for clinical research on microbiology relating to vaccines and epidemiology in the community."

Dr Stuart Clarke, School of Medicine

During small pilot studies in these countries, the team discovered new strains of pneumococcus that had not previously been described elsewhere in the world. "This finding shows that countries in South East Asia shouldn't use data solely from the west to inform their vaccine policy. They may have different types of the bacteria and the impact of the vaccine programme may be different," Stuart explains.

Through these partnerships, researchers at Southampton can better understand the epidemiology of the disease in South East Asia, and vice-versa. PhD students, both in Southampton and in the Far East, can gain valuable experience and training abroad.

Cross-disciplinary working

Stuart's research is part of a broader collaboration with Dr Saul Faust, Director of the Wellcome Trust Clinical Research Facility and others in the School of Biological Sciences, the School of Engineering, and Southampton University Hospitals NHS Trust. Stuart's research team includes senior scientist Dr Johanna Jefferies and two PhD students, Anna Tocheva and Rebecca Gladstone, both from the School of Medicine.

There are opportunities for undergraduate students to work in this area: each winter two fourth-year medical students join the team as part of their in-depth study. This summer, a student sponsored by the Nuffield Foundation will also be joining for a placement project. "We are supportive as a group in terms of training and we also have major collaborations across the School of Medicine and Biological Sciences, which give our members opportunities for multidisciplinary working," says Stuart.

One important partnership involves a groundbreaking project on designing new vaccines to protect against the pneumococcus that has won funding from the Bill and Melinda Gates Foundation. The aim is to create vaccines to stop bacteria 'ganging together' and forming a defence layer, or 'biofilm', against antibiotics and the body's immune system. By targeting these biofilms, the team hopes to reduce the mortality associated with meningitis and pneumonia.

The project is led by Dr Jeremy Webb from the School of Biological Sciences. Stuart's team will be a key part of the project and will work alongside researchers from the universities of Liverpool and Bristol.

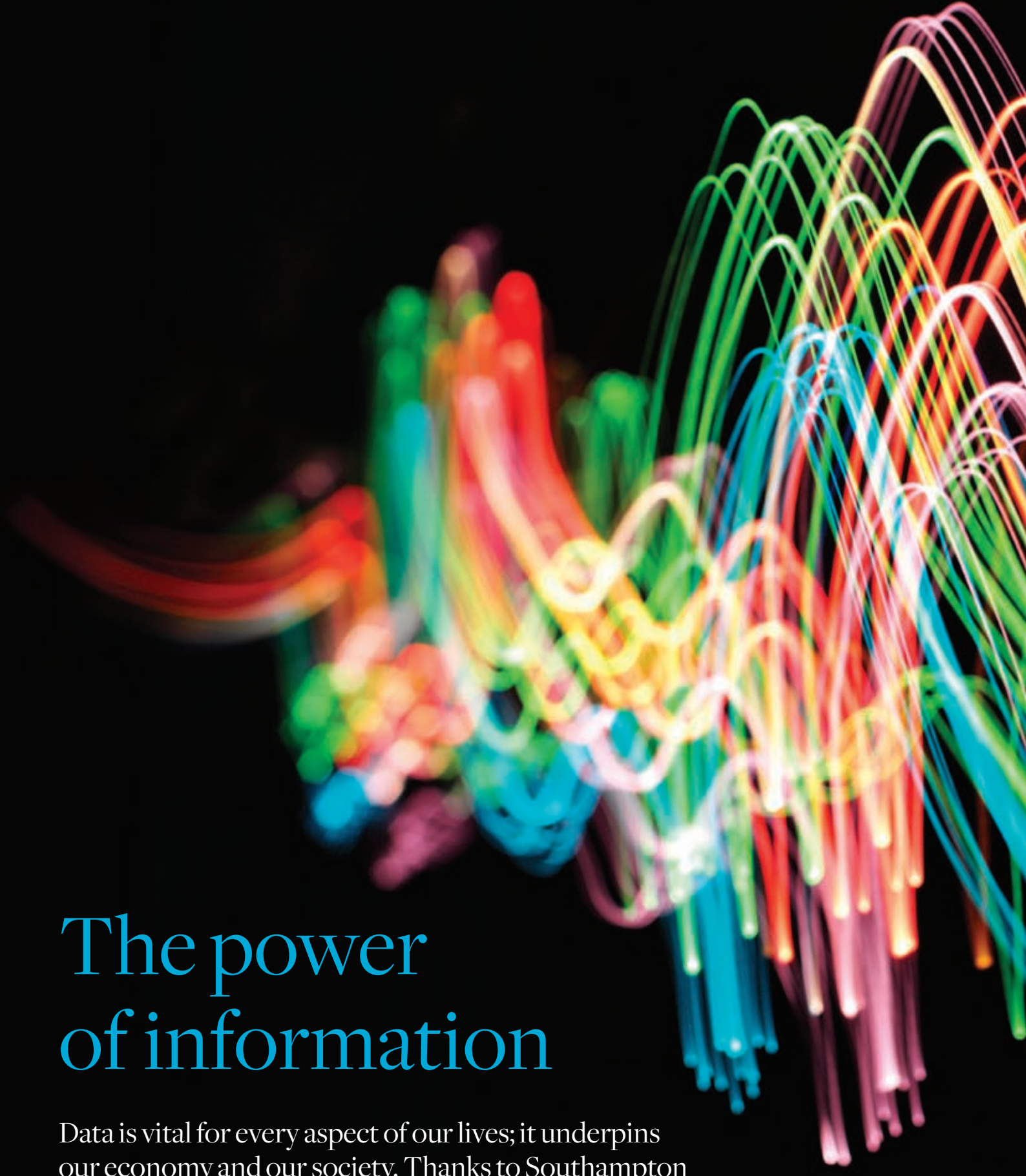
Jeremy comments: "People often think of bacteria as single organisms, but in reality most bacteria cooperate to form complex communities.

