COLLABORATIONS
ART MEETS SCIENCE ON CROSBY BEACH
Naked statues have become an unlikely living laboratory

ARTS
THE SHAKESPEARED BRAIN
Can Shakespeare change your brain?

ENGINEERING
HIGHLY CHARGED
Helping NASA design the future

CORPORATE
UNIVERSITY CHALLENGE
How the University is helping to improve the economic future of the Liverpool city region

SOCIAL AND ENVIRONMENTAL STUDIES
IMPACTS 08
Going 'live' in the Capital of Culture year

red brick

THE FIRST RED BRICK UNIVERSITY
THE UNIVERSITY OF LIVERPOOL MAGAZINE FOR STAKEHOLDERS
WINTER 2006 #3

welcome

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Welcome to the third edition of the award-winning *Red Brick*.

The last edition of the magazine won a silver medal in the 2006 Circle of Excellence Awards, hosted by CASE, the Council for the Advancement and Support of Education. It was a double celebration for the University of Liverpool, as we also won a gold medal for *2005 News*, our annual report. CASE honours institutions which excel in the arena of educational advancement and communications, and it was particularly pleasing to receive these awards as we were the only UK university to triumph in our category.

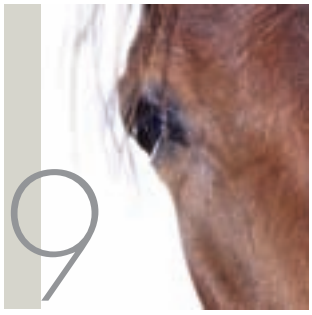
Highlights this issue include some fascinating collaborations between Science, Medicine and Art, as well as a feature on our new university in China. We also discuss the University's impact on the regional economy and our plans for even greater engagement with our community in the future. I hope you continue to enjoy *Red Brick*. Give us your feedback by emailing: **redbrick@liv.ac.uk**

Professor Drummond Bone
Vice-Chancellor

contents

13

16



19

02
03

Collaborations: art meets science on Crosby beach
Words:
Shirley Morgan
Photos:
Adrian Pallant

art meets science on crosby beach

LIFE-SIZE NAKED STATUES ON THE MERSEYSIDE COAST HAVE BECOME AN UNLIKELY LIVING LABORATORY.

***Another Place*, the controversial art installation by sculptor Antony Gormley, has come under the critical gaze of not only the nation's art lovers but also marine biologists from the University of Liverpool's School of Biological Sciences.**

The 100 cast iron figures, each a replica of the artist's own body, rise from the sand on Crosby beach and stare out towards the sea. In the year since their installation they have become home to a thriving colony of barnacles which have provided the marine biologists with some important information on colonisation, having – not to put too fine a point on it – invaded the most intimate cracks and crevices of each sculpture.

That's an important finding for Dr Leonie Robinson and her team, but even she can't resist a wry smile when she talks about the colonisation of the statues.

She says: "It's a strange thing to study but it's true that the barnacles like to live where they are protected from environmental extremes. This is why they prefer parts of the statues they can nestle into – for example, the armpit is a favourite settlement spot and they generally prefer the back of the body because it affords more shelter than the front."

The installation of the statues has provided the Biological Sciences team with a unique opportunity to study the colonisation of a man-made structure on the shoreline. Because each statue is identical in size and shape and made from the same material, they provide a perfectly replicated study design to test for the effects different locations have on barnacle settlement.

Each one is subject to different prevailing currents and tides; some are totally submerged at high water whereas some are not, and it's these variations that are crucial in the study.

"We are really using them to test some well-established theories on the colonisation of intertidal rocky shores," says Leonie. "Although the key facts about barnacle colonisation are well-known, it is rare that such a perfect opportunity arises to test all of them together in such a well-designed ecological experiment."

Creatures like barnacles and mussels would not normally be found on a sandy shoreline like Crosby, but the statues give them a perfect anchor point and by looking closely at each statue and comparing it with its neighbours, the team can see which ones the creatures prefer, how quickly they establish a community and even find out where they have come from.

"Although the key facts about barnacle colonisation are well-known, it is rare that such a perfect opportunity arises to test all of them together in such a well-designed ecological experiment."

Dr Leonie Robinson
Lecturer in Marine Biology
School of Biological Sciences

Collaborations: art meets science on Crosby beach
continued

Leonie says: "By taking DNA from the barnacles, for example, we hope to locate their seeding populations or 'home' colonies to see how far these juveniles have travelled and whether they have had any element of choice in deciding where to fix themselves. If there is more than one species we will also be able to see if the species are distributed as theory would suggest, with the more dominant species inhabiting the most hospitable places – in this case the statues which are most deeply submerged."

The idea to use art as a vehicle for scientific research came as a result of a discussion between Leonie and her colleague Dr Dave Wilson, who is also involved with the study. They realised that the Gormley figures were a unique opportunity to have 100 perfectly matched but randomly distributed test sites – the sort of replication that is almost impossible to find otherwise.

They won a grant for the study from the British Ecological Society, which funded a student, Matthew Iles, who has recently completed a degree in Zoology at Liverpool.

He has been on the beach regularly assessing the colonisation of the statues – the location of each has been accurately plotted by the team using GPS – and recording the results, which will be shared with the British Ecological Society and other interested parties.

The Gormley statues have been in place at Crosby for 14 months, but the study will have to come to an end in November when they are due to be uprooted and moved to a new home in New York. Before transit they will be cleaned of all trace of Merseyside marine life – just as they were cleaned when they arrived in Crosby from their previous 'homes' in Europe and Scandinavia.

Leonie said: "As far as we are aware marine biologists in other countries have not embarked on a study like this and, though we can't do any sort of follow-up once the statues have gone, it would be interesting to set up some kind of collaborative research with scientists in New York when the sculptures are relocated there.

"We will be very sorry to see them go, but in a relatively short time we have been able to test some key ecological theories about the colonisation and successional development of communities on intertidal shores.

"I'm very grateful to the British Ecological Society for supporting such an unusual study and to the Antony Gormley group for giving us permission. I'm pleased that we have been able to use the statues for something other than visual pleasure. I think they are incredibly beautiful and their acting as hosts for marine life – even when that life makes its home in a rather delicate spot – has been of real benefit to marine and ecological science."

Researcher Matthew Iles gets close up and personal with one of the statues *(Photo: School of Biological Sciences)*

ANOTHER PLACE

The Gormley statues, which raised a few eyebrows when first unveiled in Crosby, have already been exhibited in Belgium, Norway and Germany. Each statue is a cast of the artist's own body, weighing 650kg and standing 1.96m tall.

The figures are randomly spread 3km along the coastline and 1km out to sea, and are partly submerged at different times of day, depending on changing tides and weather conditions.

Antony Gormley won the prestigious Turner Prize in 1994 and he is best known among the British public as the creator of *Angel of the North*, the massive sculpture in Gateshead now designated one of 12 official 'Icons of England' in a Government-sponsored Culture Online project.

Almost all of Antony Gormley's art takes the human body as its subject, with his own body used in many works as the basis for metal casts. According to Gormley, *Another Place* "harnesses the ebb and flow of the tide to explore man's relationship with nature".

The statues caused some controversy when first sited at Crosby – and at least one has been spotted wearing an Everton shirt – but they have attracted visitors from across the UK.

"I think they are incredibly beautiful and their acting as hosts for marine life – even when that life makes its home in a rather delicate spot – has been of real benefit to marine and ecological science."

Dr Leonie Robinson

As *Red Brick* went to press, a debate was raging over whether the statues should remain on the Sefton coastline in Crosby or move, as had been originally planned, to New York.

ABOUT THE BARNACLE

A barnacle is a type of arthropod and is distantly related to crabs and lobsters. Around 1,220 barnacle species are currently known worldwide.

Barnacles were first fully studied and classified by Charles Darwin, at the suggestion of his friend Joseph Dalton Hooker, in his quest to further his theory of evolution and natural selection.

Barnacle larvae float in the sea as part of the plankton and attach themselves to solid objects such as rocks or the shells of larger sea creatures before changing into the more recognisable hard, cone-shaped, adult barnacles. Barnacles can only feed while submerged, so are most commonly found in the intertidal zone, which is why the statues on the beach at Crosby have been so valuable a test site.

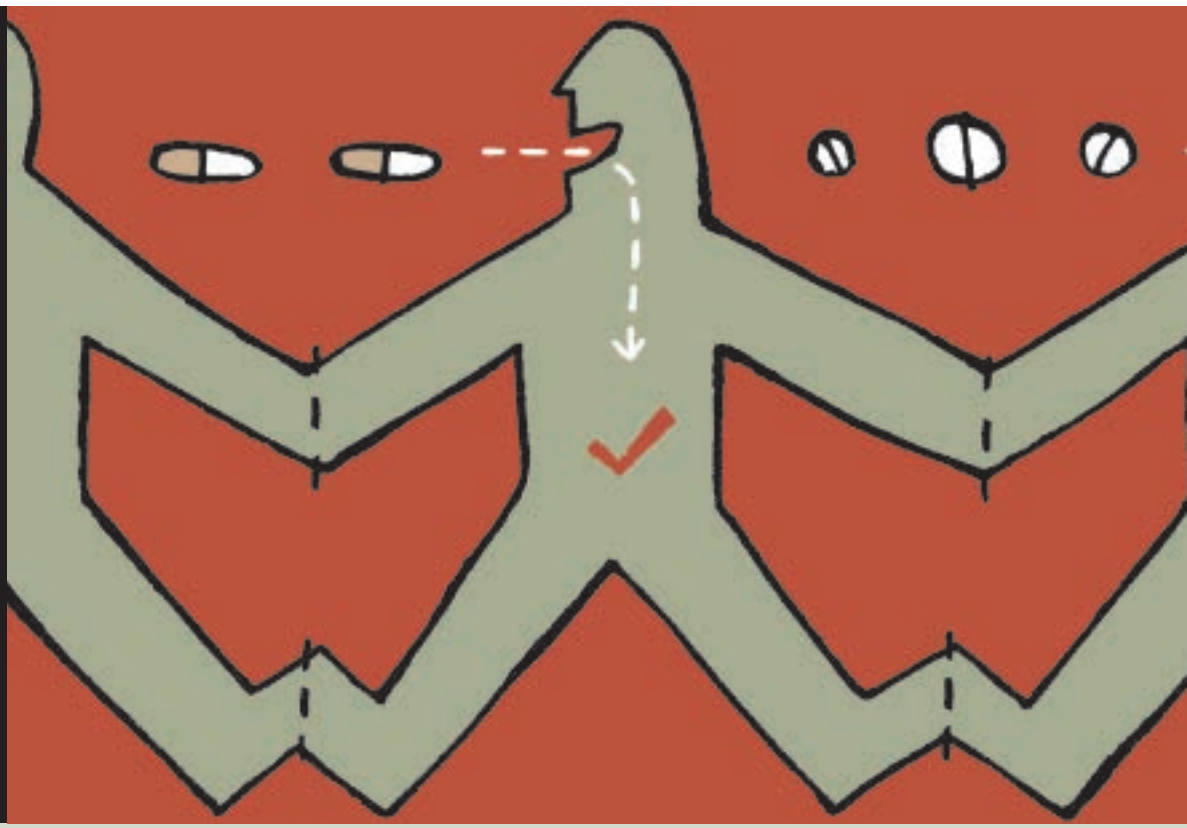
Though the research involving the Gormley statues can't shed any light on the quality of the seawater off Crosby, the speed with which barnacles took up residence on the statues indicates healthy local colonies of these tiny creatures.

The foreshore along the Sefton Coast is part of the Liverpool Bay complex of estuarine habitats. The sand dunes of the Sefton Coast form the largest dune system in England and are home to rare species such as the sand lizard, natterjack toad and great-crested newt. The coastal pinewoods support a thriving population of red squirrels.

06
07

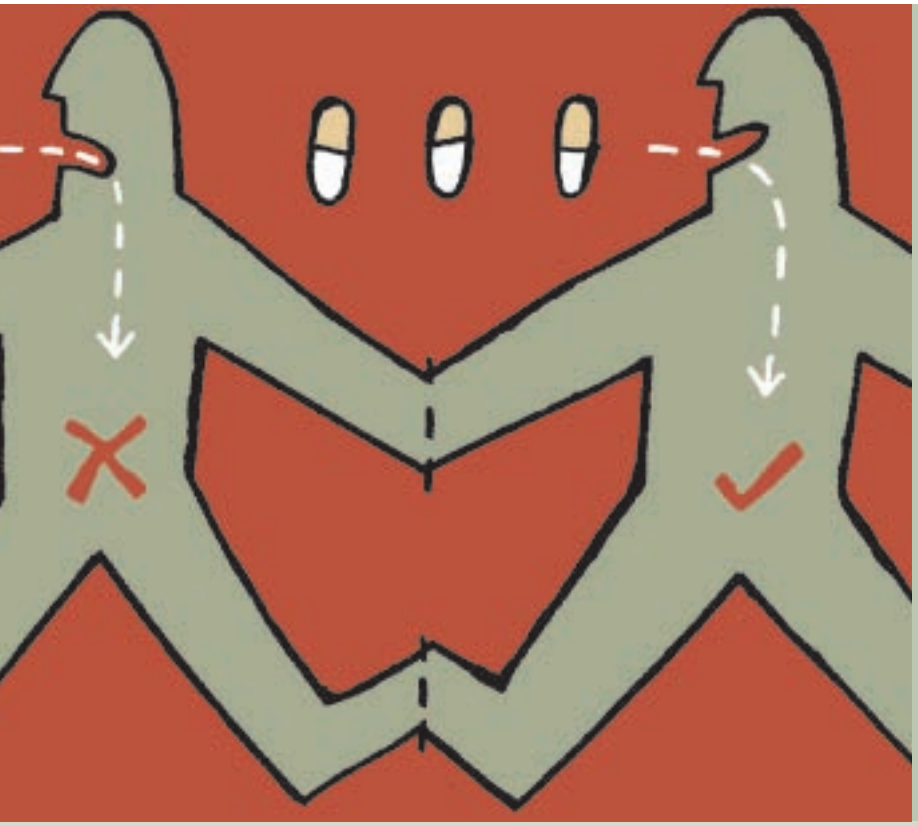
Medicine:
personalised medicines
Words: Suzanne Elsworth
Illustrations: Fréya

For more
information visit:
www.liv.ac.uk/Pharmacology
/research_metabolism.htm



personalised medicines

IT'S A PROBLEM WHICH COSTS THE NHS HALF A BILLION POUNDS AND CAUSES AROUND **10,000 DEATHS PER YEAR**. IT IS RESPONSIBLE FOR 6.5% OF ALL HOSPITAL ADMISSIONS.



Research at the University of Liverpool may help prevent drug safety disasters that kill, disable or hospitalise many people every year.

It isn't a naturally occurring disease which is having such a dramatic effect on the nation's health and the resources of the NHS. These statistics are a result of adverse drug reactions – responses to the very treatments which are supposed to help us.

But work is taking place at the University of Liverpool which will change this. Research is expanding into pharmacogenomics, or personalised medicines, which aims to identify the genetic differences that determine whether a drug benefits a patient, has no effect or, at worst, causes a severe side effect.

Currently, drugs are prescribed on a 'one dose fits all' basis but, in the future, medication will be bespoke, targeted specifically according to our genetic make-up. Plans are underway to create a dedicated centre at the University, the first of its kind in the UK, which will focus solely on research into the fundamental aspects of genetics and pharmacology.

The idea of pharmacogenomics, or pharmacogenetics as it is otherwise known, dates back to Pythagoras' time. He observed that some people eating fava beans, or dried broad beans as they are more commonly known in the UK, developed red blood cell hemolysis, a condition where the red cells break down. Some antibiotics and anti-malarial drugs have the same effect on some patients today. Subsequent research has shown that this susceptibility is due to a lack of a key enzyme which defends the red cell against toxins in beans and drugs.

The term pharmacogenetics was coined in 1959, thanks to the work of the German pharmacologist Professor Friedrich Vogel, and the University of Liverpool also has a long history of research in this area. One of the pioneers was Professor David Price Evans. He worked within the Medical Genetics Unit, which opened in 1963, when pharmacogenetics was still in its infancy. Price Evans' outstanding work was acknowledged in 1968 by the award of a personal Chair at the University and, in due course, he became Chair of Medicine. His ground-breaking studies have continued in the Department of Pharmacology and been applied particularly to the area of drug safety in a number of clinical specialties including infectious diseases and neurology.

This research has continued and expanded, taking into consideration the exciting new knowledge generated by the human genome project. The work carried out in pharmacogenomics in the University is widely recognised among other research groups in the UK and worldwide. The research is led by Munir Pirmohamed, Professor of Clinical Pharmacology at the University.

Medicine:
personalised medicines
continued

> One recent study showed that, at any one time, the equivalent of more than seven 800-bed hospitals are full of people who have suffered the side effects of drugs they have been prescribed.
>
> **Professor Munir Pirmohamed**
> Professor of Clinical Pharmacology

He explains how the findings will impact on patients' everyday life.

"When I see a patient I look at their overall health status," says Munir. "For example, imagine a patient has high blood pressure. I will decide on a drug treatment on the basis of age, gender, the other drugs they are on, and so on. Their treatment is individual, to some extent, on the basis of my clinical experience and a knowledge of the pharmacology of the drugs. Patient A may have one drug, while Patient B has another."

However, doctors cannot guarantee how a patient will react to a drug, and this has been termed (perhaps simplistically) a "trial and error" approach. A patient may not respond to the first drug prescribed. Worse still, they may suffer side effects. In the worst case scenario, these side effects could kill.

"One recent study I carried out in Liverpool showed that, at any one time, the equivalent of more than seven 800-bed hospitals are full of people who have suffered the side effects of drugs they have been prescribed," says Munir. "We cannot predict whether or not a drug is going to have a beneficial effect, but it is known that the majority of drugs we use today only work in a proportion of patients. This may be as low as 10% with some drugs, for example, drugs used to treat Alzheimer's disease.

"The amount of genetic influence varies from drug to drug and from patient to patient. In addition, there will be some environmental factors, for example, the amount a patient drinks or smokes."

Our genes can have a dramatic effect on the way we respond to drugs. Different patients will have different responses to the same drug given at the same dose for the same disease. The underlying basis for this variability is the variation within the human genome – although 99.9% of the genome is identical between different individuals, there is 0.1% that is different. This 0.1% difference determines many of our individual characteristics, such as eye colour, personality and the response to drugs.

Munir adds: "There is a genetic influence with most drugs and what we want to do is look at

these drugs to maximise their efficacy and minimise their toxicity.