"Vaccines in use today are generally based on the properties of single-celled bacteria. Our approach is new because we will target properties of the protective biofilms in order to design new vaccines."

Stuart emphasises how working at Southampton has given him a unique opportunity to work across teams. "We have the School of Medicine, a major teaching hospital, and also benefit from having the Health Protection Agency (HPA) regional microbiology laboratory downstairs from our laboratories. As I have a joint appointment between the University and the HPA, this provides excellent links for research in this field."

"There are very few other places – if any – in the country that could provide all the links needed for clinical research on microbiology relating to vaccines and epidemiology in the community."

For more information this research, visit **www.som.southampton.ac.uk/research/iii/groups/infection** ■



The power of information

Data is vital for every aspect of our lives; it underpins our economy and our society. Thanks to Southampton professors Nigel Shadbolt and Sir Tim Berners-Lee, an unprecedented range of UK government information is now freely available to the public, opening up its potential for creating practical and innovative tools.

"It's essential that the data is 'unlocked' and put onto the web so that the world's biggest challenges can be addressed by scientists working together across different disciplines."

Professor Sir Tim Berners-Lee, School of Electronics and Computer Science

"A lot of the knowledge of the human race is currently sitting on private databases and not shared. We urgently need to move away from this 'siloed' thinking."

Professor Sir Tim Berners-Lee, School of Electronics and Computer Science

We use data every day to find out if transport systems are running on time, look for doctors and dentists, and find out about house prices and crime rates in different areas. Linking different types of data together makes it all the more powerful, and this can only be done through sharing information on the World Wide Web.

Last year the Prime Minister, Gordon Brown, asked professors Nigel Shadbolt and Sir Tim Berners-Lee, of the School of Electronics and Computer Science, to help transform public access to government information. As world-leading experts in the field of computer science, they have the know-how to make this work: Sir Tim is the inventor of the World Wide Web and Nigel a leading authority on the Semantic Web. They are co-founders of the Web Science Trust and Directors of the Web Foundation, both organisations devoted to promoting our understanding of the Web and its impact on society. The two professors are also leading the new £30m Institute for Web Science, a collaboration between the universities of Southampton and Oxford set up in March with funding from the UK government's Department of Business, Innovation and Skills. In addition, Sir Tim is a Professor at Massachusetts Institute of Technology in the USA, where he also directs the World Wide Web Consortium that establishes the standards enabling the Web to run free of proprietary interests.

Public empowerment

Nigel and Sir Tim had a key role in the development of data.gov.uk, a website that allows people to view public information, with the ability to combine different threads of data and analyse them in innovative ways. Launched in January 2010, the data.gov.uk site was developed in just six months, with Nigel and Sir Tim working closely with a small group of technical and delivery experts, with leadership from the Cabinet Office.

An important part of the site's development was the release, after only a few months, of a test site that computer programmers and developers could use, comment on and help improve. Data.gov.uk was then launched to the public in January as a work in progress. It was built with very modest resources and uses open-source software.

Data.gov.uk contains almost 3,000 sets of data from across government about all aspects of our lives, ranging from information about education and traffic, to tax and crime. All the data is anonymous. It has all been collected, and has been paid for by the taxpayer already. The data has been released on data.gov.uk in a format that can be reused by any individual or business to create innovative new applications. These include giving information on house prices, local schools, amenities and services, or access to local hospitals. There is even a mobile phone application that lets you know the current anti-social behaviour order (ASBO) rate for your area.

The data.gov.uk site has been favourably compared to the US version, data.gov, which was introduced last year by the Obama administration and also offers open-access data to the public.

Mashing up the data

The ethos of data.gov.uk is to encourage people to be inventive and combine the different types of government information in innovative ways. This enables the creation of useful practical applications that go beyond what we could do with single, isolated sets of data.

With blogs, forums and other ways to share ideas, visitors to the website are actively encouraged to get involved and add their ideas for 'data mashups'. These are novel ways of combining different sets of data, and great examples of collaborative working in action. For example, a mashup combining addresses of local schools and their league table results could form a useful mapping tool for parents and school-age children who want to find out where the high-achieving schools are in their area.