"It's like finding the different pieces of a jigsaw. We need to do large scale studies on patients and, at the end of it, produce simplified prescribing information that is easy to understand. The genetic test may show that this patient has gene A and gene B. Taken together with clinical information such as weight and smoking status, it will be possible to put all this information into a computer which will then calculate whether drug C or drug D is the best treatment for this patient."

This is already happening. For example, with the anti-AIDS drug Abacavir, the occurrence of a life-threatening side effect has been reduced by using pharmacogenomics. Around 5% of patients experience a severe reaction. If a patient recovered from this reaction, but was given the drug again, they could die from the second exposure. Thanks to pharmacogenetics, this genetic factor, named HLA B57, has been identified and is now being used in HIV treatments. Patients' genetics are tested and if they are proved to be B57 positive, they are not given the drug.

"The direct, immediate, benefit of pharmacogenomics is that the patient is given the right drug at the right dose," says Munir. "There will be knock-on effects of this approach; for example, fewer hospital beds will be blocked by patients who have suffered adverse reactions. But the benefits will be even more far-reaching. We are going to learn a lot more new biology which will lead to the development of better drugs. For example, we can learn the function of gene X, and then develop drugs which will target gene X.

"We may also be able to use the knowledge to learn more about how our genetic make-up decides who is predisposed to other conditions. For example, alcohol is the commonest drug we take, but it affects people in different ways. Only 20% to 30% of heavy drinkers develop liver cirrhosis. Not everybody who smokes gets lung cancer. It's all interconnected."

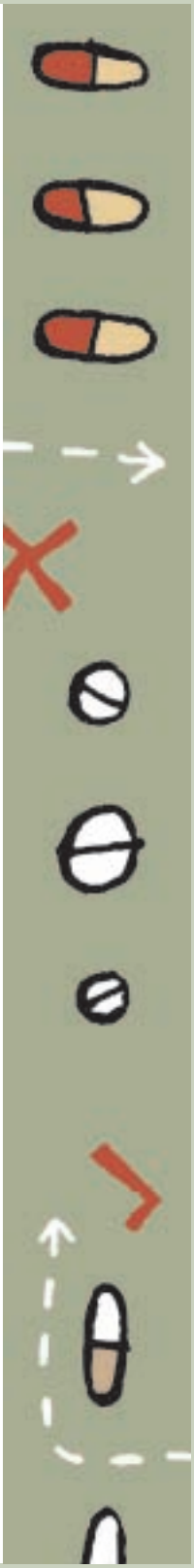
The new Centre for Personalised Medicines, which will be created within the Department of Pharmacology, will cost £10 million to set up. Initially, it will focus on drug safety, epilepsy, diabetes, HIV and thromboembolic disease, but would also start recruiting collaborators and patient samples where large patient cohorts have already been identified, including cancer, hypertension, and immunosuppressive drug therapy. The tests are relatively easy – a mouth swab or blood sample is taken to provide the patient's DNA. But the NHS currently doesn't have the infrastructure to collect, store and test the vast number of DNA samples required to take the research forward. That's why the Liverpool centre is so important.

"We have an amazing patient base here because the North West is relatively unhealthy in comparison to other regions of the UK," Munir says.

"This is a truly multidisciplinary area of research. We work with clinicians, pharmacologists, chemists, statisticians and nurses, but outside that we work with economists and social scientists, the drug regulators and the pharmaceutical industry. If we are introducing genetic tests on the NHS, but they are going to cost more than patients' adverse reactions are costing, those tests are never going to be adopted. Pharmacogenomics also has to make economic sense.

"Social scientists look at the acceptance of genetic testing. They talk to patients and clinicians and find out what they think. There are worries that people have, particularly around the ethics of genetics. But for the patients, there are other concerns. For example, will their insurance be affected if it is discovered that they are genetically predisposed to some disease? These are questions that are problematic for the Government; as a result of this, a moratorium has been placed on using genetic information for insurance purposes until 2011.

"Patients may not benefit immediately but they will benefit in the long term. It is envisaged that initial benefits from the Centre will be seen within two years, and an impact on clinical practice with certain drugs seen within five years. In the long term, the new understanding of drug response at the individual level will be translated into the design of new drugs with improved safety and efficacy profiles across the whole population."



10
11

Social and Environmental Studies: meteorology versus malaria
Words: Simon Hadlington

For more information visit:
www.amma-international.org

meteorology *versus* malaria

THE RELATIONSHIP BETWEEN WEATHER PATTERNS AND MALARIA EPIDEMICS.

This west African village hut, houses scientific instruments that measure the temperature and humidity at various locations both inside and outside every 10 minutes

MALARIA – AFRICA'S SILENT ASSASSIN

Malaria is caused by a single-celled parasite called plasmodium. The parasite is transmitted between humans by female mosquitoes of the Anopheles species. The female mosquito requires protein from blood to enable its eggs to develop. When feeding on an infected person, the mosquito picks up the parasite and becomes infectious about 10 days later, when it can transfer it to the next person it feeds on. Around the world there are more than 300 million cases of malaria each year, resulting in at least a million deaths. The vast majority of deaths from malaria occur in Africa, south of the Sahara.

It has been calculated that malaria costs the African economy more than £6 billion each year. The disease is the main killer of children under five in Africa. The majority of malaria infections in Africa south of the Sahara are caused by plasmodium falciparum, the most virulent and life-threatening form of the disease. The region is also home to the most efficient, and therefore deadly, species of the mosquitoes which transmit the disease.

In a small village in Niger in west Africa, about two hours' drive from the capital Niamey, is a rather unusual laboratory. From the outside it resembles a typical village hut, circular in shape with walls made from a framework of wooden sticks clad with woven straw and topped by a thatched roof.

Instead of being occupied by people, however, the hut's resident is a suite of scientific instruments that measure the temperature and humidity at various locations both inside and outside the hut every 10 minutes. This information is logged automatically and stored, along with observations of the mosquito population that resides within the roof space of the hut, and will eventually be used to test model forecasts of highly localised atmospheric conditions.

The hut experiment forms part of a hugely ambitious, multi-national research programme called AMMA – the African Monsoon Multidisciplinary Analysis *(see box on page 12)* – aimed at understanding the processes that cause the monsoon weather patterns in western Africa, which have an immense impact on the lives of millions of people in the region.

The timing of the monsoons and the amount of rain that falls are unpredictable, and one effect of this is that in particularly wet years there can be devastating epidemics of malaria. The experiments in the hut form part of the work to understand the relationship between weather patterns and malaria epidemics, and to investigate the possibility of developing new forecasting models that could predict the likelihood of an outbreak of malaria *(see box above)*.

Dr Andy Morse, Senior Lecturer in the Department of Geography, is one of the co-leaders of AMMA's climate impact working group. "One of our principal interests is looking at epidemic malaria on the fringes of the desert in west Africa," he explains. "Malaria is prevalent throughout tropical Africa but, where it occurs every rainy season, the adult population – apart from pregnant women – develop immunity. Children under five can die because they have immature immune defences, and pregnant women have compromised immune systems.

"However, on the desert fringes where malaria does not occur every year, the population does not develop immunity," Andy says. "In a particularly wet year mosquitoes breed and there can be a serious malaria epidemic that will kill across all ages, including the principal breadwinners, and this can have devastating social and economic consequences."

In these areas of west Africa, if it were possible to predict an epidemic of malaria, relevant agencies could mobilise efforts to implement strategies to mitigate against the effects of an epidemic – by issuing prophylactic drugs, for example, provided sufficient funding was available.

12
13

Social and Environmental Studies: meteorology versus malaria
continued

The mosquitoes that carry the malaria parasite require water for their breeding cycle, so rainfall is key. If the timing and extent of the rains could be predicted well in advance, then so could the likelihood of an outbreak of the disease.

"The climate here is monsoonal with a distinct rainy season," says Andy. "The problem is that the rains are very variable not only from year to year, but there also appears to be a longer-term cycle over decades. For example the 1980s were dry while the 1960s were wet, and the 1990s relatively wet. During the dry years, any immunity to malaria that might have been built up by the population is lost."

So the question is this: is it possible to take large-scale global models that forecast weather patterns across the planet and use these to zoom down to the scale of an individual village to try to predict if conditions are due to be ripe for malaria-carrying mosquitoes to breed?

"This kind of climate modelling in west Africa is tricky, to say the least," Andy concedes. "There is an extremely complex monsoon system that has never been studied at this scale. But if we can make progress it will be very valuable for many reasons. There are large populations of people who are vulnerable to rainfall variability and, if the climate is changing due to global warming, this is the sort of area in the world where the manifestations will be seen very early on: if something is going to shift we may see it here first."

Andy, together with colleagues from the University of Leeds and the Centre for Ecology and Hydrology, is looking at the problem from both ends of the scale – predictive models of global weather patterns on one hand and what is, literally, happening in a hut in a village on the other – and trying to find ways of filling in the gaps. In an ideal world, the ultimate goal would be to say 'the computer model predicts that there will be rainfall of this intensity falling at this time in the future, and therefore we can say with a degree of certainty that we can expect a lot of mosquitoes'.

Whether this aim will be achievable is, at this stage, impossible to predict. "This is, after all, a research project," says Andy. "It is undoubtedly a massive scientific challenge, but unless we try to tackle these issues we will not know if they can be done."

AMMA – UNLOCKING THE MYSTERIES OF THE MONSOON

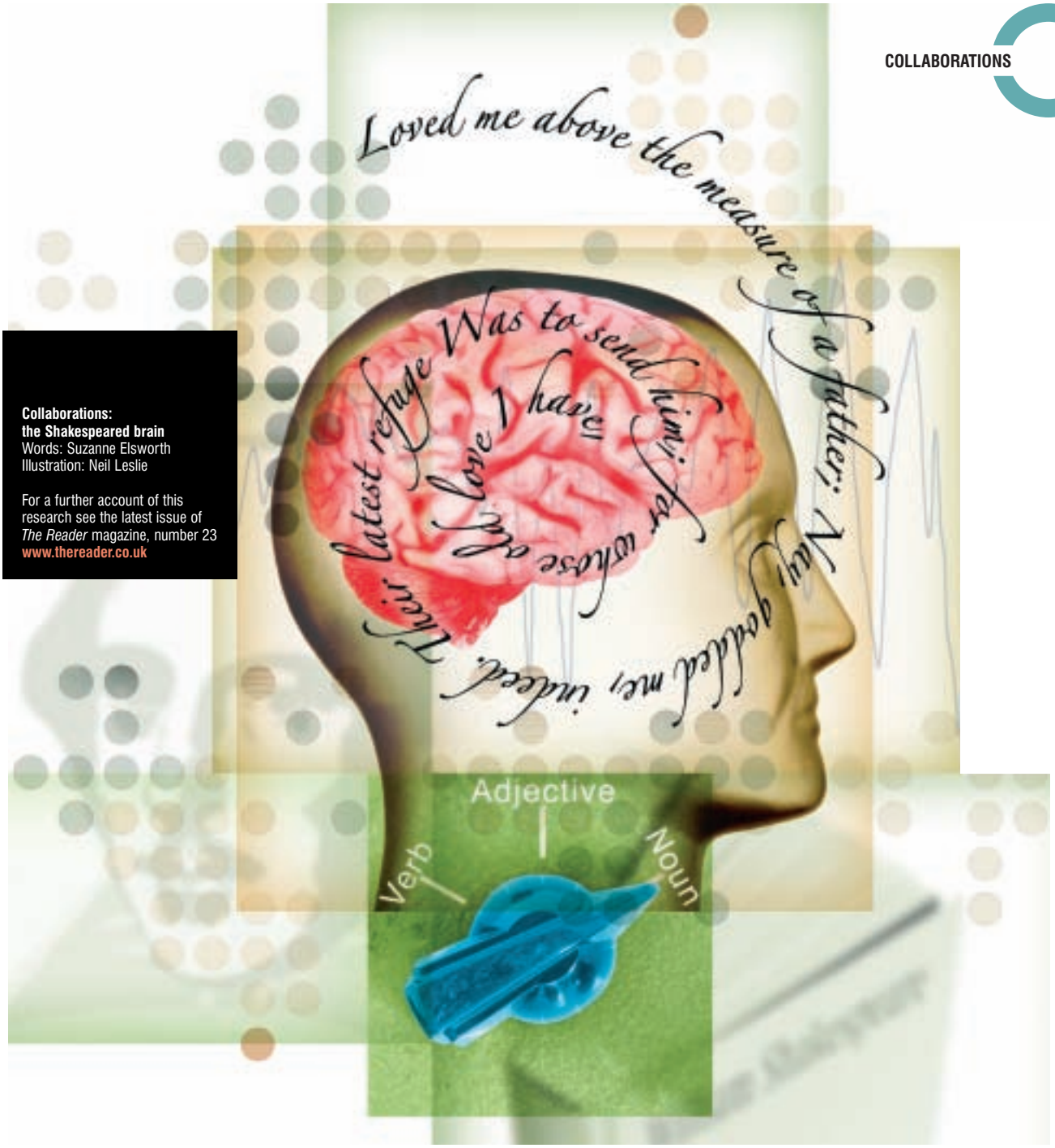
AMMA, the African Monsoon Multidisciplinary Analysis, is a research programme involving hundreds of scientists from 25 countries. Based on a French initiative, AMMA was built by an international scientific group and is currently funded by a large number of agencies, particularly from France, the UK, the US and Africa. It has been the beneficiary of a major financial contribution from the European Community's Sixth Framework Research Programme.

AMMA has three essential goals: to improve our understanding of the west African monsoon and its influence on the physical, chemical and biological environment; to provide the underpinning science that relates variability of the monsoon to issues of health, water resources, food security and demography for west African nations and defining and implementing relevant monitoring and prediction strategies; and to ensure that the multidisciplinary research carried out in AMMA is effectively integrated with prediction and decision-making activity.

AMMA will undertake many years of observations and recordings, and has been described as the largest terrestrial meteorological experiment ever undertaken.

Detailed information on scientific co-ordination and funding of AMMA is available on the AMMA International website: **www.amma-international.org**

Is it possible to take large-scale global models that forecast weather patterns across the planet and use these to zoom down to the scale of an individual village?



Collaborations:
the Shakespeared brain
Words: Suzanne Elsworth
Illustration: Neil Leslie

For a further account of this research see the latest issue of *The Reader* magazine, number 23
www.thereader.co.uk

the shakespeared brain

'THAT BOOK CHANGED MY LIFE' IS A COMMONPLACE, IF NOT OVERUSED, PHRASE BUT COULD IT BE THE CASE THAT A BOOK COULD CHANGE YOUR BRAIN?

"If you slot things into the brain's pigeonholes, it's boring. Confuse those pigeonholes and you get drama."

Professor Philip Davis
School of English

Collaborations: the Shakespeared brain
continued

Literary experts and scientists have joined forces to investigate the effect Shakespearian syntax has on neural pathways. They have discovered that the brain reaches heightened levels of function thanks to the Bard's unusually powerful use of words. Now more research is taking place to see if this increase in activity is acting as a work-out for the brain which could have lasting beneficial effects.

The initiative is the creation of Professor Philip Davis in the University's School of English who felt there was something special happening when certain phrases were read.

"I had a specific intuition about Shakespeare," he says. "I thought that the shapes of his lines and sentences somehow had a dramatic effect at deep levels in my mind. I have become interested not only in the contents of the thoughts I read and their meaning for me, but also in the very shapes and leaps that these thoughts take.

"Literature has always been dynamic to me and I dislike the taming of it, in terms of set ideas and agendas; but Shakespeare is extra-dynamic because the explosive language he uses somehow gets further inside us."

For example: Shakespeare uses a linguistic phenomenon known as functional shift or word-class conversion. This is where the writer uses one part of speech, such as a noun or an adjective, to serve as another, in many cases as a verb.

"Shakespeare shifts a word's grammatical nature with minimal alteration to its shape," says Philip. "Take, for example, the phrase 'he godded me', from the tragedy of *Coriolanus*. He's talking about what it's like to be treated like a god.

"The word 'godded' is unusual; it has changed a noun into a verb. But it is not just like paraphrasing, it's about a moment where the brain is surprised by what it is feeling. I am interested in the moment that creativity happens.

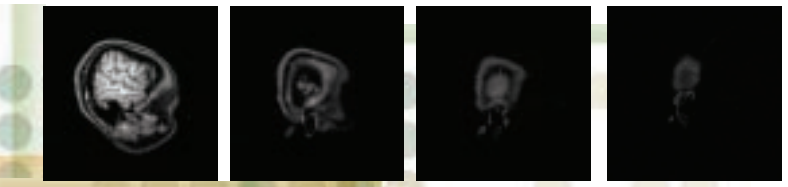
"The novel aspect of this research is that it provokes a positive mistake – the brain hesitates, but it is meant to do that. The brain is positively confused. It produces a burst of suddenly excited consciousness. Localised areas of the brain have to speak to each other: is this a noun? is it a verb? This produces a new level of live realisation. If you slot things into the brain's pigeonholes, it's boring. Confuse those pigeonholes and you get drama.

"It's not about tamed knowledge of Shakespeare or literature," he adds. "Something happens which confounds knowledge. Shakespeare changes word order, he crosses the line. His sentences use words which you are not used to, but you find you make sense of them, in a new burst of meaning."

Philip took his hypothesis about grammatical or linear shapes to a scientist, Professor Neil Roberts, who heads MARIARC, the Magnetic Resonance and Image Analysis Research Centre at the University of Liverpool, and Dr Guillaume Thierry, from the University of Wales, Bangor. They came up with experiments which tested this theory. With assistance from Dr Victorina Gonzalez-Diaz in the School of English, they designed 40 groups of text, each containing four sentences, one of which contained Shakespeare's functional shift.

For example:

a) I was not supposed to go there alone; you said you would accompany me.
b) I was not supposed to go there alone; you said you would incubate me.



Left:
MRI scans used in the experiment

c) I was not supposed to go there alone; you said you would charcoal me.
d) I was not supposed to go there alone; you said you would companion me.

The first of these sentences (accompany) is grammatically conventional, makes simple sense, and acts as a control for the experiment. The second (incubate) does not make semantic sense, while the third (charcoal) is both semantically and grammatically odd. The fourth is an example of Shakespeare's shift from noun to verb.

The team monitored subjects' brain activity as they completed the task. Initially they used EEG (electroencephalogram), with electrodes placed on various parts of the subjects' scalp, to measure when there was a reaction in the brain. After the EEG tests, MEG (magnetoencephalography) was used. This involves a helmet-like scanner which better measures effects in terms of their locations in the brain, as well as their timing. Finally, fMRI (functional magnetic resonance imaging) is now being used for more in-depth focus on locations within the brain.