Other ideas posted on the website include a map showing where all the CCTV cameras are in the UK and an application that generates shopping lists based on foods ranked by the Food Standards Agency's 'traffic light' system.

Sir Tim has long been an advocate of the release of data from public sources and for inspiring people to share their data in this way to promote innovation. "Government data should be a public resource. By releasing it, we can unlock new ideas for delivering public services, help communities and society work better, and let talented entrepreneurs and engineers create new businesses and services," he says.

The website aims to change the culture of Whitehall and town halls so that data is seen as public property. Nigel comments: "Making more public sector information and data available is crucial if we are to exploit the innovative talent available to us in this country to produce really outstanding applications that have social and economic value.

"The vision is that citizens, consumers and government can create, reuse and distribute public information in ways that add value, support transparency, facilitate new services and increase efficiency. It is a job that is never going to be entirely finished; governments are always collecting data."

Creating links to unlock innovation

The ethos of discovery of data.gov.uk is underpinned by the ideas behind the Semantic Web, which is evolving from the World Wide Web. The brainchild of Sir Tim and the major area of Nigel's research, the Semantic Web enables data to be linked in imaginative new ways. Just as people add value to the familiar web of documents by creating links between pages, it is also possible to add value between data sets using a range of semantic technologies. The ability to link (or mash up) different data sets provides new information and new ways to access it.

Sharing raw data allows scientists to ask questions no one has asked before. "It's essential that data is 'unlocked' and put onto the web so that the world's biggest challenges can be addressed by scientists working together across different disciplines," says Sir Tim. "A lot of the knowledge of the human race is currently sitting on private databases and not shared. We urgently need to move away from this 'siloed' thinking."

Democracy in action

Nigel is now leading a panel of experts, which includes local government chief executives, information technology experts and entrepreneurs. They will work closely with key and relevant organisations to help improve local public services and empower citizens. Over a period of two years, the panel will aim to advance understanding of why the release of local public data is also important and how it can be used for the benefit of the public. This work will also feed into the continued development of the data.gov.uk site for all public data.

The website has been warmly received. Referring to the achievement of data.gov.uk, the Prime Minister, Gordon Brown, has commented: "Already as a result of the Berners-Lee–Shadbolt initiative a transformation is at work. A myriad of applications are being developed on the web by citizens for citizens – new websites on health, education, crime and local communities – that inform, enrich and enliven our democracy. It is truly direct democracy in action."

For more information about the project, visit www.data.gov.uk

For more details about research at the School of Electronics and Computer Science, see **www.ecs.soton.ac.uk/research** ■

Training tomorrow's technical experts

Today's global challenges require the world's top research talent. Southampton's three Doctoral Training Centres rise to this challenge, providing a revolutionary learning environment for tomorrow's leading researchers.

The Doctoral Training Centres (DTCs) in Complex Systems Simulation, Transport and the Environment, and Web Science give students the skills they need to address some of society's biggest challenges, including climate change, energy, our ageing population and high-tech crime. Funded by the Engineering and Physical Sciences Research Council (EPSRC), these Centres form part of a UK-wide £250m initiative to build capacity in technical expertise.

Each Centre offers a four-year multidisciplinary postgraduate programme. The first year is taught, and includes short courses and project work tailored to the students' backgrounds and research interests; this prepares them for three years of challenging and original research at PhD level. Wherever they are based, students benefit from the continued support of staff and peers from the DTC, throughout their PhD and beyond.

Complex Systems Simulation

Improving our understanding of large-scale, complex systems – such as IT networks, ecosystems and financial markets – is essential for addressing the most pressing challenges for society, government and industry today.

The DTC in Complex Systems Simulation brings together world-class simulation modelling research activities from across the University, including our state-of-the-art supercomputer. Over 50 academics spanning 14 research groups are involved in the Centre, which is recruiting 100 new doctoral research students over the next five years.

"The great thing about the DTC is that it combines state-of-the-art modelling to tackle today's biggest challenges, such as climate change, drug design and global finance, with research into some of the most profound fundamental questions in science and engineering," says Dr Seth Bullock, Director of the Complex Systems Simulation DTC.

Postgraduate student Angela Watkins, in the first year of her programme at the DTC, is researching the movement of mammals through fragmented habitats. This will improve the evidence-base for land managers and conservationists. She comments: " The eclectic mix of people is what really makes this course work. It has been an excellent learning environment, opening up doors to collaborate with people and using ideas from other fields and disciplines."

Transport and the Environment

Transport systems around the world face major challenges in terms of reducing carbon emissions, improving capacity, maintenance of an ageing infrastructure, and adapting to an ageing population and climate change. The world needs researchers who can provide solutions to these challenges.

Through the Engineering Doctorate (EngD) scheme, the Industry Doctoral Training Centre (IDTC) in Transport and the Environment gives students the business skills they need to turn pioneering ideas into products and services, boosting their impact on the UK's economy. The EngD scheme is unique in combining master's-level technical and management courses with PhD-level research in collaboration with an industry sponsor. There are 10 fully funded EPSRC studentships available each year.