"EEG gives graph-like measurements," said Guillaume. "When the brain senses a semantic violation, where the sentence doesn't seem to make sense, it registers what is called a N400 effect. This is a negative wave modulation 400 milliseconds after the onset of the word which is disrupting the meaning of the sentence.

"However, when the sentence is grammatically incorrect and the brain senses a syntactic violation, there is a P600 effect, a modulation peaking approximately 600 milliseconds after the critical word."

"Our preliminary results suggest this is the case with Shakespeare's use of words," adds Neil. "There is no P600 or N400 reaction to sentence A because it is correct both semantically and syntactically; however the dramatic opposite occurs with sentence C. With sentence B, there is no P600 as it makes grammatical sense, but there is a high N400 reaction as it does not make semantic sense. With the Shakespearian option D, there is a raised P600 as it feels like a grammatical anomaly, but no N400 as the brain will tolerate it as making sense, despite the grammatical difficulty."

Philip adds: "You begin to see that Shakespeare has produced a robust phenomenon. It's one of his intuitive working tools. It is as if he is making you forge the language anew every time."

Now, with the use of MEG and fMRI scanning, the team is trying to find out how long the heightened effect on the brain lasts, where it takes place – and whether it has lasting benefits.

"We don't know yet for how long after the key word the level of raised attention is sustained," says Philip, "and things get even more interesting long term. I think the more that people get used to this sudden deep response in the mind, the more flexible the brain is.

"It could stop mental rigidity, perhaps Alzheimer's, even more than Sudoku and the like. It's like a version of mental adrenaline. When you get to the key word there's no time to think – something is kicking in and making the mind alert. That's because the brain suddenly explores a stranger verbal environment."

16
17

Engineering:
highly charged
Words: Sophie Wilcockson
Image courtesy of NASA

For more information visit:
www.liv.ac.uk/eee

THE WORD 'DUSTY' ISN'T ONE YOU WOULD USUALLY ASSOCIATE WITH THE HIGHLY-SOPHISTICATED, TECHNOLOGICALLY-ADVANCED WORLD OF SCIENTIFIC RESEARCH. BUT THE STUDY OF **'DUSTY PLASMAS' AT THE UNIVERSITY OF LIVERPOOL COULD HELP NASA DESIGN THE SPACESUITS AND SPACECRAFT OF THE FUTURE**.

highly charged

It is estimated that 99% of the visible Universe is made up of plasma – a mixture of positive ions and free electrons – with solids, liquids and gases, in the form of asteroids, comets and planets, making up the remaining 1%.

Dusty plasmas, a term coined by astrophysicists in the early 60s, occur when micron-sized grains of matter are mixed with ordinary ion-electron plasma. This occurs naturally in space in interstellar and interplanetary dust clouds, comet tails and planetary rings, but dusty plasma can also be replicated in the laboratory.

Scientists found that when the grains are given a negative charge they interact with each other, giving them completely different properties, including the ability to 'levitate'. This discovery has led to a new form of physics, and the University of Liverpool is at the forefront of research into this emerging subject.

"We prefer to call them 'complex' rather than 'dusty' plasmas," says Dr Dmitry Samsonov, whose laboratory in the Department of Electrical Engineering and Electronics is the only dedicated complex plasma facility in the UK. "In the same way that complex fluids – which include colloids (a jelly-like substance) and liquid crystals – exhibit a range of complicated and unusual effects, such as formation of ordered structures (Coulomb crystallisation), phase transitions, etc, complex behaviour is also characteristic of complex plasmas.

"Also, when we create complex plasmas in the lab, instead of 'dust' we use plastic microspheres which have nearly perfect spherical shapes and the same diameters. These are very complicated to manufacture, and cost typically a few hundred pounds per gramme, so it is a bit more sophisticated than plain dust!"

"This is an exciting time in physics and the University of Liverpool is leading the way in this challenging new subject."

Dr Dmitry Samsonov Department of Electrical Engineering and Electronics

Engineering: highly charged
continued

Russian cosmonaut Sergei Krikalev holds the experimental container (weighing about 50kg) on the tip of his finger on board the ISS during the first expedition

Photo courtesy of Yuri Gidzenko

Complex plasmas have many benefits for scientists. They are unique in that they can behave like solids, liquids or gases, and sometimes exhibit properties of all three simultaneously. This means they can be used as a model to study a range of phenomena and conduct experiments that could not be performed on real liquids and solids.

"The grains also have large spacings between them which means they can be studied using a standard video camera, or even with the naked eye," adds Dmitry. "Unlike in true solids, we can observe and measure the motion of every grain and we don't need expensive specialist equipment."

So, what does the discovery of this new area of physics mean in the real world? As well as applications in astrophysics (the study of planetary rings, for example), and plasma processing, the study of complex plasmas could be extremely useful in space exploration – in fact, the experiments taking place in Dmitry's lab in Liverpool are currently being replicated on the International Space Station (ISS).

"It was found during the Apollo missions that the dust on the Moon is charged by solar UV radiation and levitates about 20cm above the Moon's surface," explains Dmitry. "Since this dust is highly abrasive it can damage spacesuits and equipment and this poses a serious problem for Moon missions. The same problem might also arise on missions to Mars.

"The trick is to apply electric fields and remove charged dust before it has done any damage, using the same technique we use in the laboratory to manipulate the grains. However, this might well make the problem worse if it's done without understanding the physics of complex plasmas."

Obviously, in order to apply complex plasmas to space exploration, the experiments have to be replicated under zero gravity conditions. A device, similar to the one used by Dmitry in Liverpool, was launched to the ISS in 2001 and this allowed the first scientific experiments to be conducted on the space station. The experiments have been continuing ever since, with the new upgraded version of the experiment launched in December 2005.

As there is no reliable data link to enable remote operation of the device, physicists on the ground relay instructions to the Russian cosmonauts, who conduct the experiment, via a radio link which is available every 90 minutes as the space station turns.

The device was designed and built at the Max Planck Institute for Extraterrestrial Physics in Germany, where Dmitry worked before joining the University of Liverpool. Thanks to him, the two institutions now have an agreement of co-operation which allows scientists in Liverpool to share the data collected on the ISS and compare it to experiments conducted on earth.

WHAT IS PLASMA?

Plasma can be described as a soup of electrical charges which generates and interacts with electric, magnetic and gravitational forces to produce fantastic phenomena such as stars, solar flares and supernovae. On Earth, the ionosphere, the aurora borealis and aurora australis (the northern and southern lights), St Elmo's fire (a ghostly glow observed at the top of ship masts) and lightning are examples of naturally occurring earth-bound plasmas.

As well as plasmas that occur in space, we are surrounded by technological plasmas inside light bulbs, as candle flames and on the streets in fluorescent neon shop signs. Plasmas are also used as display devices such as plasma TVs, as thrusters for satellites, to sterilise medical and bio-technological equipment, to treat the toxic emission of environmentally harmful gases and to recycle waste products.

By far the main application is material processing where they are used to alter the properties of materials such as increasing surface hardness, to deposit thin optical films for filters, and in the fabrication of microchips and electronic components found in every electronic device.

Veterinary Science: watching over the Grand National runners
Words: Kate Spark

For more information visit:
www.liv.ac.uk/vets

watching over the grand national runners

LIVERPOOL'S SPECIALIST VETERINARY TEAM IS RESPONSIBLE FOR THE WELFARE OF THE HORSES DURING THIS DEMANDING 4.5 MILE RACE.

2021

Veterinary Science: watching over the Grand National runners
continued

Watched by around 600 million people around the world, the Grand National is one of the UK's best loved sporting events with a record crowd of more than 70,000 watching Numbersixvalverde storm to victory earlier this year at Aintree.

But one of the most important cogs in the well-oiled National machine is relatively unseen by the thousands who come to experience the magic of the world-famous steeplechase. Most are unaware of the specialist veterinary team from the University of Liverpool which, behind the scenes, is responsible for treating any injuries sustained by the horses during the 4.5 mile race.

For Professor Chris Proudman and the Liverpool team, it's both a rewarding and challenging opportunity to use their veterinary skills at one of the most demanding events in the horse-racing calendar. Chris and his colleague Dr Ellen Singer have provided veterinary care with five other vets for the entire Aintree Festival – including the Grand National – for the past eight years. They also provide a referral hospital facility for five other North West racecourses including Haydock Park.

Chris explains: "We became involved in veterinary care at Aintree as an extension of the services offered by the University's Equine Hospital. As specialists in the diagnosis and management of horses with serious injuries, we are able to offer the very best level of care to horses running in the Grand National."

Veterinary care at racecourses has developed a great deal in recent years. Assumptions used to be made by the public that horses badly injured on a racecourse would be destroyed but those days are gone.

"In the past, fractures were very difficult to treat," says Chris, "but with advances in medicine, surgery and anaesthesia, there are now many fractures that racehorses incur which we can successfully fix, and these animals can go back to racing."

Chris and Ellen treat minor injuries at Aintree itself but horses with more serious injuries are taken to the Equine Hospital at Leahurst on the Wirral. Two horse ambulances are on duty in case any runners need to be transported and local police provide an escort. "People don't realise the effort that goes into preparing for the Grand National meeting. We rehearse for every situation," says Chris.