"The programme offers a 'fast track' route to chartered membership of the engineering institutions and past Southampton EngD graduates have achieved rapid promotion within their companies," says Dr. R. Neil Richardson, EngD Director at the IDTC.

EngD student Kevin Briggs is studying the impact of extreme seasonal weather and projected climate change on the stability of the UK's railway embankments. His findings will provide guidance for Network Rail and London Underground. Kevin is in the third year of his EngD, and his research has already won several prizes.

"For me, the main benefits of the DTC have been seeing my project driven at an industrial pace and to have gained recognition from industrial peers: I can already see the results of my research applied to the real world," says Kevin.

Web Science

Web science is a new but rapidly growing interdisciplinary research area, pioneered by the University of Southampton and Massachusetts Institute of Technology. The increasing global interest in researching the World Wide Web will enable greater understanding of the complex technical, social, economic and cultural inter-relations that are shaping its growth, diversification and development.

Funded by the Research Councils UK Digital Economy programme, the DTC in Web Science brings together researchers from across the University, from the Schools of Health Sciences, Law, Economics, Sociology, Mathematics, Psychology, Humanities and Electronics and Computer Science. It will train 80 PhD students over the next eight years.

"We believe that career prospects for web scientists will be very bright indeed as companies increasingly become aware of the need for highly qualified people with this range of interdisciplinary skills," says Professor Dame Wendy Hall, Director of the Web Science DTC.

Postgraduate student Mark Schueler is researching internet-enabled social software used in organisations – popularly known as Enterprise 2.0; he is particularly interested in its uses and social impacts. "The DTC has provided me with solid training in research methods and related skills, as well as access to a wider research community working in related domains," says Mark.

For more information, visit the web pages for the three DTCs.

- Complex Systems Simulation **www.southampton.ac.uk/icss**
- Transport and the Environment **www.southampton.ac.uk/idtc**
- Web Science **www.webscience.ecs.soton.ac.uk/dtc** ■

Harnessing life-changing energy

Many people in rural villages across Africa have no electricity. An energy supply would create life-changing benefits, such as pumped water and refrigeration for vaccines. Southampton researchers are leading an innovative project looking at how this energy can be introduced in an economically and environmentally sustainable way.

The University of Southampton is leading an international and multidisciplinary consortium to develop a model for introducing a sustainable electricity supply to rural communities in Africa over the next five years. The project has been awarded £2.6m from the Engineering and Physical Sciences Research Council (EPSRC).

Researchers from the University's School of Civil Engineering and the Environment are designing and sourcing the sustainable energy equipment needed for the electricity supply. They are working with researchers from the School of Social Sciences who will engage with the local communities and introduce the electricity from a cultural and social perspective. Researchers from Imperial College London are developing business models with the aim of making the new energy supply economically sustainable for the villages. Project partners include the World Bank, Department for International Development, International Energy Agency, Alliance for Rural Electrification and universities across Africa.

"The overall ethos is enabling people in the villages to become a partner in this project that will deliver them electricity; this partnership is crucial so that the energy supply remains sustainable and profitable for in the long term," explains project leader Professor AbuBakr Bahaj, from the School of Civil Engineering and the Environment.

Innovative approach

The first step is extensive groundwork to select the villages that will benefit most from an electricity supply. The team are using mapping data from Kenya and the World Bank that defines poverty levels and identifies areas where there is no electricity and no immediate plans to connect to the existing grid, often because large distances or difficult terrain make it too expensive.

Having lived in Kenya for some years, Professor Nyovani Madise, from the School of Social Sciences, appreciates the challenges: "Typically the types of villages we're looking at have mud houses with thatched roofs; often the main source of fuel is wood, which has implications for forest degradation."

"The geography of the village is a key consideration for the type of renewable energy we introduce," explains AbuBakr. "We will be creative in introducing the technology – depending on the natural resources and the needs of the village."

Community engagement

For a village that has never had electricity, its arrival can be life-changing. There are many potential benefits to health and wellbeing, education, security and the local village economy. For example, the additional light enables longer opening hours for community clinics and small businesses, as well as more hours for schooling and studying.

Engaging with the villages early is a key part of this process – and getting it right first time is crucial. "The villages have an organisational structure: there is usually a village head man or woman in charge, who will be our 'gatekeeper' to the rest of the village," explains Nyovani. After meeting the village chief, the next step is a community meeting in a public place at the village. The team from the School of Social Sciences will then spend time with local people in several identified villages in Kenya, finding out how each community would use an electricity supply.

"This could include agriculture, business ventures or healthcare," explains Professor of Global Health and Social Statistics, Zoe Matthews. "We are seeking to identify villages where there is a good chance of implementing a renewable energy supply that the village is able to sustain."

Technology solutions

Any sustainable technology used in the villages will need to be easy to run and maintain. Solar photovoltaic panels are a good example of low-maintenance renewable energy; one panel, measuring one metre by half a metre, will power a few lights in a building. Solar panels can be added or removed depending on the demand for energy. The only maintenance needed is changing the battery around every five years.

"The overall ethos is enabling people in the villages to become a partner in this project that will deliver them electricity."

Professor AbuBakr Bahaj, School of Civil Engineering and the Environment.

A wind turbine may be the best option for some villages in exposed windy areas, but as these have moving parts, they need more maintenance. So to be self-sufficient, this is only a viable option in villages that can repair and maintain a turbine. Other options for energy systems include hydropower – making use of a fast-flowing stream using a water-wheel to generate electricity, using biomass: food or agricultural waste to generate heat, or even a 'hybrid' system using a combination of different energy sources.

The energy systems will be 'modular', with each village having a customised energy solution. "Each hut could have its own energy supply; or if the huts are in close proximity, they could be connected in a 'mini-grid'. However, the issue with a mini-grid is that some people may take more power than others; this is where understanding the social dynamics of the village becomes crucial," explains AbuBakr.

Good business sense

For the project to succeed in the long run, the villagers need to take ownership of the resource and make it profitable, so it will continue to run long after the five-year project finishes.

Nyovani explains: "The way this works depends on what the villagers decide to do with the electricity. 'Profit' could be the overall improvement in wellbeing or things they can do as a community. One key example is education: a lot of young people study in the evenings by candle light. But if there was electricity in a nearby school, they would have the option of studying at the school."

Many rural villages have community development committees, which generate funding to put back into the community, for example, by charging for the use of a communal facility. "From my experience in Kenya, I've learned that charging mobile phones could be a very profitable business. Most people in rural Africa own a mobile phone, and they may have to walk for miles to get it charged – so villages could provide this service if they have electricity," says Nyovani.

Studying the long-term effects

By looking at comparable villages – including both control groups (with no electricity) and intervention groups (where the electricity has been introduced), the team will objectively measure the effects the energy has on the community.

The socio-economic status of each household will be a key factor to measure, and one way to do this to look at how much a family spends on food. "This doesn't always work where the transactions involve exchanging goods – for example trading different types of vegetables. So we are using innovative approaches to ensure we include all transactions, even when money doesn't change hands," explains Nyovani.

The team will also look at the effects on health – for example the facilities available for pregnant women, children's health and the educational attainment of young people.

Extending valuable knowledge

Along with improving the wellbeing of local people, this project will add to the sparse body of knowledge about the electrification of rural villages. Partner organisations and researchers in Tanzania, Mozambique, Uganda and Ghana have already expressed interest in the findings. ▸

Photovoltaic

"A lot of young people study in the evening by candle light. But if there was electricity in a nearby school, they would have the option of studying at the school."

Professor Nyovani Madise, School of Social Sciences

"This project seeks to progress existing work from 'one-off' projects to the delivery of replication models that drive down costs, raise quality and local participation, and enhance the villagers' quality of life," says AbuBakr.

Research fellow Hildah Essendi joined the team this year as part of her PhD at Southampton, having studied anthropology and worked as a researcher in Kenya. "This project gives me a great opportunity to develop my interest in maternal and child health by looking at how electricity impacts on health of the community. Working in a multidisciplinary team and having access to cutting-edge facilities in the School of Social Sciences means I have access to expertise and equipment that wouldn't be available elsewhere," says Hildah.

Seven of the project partners are based in Africa. Leaders in the field from these partners will be invited to Southampton to take part in workshops, enabling them to become champions for introducing sustainable energy in their own countries.

Nyovani comments: "Working with researchers and partner organisations based in Africa will expose the UK researchers to different perspectives and a better understanding of the local context. There are also opportunities for us to provide training and knowledge transfer to less well-resourced social science departments around the world. For all involved, our collaboration provides an opportunity to nurture lasting working relationships."

For more information on this project, see **www.energyfordevelopment.net** ■

Providing for an ageing population

Older people are the major users of health and social care services – and our population is ageing. Southampton researchers are providing new evidence on how these trends are affecting both the supply and demand of healthcare.

In the UK today, people are living on average nearly 20 years longer than at the turn of the twentieth century, which is impacting on both the supply and demand of healthcare. The University will have a key role in improving the evidence base for informed healthcare policy through a five-year multidisciplinary research project with £3.3m funding from the Engineering and Physical Sciences Research Council (EPSRC).

Considering both supply and demand

This project brings together world-leading research teams from four of the University's leading international research centres: the Centre for Research on Ageing (CRA); Economic and Social Research Council (ESRC) Centre for Population Change (CPC); Centre for Operational Research, Management Science and Information Systems (CORMSIS); and Institute for Complex Systems Simulation. They will work together for the first time to collate and analyse data on a range of factors influencing health and social care, including population, ageing, disability, disease, new technologies, income and wealth.

"The increase in the number of over 65s is leading to a two-way pressure on care services. Demand is increasing, while the supply of care workers is decreasing as the workforce gets older. Furthermore, changes in family dynamics will also affect the potential supply of informal care," says project lead and Director of the CPC, Professor Jane Falkingham.

"This will be the first piece of research to deal comprehensively with both the supply and demand sides of both health and social care."

Cross-disciplinary working

The project will draw on the strengths of the four research centres across a diverse range of research methodologies. The research team will carry out interviews, workshops and focus groups to discover the supply and demand issues for health and social workers, as well as the receivers of care, on an individual basis. They will analyse the best available empirical data on individual and household demand for social care.