The expert care available at the Equine Hospital is held in high regard by the racing community and the steady influx of famous patients from the world of racing means the veterinary team are well known among trainers and owners alike. One of those is JP McManus, whose horse Youlneverwalkalone injured his right front leg during the 2003 National. After identifying the injury as a fracture, the team immediately took the horse to the Equine Hospital where Ellen – an orthopaedic surgeon – placed 10 bone screws in his cannon bone. The surgery was a great success and after two months Youlneverwalkalone had recovered sufficiently to travel home to Ireland to complete his recuperation.

JP comments: "The expertise and level of care offered to horses at the University of Liverpool's Equine Hospital is second to none. Youlneverwalkalone received first-rate care."

Thankfully these serious cases are in the minority, with most of Chris and Ellen's time taken up with the treatment of cuts, bruises and tendon or ligament

£5 MILLION FUNDRAISING INITIATIVE

The University is keen to build further on its range of clinical expertise and research capability in the prevention of injury and disease in racehorses and eventers, and a £5 million fundraising initiative is underway to facilitate the development of an Equine Performance Unit and a Centre for Colic Prevention.

Liverpool has one of the strongest gastrointestinal research groups in the world and an unrivalled reputation for its treatment of colic cases. The condition results from distension of the intestine which causes severe pain and often requires emergency surgery. Vastly distressing even in its mildest form, it shows no respect for breeding or value and is just as likely to affect the most valuable racing thoroughbred as it is a child's pony.

The Centre for Colic Prevention will include dedicated research laboratories for four major colic-related studies. The heavily-used operating theatre for colic cases will be completely refurbished and a post-operative intensive care unit developed, including an isolation unit to care for horses with intestinal disease which are at increased risk of infectious diarrhoea.

Also renowned for its research in the field of racehorse injuries, the University is keen to enhance its diagnostic and therapeutic capabilities for equine athletes with the development of an Equine Performance Unit. This will include magnetic resonance imaging (MRI), gait analysis equipment and facilities for cardiorespiratory function testing.

Just as the physiological performance and health of human athletes is evaluated during exercise as well as at rest, it is also now recognised that the health of racehorses must be assessed at exercise. The University already has a high speed equine treadmill but has embarked on a major fundraising campaign to finance the purchase of additional equipment for advanced performance assessment.

Dean of Veterinary Science, Professor Sandy Trees, explains why the new unit is so important: "We have one of the busiest equine hospitals in the UK and are well known for the level of expertise we offer in the diagnosis and treatment of complex problems affecting racehorses.

"The sophisticated equipment now available to us means that in the future we will quickly be able to identify and treat a whole range of injuries and disorders affecting race performance.

"Many of the techniques used, for example, to assess subtle differences in the performance of elite athletes, can also be used to diagnose and monitor the therapy and recovery of horses suffering from respiratory or cardiac disease. We are very keen to have this capability at Liverpool."

The Equine Performance Unit will include a video endoscopy system for the evaluation of airway function during exercise and digital gait analysis equipment to evaluate movement on the treadmill and detect lameness. Cardiac ultrasound will be another important addition, as well as a Thermography Camera to diagnose muscular injury, particularly in back disorders.

The Unit will also enhance the University's outreach and continuing education programmes for veterinarians as well as veterinary-related courses for owners and trainers.

If you would like to consider giving to the Liverpool VET (Veterinary Education Trust), please contact Richard Nicholls in the University's Development Team on +44 (0)151 794 6987.

Above left:
Artist's impression of the new Centre for Colic Prevention

injuries. This year, a number of horses including First Gold and Clan Royal were treated by the Liverpool team – First Gold for a soft tissue injury and Clan Royal for a wound to his belly.

Chris adds: "Sometimes horses will overheat if it's a warm day, so the horse ambulances carry oxygen. There is oxygen at the last fence and close to the pull-up area. The Jockey Club vets keep a database of horses that are known to need oxygen or need cooling off at the end of races and they give us prior warning of any high-risk horses that day so we can task one of the vets with taking particular care of that horse as it pulls up."

The facilities available to the vets at Aintree have been significantly enhanced this year, with the construction of a purpose-built veterinary first-aid facility with two treatment boxes in the new stable yard. The treatment areas at Aintree also have X-ray capability so fractures can be quickly diagnosed.

Chris adds: "The facility has a padded floor – so that a distressed animal can't hurt itself further by going down – and good lighting which is essential for stitching wounds.

"We have a TV and video recorder, because seeing how horses fell can offer us important clues to their injuries. We also have a digital X-ray unit and a computer point, enabling us to send the images directly to experts around the world."

The keen attention paid to the race by the animal rights lobby means the National is one of the most heavily scrutinised sporting events in the UK. Aintree invests hugely in safety provision and recently commissioned the University of Liverpool to conduct research into which factors influence whether a horse is likely to complete the race.

The research – part of a larger study of National Hunt racing – is leading to safety improvements in jump racing across the UK for both jockeys and racehorses but is also proving useful to those studying form in order to predict winners.

Chris and his team studied data from 15 Grand National races and found that horses which had successfully completed the National course previously, were twice as likely to complete the course and 2.5 times less likely to fall than those that had never run on the course before.

Contrary to popular belief, The Chair and Becher's Brook are not the most difficult fences on the course. Chris's research showed that the first fence often results in the highest number of fallers. The research also found that ground condition and starting odds are predictive of the probability of horses finishing the race. Ground classed as soft or heavy results in significantly fewer finishers.

Says Chris: "As well as improved schooling over National-type fences, our study also indicated that providing good-to-soft ground may improve completion rates and decrease the risk of horses falling."

The findings stirred a great deal of interest among the racing community and featured on the front page of *The Times* on Grand National day. Charles Barnett, Managing Director of Aintree Racecourse, says: "Equine welfare is our highest priority at Aintree and scientific research in this field was clearly required. We are implementing many of the recommendations outlined within the research and we're indebted to the University for the work carried out."

22
23

Science:
125 years of Physics
Words: Samantha Martin
Illustration: Martin O'Neill

For more information visit:
www.liv.ac.uk/physics

125 years of physics

THE DEPARTMENT OF PHYSICS CELEBRATES ITS **125TH ANNIVERSARY**

In a vacated lunatic asylum in 1881, Liverpool workmen began to transform a padded cell into a modern science laboratory. The asylum on Brownlow Hill was to become home to the Department of Physics – the University's first and oldest academic department – and its labs and lecture theatres were to be used by some of the world's most renowned physicists, among them three Nobel Prize winners. It is now celebrating its 125th anniversary.

Oliver Lodge – the first Professor at University College Liverpool, as it was then – toured Europe searching for the ideal

1881
DEPARTMENT OF PHYSICS IS FOUNDED IN LIVERPOOL'S VACATED LUNATIC ASYLUM

1902
CHARLES BARKLA, LODGE'S MOST PROMISING STUDENT, BECOMES ASSISTANT LECTURER IN ADVANCED ELECTRICITY

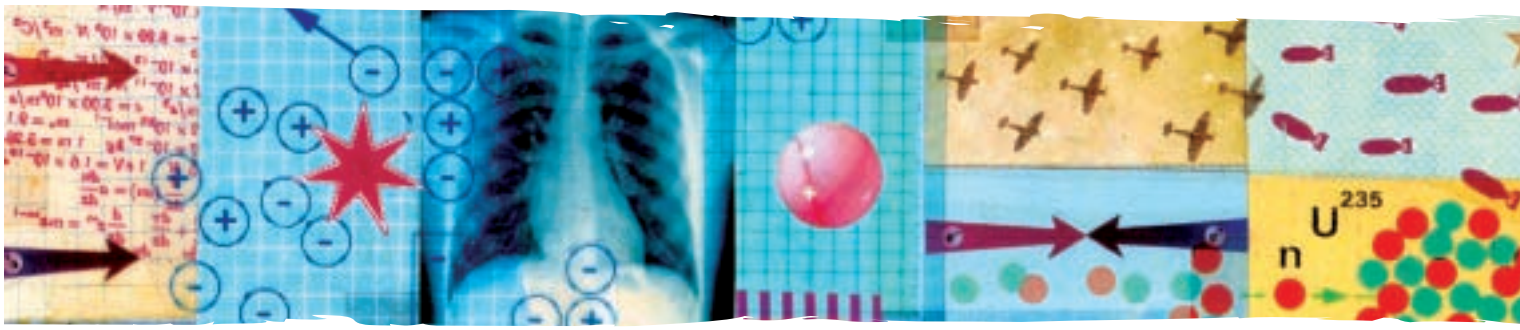
1917
BARKLA IS AWARDED THE NOBEL PRIZE IN PHYSICS FOR HIS WORK IN IN X-RAYS AND RADIATION

1939
JOSEPH ROTBLAT IS APPOINTED TO PHYSICS DEPARTMENT BY JAMES CHADWICK

START OF THE SECOND WORLD WAR

1940
DEATH OF **OLIVER LODGE**

CHADWICK AND **ROTBLAT** BEGIN RESEARCH TO PROVE THAT URANIUM COULD BE USED FOR PRODUCING BOMBS



1894

OLIVER LODGE, THE FIRST PROFESSOR AT THE UNIVERSITY, DEMONSTRATES THE TRANSMISSION OF INFORMATION BY RADIO WAVES

1935

JAMES CHADWICK IS APPOINTED PROFESSOR OF PHYSICS AND RECEIVES A NOBEL PRIZE FOR DISCOVERING THE NEUTRON

1939
ROTBLAT BEGINS RESEARCH WITH THE CYCLOTRON, A PARTICLE ACCELERATOR, LATER USED TO KILL CANCEROUS TUMOURS

equipment to use in the refurbished building.