Using the University's state-of-the-art supercomputer, the research team will create models of the socio-economic processes and organisations within the UK's health and social care system. These models will address the supply and demand for health and social care, both formal and informal.

Members of the research team are experts in using computer simulations to model systems of humans and their interactions. "It's a bit like the computer game SimCity," explains Professor Sally Brailsford of CORMSIS. "You have an artificial population, say a virtual care home, and you can see the effects of changing certain factors, such as the number of nurses.

"The models range from individual clinics, to cities and to nations – and these exciting new modelling approaches will enable us to look at the interaction between these different scales. It's also important to realise that every health worker is a potential patient."

Joined-up thinking

A key outcome of the project will be to effectively communicate the results of the complex models to policy makers and the public. The research team will engage with policy makers, communicating the results of the models with them and also feeding back into the models with findings from focus groups and interviews.

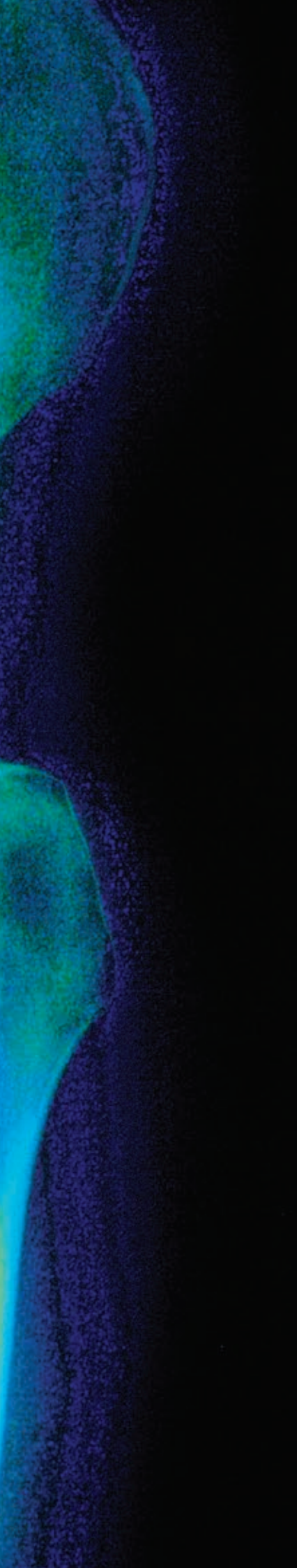
"This multidisciplinary approach is essential: we have come as far as we can with the individual approaches and now we need this fresh perspective, using several different techniques, to see the challenges properly," says Maria Evandrou, Director of CRA.

The project will create opportunities for early career researchers. Five EPSRC-funded research fellows will be appointed later this year and there will be four linked PhD studentships.

"This study has a huge potential impact on society," says Jane. "It can take many years to train a specialist healthcare worker, so governments need to plan ahead. Our results will improve the evidence base on how many doctors, social workers and nurses we will need in years to come, allowing policy makers plan for the future."

For more information about our other multidisciplinary research themes, visit **www.southampton.ac.uk/research/themes** ■

Innovation through business partnerships



Business partnerships with the University give companies access to our world-leading research and expertise, as well as having a positive impact on the wider world.

Knowledge Transfer Partnerships (KTP) can lead to a wide range of benefits, from healthcare innovations, to green energy solutions, to improving the educational prospects of disadvantaged children. KTP is a part government-funded scheme that enables a graduate to work in a partner organisation to manage a specific business project.

Working on the project for up to three years, with continued support from an academic supervisor at the University, the graduates benefit from real industry experience, while partner companies can tap into the University's vast range of research expertise to create new and innovative products and services. Many of our Graduate KTP Associates have gone on to study for a PhD.

All the projects have strategic importance to the company and their findings can be applied to the wider world. The following two case studies show the difference a KTP with Southampton can make.

Bringing a life-changing product to market

Every year thousands of people need a hip resurfacing operation to improve their mobility or reduce joint pain caused by arthritis. A partnership between the University and global company Finsbury Development Ltd has led to the creation of a new ceramic implant that is much more hard-wearing than the metal implants that are currently used. This groundbreaking new device could improve the lives of thousands of people every year.

Finsbury develop advanced joint replacement products – such as knee, hip and small joints replacements. They approached the University in 2006 for a KTP to help them develop a novel hip resurfacing system. In previous years they had also successfully engaged with students in the School of Engineering Sciences in individual and group design projects, benefiting from the University's high-calibre mechanical and computational modelling expertise.

"We opted for a KTP because we knew it would help us develop a new product range with a high level of control as a result of hosting a graduate to carry out the development on site," says Andy Taylor, Managing Director of Finsbury Development.

There are many advantages for using ceramic rather then metal implants, including their extreme wear resistance and inertness. In the past, concerns about the brittleness of ceramics have limited their use. However, in this KTP, large ceramic implants have been developed that enable the hip to retain its natural range of motion more closely while having a very high fracture resistance. ▸

"The economic downturn has meant that the development of this new product has been even more business critical. We estimate that through this KTP we have saved 30 per cent of the product development costs. Alongside the University, we've presented this work at many different conferences, which in turn has raised our company profile enormously," says Andy.

Graduate KTP Associate Alex Dickinson, who graduated from Southampton in 2006 with a first-class honours master's degree in mechanical engineering, says: "I was very fortunate that Finsbury trusted me with a project that was critically important to their future development. We have developed a mechanically and biologically sound implant design with a commercialisation and marketing strategy, which should enter clinical use this year.

"All of this work has contributed to my PhD with the University's Bioengineering Research Group on the development of improved pre-clinical analysis techniques for new hip replacement designs."

Academic supervisor Dr Martin Browne from the Bioengineering Research Group comments: "This collaboration has led to the development of new, state-of-the-art computational modelling tools. We can now apply these tools to the modelling of other implants."

Patented by Finsbury, the ceramic implant will be completely unique in the market place. The project was shortlisted as a finalist in The Engineer 2009 Technology and Innovation Awards, and four journal papers have been published based on the underpinning research. The work has been presented at five international conferences, winning the prestigious Biolox Award for the best paper at the Biolox Symposium in Edinburgh.

Breaking down barriers in education

A recent KTP has developed an evidence-based educational model for girls with special needs at a Southampton school, with the potential to benefit many more young people. The groundbreaking project with the Serendipity Centre was completed in February 2010, culminating in the girls from the Centre participating in an art exhibition as part of the *Margins* season at the Ashcroft Arts Centre, Fareham.

The Serendipity Centre is an independent secondary school specialising in the holistic education of girls aged 11 to 16 who have been excluded from mainstream education. Many have behavioural, emotional and social difficulties. Centre founder and Director Sue Tinson comments: "Girls represent 17 per cent of permanent exclusions, a figure that is rising. The girls come to us with many obstacles that prevent them from accessing traditional education and from reaching their full potential."

To develop the model, graduate KTP Associate Georgie Boorman used published research and data from a range of stakeholders on the educational and social needs of girls who have experienced disaffection and exclusion. Georgie, who is now studying for a PhD in the School of Education, explains: "An important element of the project was to hear the views of those involved – the students, staff, parents, carers and other professionals, in order to develop a model that was meaningful and relevant."

Key features of the model include: a holistic approach, an integrated curriculum, and enabling the girls to have a sense of control and choice. It focuses on raising the girls' aspirations for the future, such as re-joining mainstream school or college.

The Serendipity Centre was deemed to be 'outstanding' in their latest Ofsted inspection, and they acknowledge that the KTP played a big part in this. Sue explains: "The new model has introduced dramatic changes at the Centre. The curriculum has significantly improved our students' welfare and attainment both within the school environment and outside. Some of our students have returned to mainstream education, while others are leaving with recognised qualifications – something that was unthinkable before they came to us."

The project involved using multiple media to communicate the model through a web-based portal. "This new technology has been embedded in the curriculum, giving the School new engaging and visually appealing teaching materials," explains Georgie.

The partnership was supervised by Professor Melanie Nind and Dr Gill Clarke, both from the School of Education at the University. Melanie says: "This project has connected and applied strands of research in gender-specific and inclusive education as we set out to do.

"It has also led to exciting synergies between research in social justice and inclusion, narrative research, creativity and digital technologies, opening up new networks and possibilities for the academic community."

The model is transferable and is now being used for the development of a commercial product by the Centre, which could be applied to other settings supporting students who have been excluded from the current mainstream education structure.

Opportunities

The University of Southampton has a range of schemes to enable external organisations to access the expertise of the University.

To find out more, visit **www.southampton.ac.uk/business** or email businessenquiries@southampton.ac.uk ■

In brief

Going for gold

Two Southampton research engineers played an integral role in UK Sport's research and innovation team, working with British Bob Skeleton, to help Amy Williams win her gold medal in Vancouver.

Rachel Blackburn and James Roche, both Engineering and Physical Sciences Research Council (EPSRC) funded Engineering Doctorate students, have been working with British Skeleton and UK Sport to help athletes prepare for major competitions since October 2006. Their research has helped to improve the understanding of bob skeleton performance.

The four-year project combined experimental work, the latest computational analysis techniques and has included testing in the University's R J Mitchell wind tunnel. Rachel and James worked under the supervision of Dr Stephen Turnock from the School of Engineering Sciences and colleagues in the Performance Sports Engineering Lab.

Steve says: "I am delighted with the vindication of James and Rachel's research and proud of how well they have worked as an integral part of the partnership that supported British Bob Skeleton. They have demonstrated that engineering excellence can be delivered by a small dedicated team with a clear vision."

Photograph: Sarah Winterflood/UK Sport

Pioneering stem cell research to mend broken bones

A new study led by Southampton scientists could allow the development of new and better treatments for broken bones and other orthopaedic problems associated with ageing.

Fractures, bone loss due to trauma or disease and other orthopaedic conditions pose a significant clinical and socioeconomic problem, especially with an ageing population, but as yet there is no large-scale, effective treatment for replacing or repairing damaged bones.