Dr Peter Rowlands, physicist and science historian in the Department, said: "Oliver Lodge was one of the University's most charismatic scientific leaders; at a commanding six feet four inches tall, his students saw him pacing the length of his lecture theatres, his hands in his velvet coat, explaining the most complex theories in the simplest of forms.

"Lodge never had any difficulty recruiting students to his courses. Students appreciated his easy manner and relaxed attitude; he once allowed a lecture to be interrupted for half an hour so that students could get their first glimpse of a motor car – which had just arrived in the College quadrangle."

Lodge remained at Liverpool for 19 years and during that time created a profound volume of research which included his work in wireless telegraphy. He received international recognition for perfecting the 'coherer', a radio-wave detector at the heart of the early radio receivers. He transmitted Morse signals through three stone walls to a stunned audience at a British Association meeting in 1894, two years before Marconi took out the first patent on wireless telegraphy. Lodge often used the University's Victoria Building tower for his radio experiments and would signal to a receiver at the top of Lewis's department store, half a mile down Brownlow Hill in the city centre.

Aside from his scientific work, Lodge was a spiritual man who believed there was a way to communicate with the dead. As president of the Society for Psychical Research, he expressed a belief in telepathy and spent many years investigating psychic phenomena with his friend Sir Arthur Conan Doyle. Before his death in 1940 he deposited a sealed message with the Society for Psychical Research claiming that he would make contact with the living from 'the other side'.

Lodge's most promising student, **Charles Barkla**, graduated from the University with a first class honours degree and later returned to Liverpool as an Oliver Lodge Fellow and Assistant Lecturer in advanced electricity in 1902. During his time at the University he discovered that X-rays had similar properties to ordinary light, finding they were both essentially the same type of radiation (electromagnetic) but with different wavelengths. He was awarded the Nobel Prize in Physics for this work in 1917.

Dr Rowlands said: "Barkla was a star student and physicists welcomed his return to the University as Assistant Lecturer. Not only was he a great scientist, but he had a very theatrical nature. He was well-known for his singing, with a powerful baritone voice."

1941

PEARL HARBOUR

CHADWICK AND **ROTBLAT** RELOCATE TO AMERICA TO JOIN THE MANHATTAN PROJECT FOR THE DEVELOPMENT OF THE ATOMIC BOMB

1944

DEATH OF **CHARLES BARKLA**

ROTBLAT RESIGNS FROM THE MANHATTAN PROJECT

1945

BOMBS ARE DROPPED ON HIROSHIMA AND NAGASAKI

END OF SECOND WORLD WAR

ROTBLAT RETURNS TO BRITAIN AND DEMONSTRATES THAT NUCLEAR EXPLOSIONS PRODUCE CONTAMINATED FALL-OUT

1957

ROTBLAT, BERTRAND RUSSELL AND **ALBERT EINSTEIN** ESTABLISH THE PUGWASH CONFERENCES TO BRING SCIENTISTS TOGETHER TO DIMINISH THE DANGERS OF NUCLEAR WEAPONS

1995

ROTBLAT IS AWARDED THE NOBEL PEACE PRIZE FOR HIS RESEARCH ON NUCLEAR WEAPONS

2003

THE DEPARTMENT PRODUCES *BIG BANG!* – A MUSICAL SHOW AIMED AT BRINGING THE EXCITEMENT OF SCIENCE TO SCHOOL CHILDREN

2005

ROTBLAT DIES CLOSING A DISTINGUISHED CHAPTER IN THE HISTORY OF THE DEPARTMENT OF PHYSICS AT THE UNIVERSITY OF LIVERPOOL

2006

LORD SAINSBURY OPENS THE DARESBURY SCIENCE AND INNOVATION CENTRE AND THE COCKCROFT INSTITUTE, WHICH WILL HELP SCIENTISTS BUILD ACCELERATORS TO RECREATE THE EARLIEST MOMENTS AFTER THE BIG BANG

Science:
125 years of Physics
continued

Some 20 years after Barkla's departure from the University, the Department of Physics entered a new era of scientific prestige. The appointment of **James Chadwick**, then Professor of Physics, was a huge step forward in attracting international scientists to the University. Chadwick revitalised the Department, giving it a thoroughly modern approach. He was very business-like and his recruitment of additional world-renowned scientists allowed the University to exert powerful influence over scientific research in the UK.

One of Chadwick's most significant appointments was that of **Joseph Rotblat**, a Polish-born physicist working at the University of Warsaw. Chadwick had just been awarded the Nobel Prize for discovering the neutron – a significant step in understanding the structure of atoms as well as the possible use of atomic energy – and scientists all over the world were eager to work with him. At his invitation Rotblat came to Liverpool in 1939, only a few months before the start of the Second World War.

Rotblat was particularly keen to begin research using the newly developed cyclotron, built in the basement of the Department of Physics. The cyclotron was one of the earliest particle accelerators, used to accelerate moving charges in a circular path with electric and magnetic fields. Scientists discovered that the radiation from the cyclotron could be used to produce radioisotopes to kill cancerous tumours.

The machine was fully operational in 1939 and was the first of its kind in the UK. Liverpool scientists have continued to develop the technology right through to the present day and are now helping to construct the world's largest particle accelerator based at CERN, the European centre for particle physics research in Switzerland.

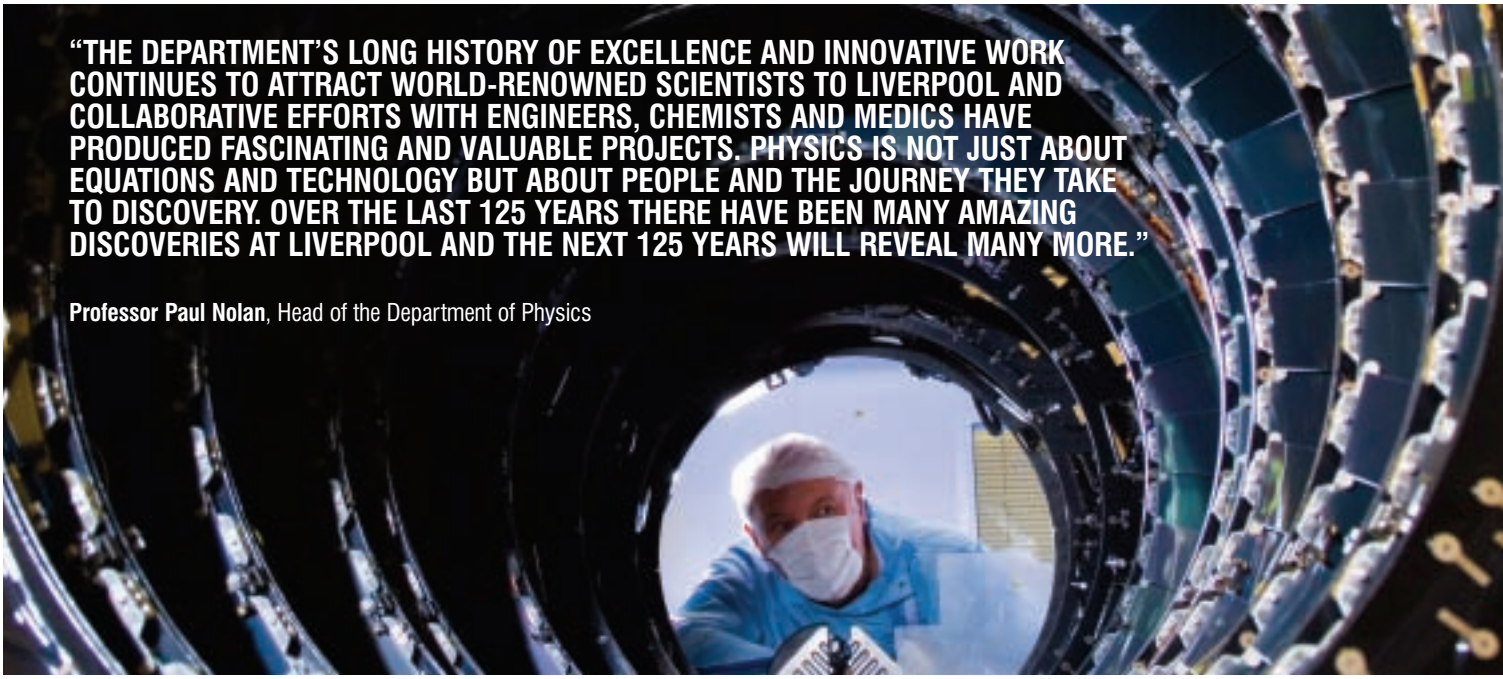
The work of Chadwick and Rotblat took on additional meaning at the outbreak of the Second World War. Physicists believed that the threat of nuclear weapons was imminent, making Liverpool's current research into uranium more urgent. While the city and University were under constant bombardment, Chadwick and his team worked tirelessly to prove that uranium could be used for producing bombs and other sources of power.

At this time only Chadwick and Rotblat believed that a uranium bomb was practicable, but research conducted by Otto Frisch and Rudolf Peierls at the University of Birmingham in 1940, stated categorically that the bomb could be constructed if Germany were to obtain enough uranium-235.

Chadwick recruited Frisch to Liverpool. Originally from Austria, Frisch was known for breaking all the rules of war, from straying outside the city boundaries to riding his bicycle after dark with or without lights!