Researchers at the University, working alongside colleagues from Keele, Imperial College London and Nottingham universities, will combine stem cell science and tissue engineering to look at the development and repair of human skeletal tissue. The research is funded by the Biotechnology and Biological Sciences Research Council.

Project leader Professor Richard Oreffo, from the University's School of Medicine, says: "Despite intense research, significant challenges for the reconstruction of tissues such as bone remain. A key requirement for these regeneration strategies to succeed remains our ability to understand skeletal cell activity, develop appropriate scaffolds (a material structure on which cells grow) and to understand how the environment the cells find themselves in affects their ability to interact with other cells to form new bone or cartilage."

Uncovering secrets of the Roman Empire

University archaeologists have led a major excavation of Portus, the ancient port of Rome, uncovering the remains of at least five buildings over an area of one more than one square mile (nearly 3km²).

The excavation team, funded by the Arts and Humanities Research Council, worked in collaboration with the British School at Rome, the *Soprintendenza Archeologica di Roma*, University of Cambridge and universities across Europe. They conducted the first ever large-scale dig at Portus, a hexagonal-shaped harbour near the Italian capital.

"This is one of the great archaeological sites of the world that clearly deserves World Heritage status. It has much to tell us about how the Romans controlled the Mediterranean basin for over 500 years," says Portus Project Director and leading expert in Roman archaeology at the University of Southampton, Professor Simon Keay.

The team has developed an innovative approach, combining traditional excavation with a range of geophysical survey techniques, allowing them to uncover details on the layout of the buildings. One of these buildings, the so-called imperial palace, was probably the administrative heart of the port.

The University's Archaeological Computing Research Group is producing computer-generated images to bring the port to life, giving archaeologists a valuable tool with which to explore the site.

New supercomputer powers research

The University's new supercomputer, which has the power of over 4,000 PCs, has been named as the fastest Microsoft Windows-powered computer in Europe.

The £3m new supercomputer will be used by leading-edge researchers across the University to make highly complex computations in fields ranging from cancer research to climate change. It is the first IBM System iDataPlex at a UK university, and one of the 100 most powerful supercomputers in the world and the fastest University-owned supercomputer in the UK. It is also in the top 25 most energy efficient supercomputers worldwide.

The University's Deputy Vice-Chancellor, Professor Philip Nelson says: "Computer simulation is a key tool for research, and by making it more accessible we will be better able to address more and increasingly complex problems, faster than ever before.

"This significant investment will ensure that our researchers have computing facilities to rival the best in the world."

Communicating through the power of thought alone

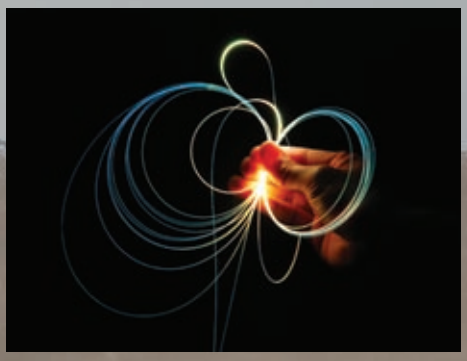
New research has shown that it is possible to communicate from person to person through the power of thought alone.

Conducted by Dr Christopher James from the University's Institute of Sound and Vibration Research, the aim of the study was to expand the current limits of brain–computer interfacing (BCI) and show that brain-to-brain (B2B) communication is possible.

BCI can be used for capturing brain signals and translating them into commands that allow people to control devices such as computers, robots, rehabilitation technology and virtual reality environments.

Christopher says: "We have yet to grasp the full implications of this, but there are various scenarios where B2B could be of benefit such as helping people with severe debilitating muscle wasting diseases, or with the so-called 'locked-in' syndrome, to communicate. It also has applications for gaming."

"These are the very first baby steps towards communication by thought. It is not impossible to imagine a future where this direct B2B interaction is commonplace. But we have a long way to go in terms of the speed, accuracy and robustness of the technology."



Photonics centre wins part of £70m boost for UK manufacturing

The University of Southampton's Optoelectronics Research Centre (ORC) is home to one of the first in a series of state-of-the-art manufacturing research centres that will help UK businesses develop the technology products of the future.

Launched in January, the Engineering and Physical Sciences Research Council (EPSRC) Centre for Innovative Manufacturing in Photonics will work with industry to develop the next generation of fibre materials and technology platforms, train engineers and fuel growth in photonics-related manufacturing.

Investment from the EPSRC in the centre will total £4.7m over a five-year period starting in March. Thirteen industrial partners will contribute a further £4.6m.

Professor David Payne, Director of the ORC, comments: "Photonics at Southampton has benefited from sustained EPSRC funding over the last 40 years and has made a huge impact on areas as diverse as the internet, laser manufacturing, environmental sensing and the biosciences."

For more information on these stories, visit **www.southampton.ac.uk/research**

www.southampton.ac.uk/research
newboundaries@southampton.ac.uk
+44 (0)23 8059 3815