Chadwick and his team were forced to work in secret and new faces continued to arrive in the Department without anyone knowing for certain what they were working on. While bombs were being dropped all around them, destroying many parts of the University, the scientists continued to work on the

Below:
Liverpool-built equipment performs key roles in giant particle detecting apparatus that form part of the world's largest particle accelerator based at CERN



"THE DEPARTMENT'S LONG HISTORY OF EXCELLENCE AND INNOVATIVE WORK CONTINUES TO ATTRACT WORLD-RENOWNED SCIENTISTS TO LIVERPOOL AND COLLABORATIVE EFFORTS WITH ENGINEERS, CHEMISTS AND MEDICS HAVE PRODUCED FASCINATING AND VALUABLE PROJECTS. PHYSICS IS NOT JUST ABOUT EQUATIONS AND TECHNOLOGY BUT ABOUT PEOPLE AND THE JOURNEY THEY TAKE TO DISCOVERY. OVER THE LAST 125 YEARS THERE HAVE BEEN MANY AMAZING DISCOVERIES AT LIVERPOOL AND THE NEXT 125 YEARS WILL REVEAL MANY MORE."

Professor Paul Nolan, Head of the Department of Physics

1891
Oliver Lodge working on the ether drag machine with Ben Davies and George Holt. The ether drag machine was built to test whether a moving object, such as Earth, pulls the ether (through which light was considered to travel) with it as it moves through space. The result of Lodge's experiment was an important factor leading up to Einstein's Theory of Special Relativity

1914
While two members of the Physics team were on fire-watching duty during the Second World War, a ton of explosives landed in the quadrangle, destroying the Engineering building and blowing out the windows in the Physics laboratory

ultimate threat to mankind – a weapon that could reduce an entire city to rubble in seconds.

In one incident, while two members of the team were on fire-watching duty in the Victoria Tower, a parachute carrying a ton of explosives landed in the quadrangle, destroying the Engineering building and blowing out the windows in the Physics laboratory. Chadwick secretly asked his colleagues to take a Geiger counter outside to see if there was detectable radiation from the rubble caused by a nuclear explosion, but he found none.

Following the attack on Pearl Harbour in 1941, the Americans became interested in Chadwick's work and that same year he and Rotblat relocated to the US to join the Manhattan Project to develop the first atomic bomb. During this period Rotblat harboured reservations about the use of science to develop nuclear weapons and he resigned from the Manhattan Project in December 1944 when it became clear that Germany had not succeeded in developing an atomic bomb. Chadwick continued on the project and was among those to witness the bomb's effects at the Trinity test site in New Mexico. Following this, bombs were dropped on Hiroshima and Nagasaki, resulting in the end of the Second World War.

Rotblat returned to Britain and went on to work in Medical Physics at St Bartholomew's Hospital. Following the conclusion of the war and additional nuclear testing by the US, he demonstrated that such explosions produced contaminated fall-out, which could prove fatal to anyone living near the site.

His strong belief in ethical scientific development led him – in collaboration with the philosopher Bertrand Russell and theoretical physicist Albert Einstein – to establish the Pugwash Conferences, which held its first meeting in 1957. The conferences were designed to bring scientists together to discuss and diminish the dangers of nuclear weapons. It was for this that he was awarded the Nobel Peace Prize in 1995 and later knighted.

During his campaign for peace, Roblat had suffered his own personal tragedy. Following his appointment to Liverpool in 1939 he returned to Warsaw for a brief visit, but his wife, Tola, fell ill just before they were about to return together to Liverpool. She was unable to leave Poland, but was due to join her husband at a later date. A few days later Germany invaded Poland and she was left stranded in their home town. Despite many years of searching Rotblat never saw her again and never remarried. His death in 2005 closed a distinguished chapter in the history of the Department of Physics and the University received hundreds of letters in tribute to a man who was a great humanitarian, scientist and writer.

Now in its 125th year, the Department is celebrating the life and works of these great men with two special conferences to reflect on the history of the Department and commemorate the life of Professor Sir Joseph Rotblat. Dr Peter Rowlands has also launched a new book reflecting on the Department's successes – *125 Years of Excellence*.

PIONEERING WORK CONTINUES TODAY

Physicists at Liverpool have continued to build on the Department's rich history of pioneering work. The £3 million Liverpool Semiconductor Detector Centre has brought international scientists and engineers together to produce a new generation of particle detectors which will be used in the bid to understand the fundamental forces of nature, including the origin of mass.

Liverpool-built equipment will also perform key roles in both ATLAS and LHCb – giant particle detecting apparatus the size of five-storey buildings that form part of the world's largest particle accelerator – the Large Hadron Collider (LHC) based at CERN.

In another collaborative project, physicists are constructing Europe's most intense terahertz (THz) radiation source that will be used for research into cancer. Scientists are constructing an ultra-high intensity THz beamline in an attempt to destroy skin cancer cells specially grown in a new tissue culture facility. The experiments will help scientists understand how to use this technology in future treatments for the disease in humans.

The THz beamline is being developed using the prototype Fourth Generation Light Source (4GLS) being constructed at CCLRC Daresbury Laboratory, which will be used to develop light sources used in X-ray technology, laser studies and radiation sources.

The importance of communicating the results of scientific research to a wider audience, as recognised by Oliver Lodge in his popular public lectures, has continued to form part of the Department's mission. The Department has established the Science Communication Unit, which has produced projects such as *Big Bang!* – a musical show aimed at bringing the excitement of scientific discovery to school children.

Major investments of more than £5 million a year from organisations such as the Particle Physics and Astronomy Research Council (PPARC), the Council for the Central Laboratory of the Research Councils (CCLRC) and the Engineering and Physical Sciences Research Council (EPSRC), have allowed the Department of Physics to remain one of the top research departments in the UK. It has the largest research income per academic staff of any UK Physics Department.

Corporate:
university challenge
Words:
Sophie Wilcockson

For more information visit:
www.liv.ac.uk/ktp
www.merseyside.org.uk

university challenge

Liverpool is a city on the up. Its imminent status as European Capital of Culture in 2008 has triggered an explosion of activity – new buildings seem to appear by the day, previously derelict areas of the city have been revitalised and given new names like The Met Quarter, and the regional economy is flourishing. As reflected in the local media, Liverpool has a new sense of pride and confidence and is enjoying a new era of wealth and prosperity for all.

But is that the real story?

Behind the excitement generated by the prospect of being European Capital of Culture, and despite a sustained period of economic growth in the region in recent years, Merseyside still lags behind other regions in several important areas. To address this apparent mismatch, the University of Liverpool is engaged in a development programme designed to improve the region's economic future.

Economic activity rates in Merseyside are lower than in any other metropolitan area and well short of the national average. There are fewer people with high-level qualifications in Merseyside, which is a major contributor to high inactivity, and the number of people out of work in the region is well above the rest of the North West and nearly double the UK figure.

Add to this the fact that Merseyside contains some of the most deprived areas in England and has one of the most unhealthy populations of any area in the UK, and the picture begins to look a bit less rosy.

"Although our economy is growing faster than the country as a whole," says Alan Moody, Director for Regional Development at the University of Liverpool, "not everyone living here is feeling the benefits of that growth."

The University of Liverpool is one of a number of organisations across the region contributing to the Merseyside Action Plan (MAP), a development programme designed to improve the economic future of what it calls the Liverpool city region – a large area encompassing the city of Liverpool and surrounding districts stretching as far as Cheshire and North Wales – for all its residents and businesses.

Much of Liverpool's economic resurgence has been due to the high levels of funding it has received, principally from Europe. It has benefited from Objective One funding, which targets aid at

Just one individual coming off benefit to become economically active and independent can be worth up to £50,000 per year to the local economy.

areas in the European Union where prosperity, measured in GVA (Gross Value Added) per head of population, is 75% or less of the European average. Due to the expansion of the EU Liverpool no longer qualifies for Objective One money so funding in the future is going to be much more difficult.

So how will Liverpool's fortunes continue their upward trajectory with only a third of the previous funding available?

The city's universities are the key, according to Alan.The city region is already established as an important economic driver for the North of England but to secure this position long-term, the MAP is focusing on expanding its other assets, such as knowledge. This is where the universities come in.

"There is a rapidly expanding global market for research and knowledge transfer," says Alan, "and Liverpool is in a great position to exploit that as it has three universities, all with considerable expertise in distinct areas. In particular, the city has a strong reputation for innovation in the field of life sciences so the MAP is focusing on knowledge transfer in this area."

The University of Liverpool is proposing the creation of the Liverpool Research Alliance, a programme based on a proven initiative in Georgia which helped lift the state into the top tier of technology-based economies in the US. Part of the Merseyside Action Plan, it has already brought together the generators and users of research, supported by public and private sector stakeholders in the region. The Alliance has, at its core, investment in attracting and retaining top researchers from around the world.

"This city region, and the North as a whole, cannot hope to compete in an increasingly competitive global knowledge economy unless it can compete in the market for talented researchers," says Alan.

Along with creating an investment fund for research centres which promote knowledge transfer, like Georgia, the Alliance will establish an 'Eminent Scholars' programme aimed at attracting the cream of the world's academics to Liverpool – and that won't come cheap.

The Alliance has set itself a five year target of building a £50 million endowment fund which will provide the revenue stream for what will be a 30 year strategy.

"We have to persuade politicians that the UK won't compete globally if it concentrates only on the 'golden triangle' of London and the South East," says Alan. "There is a wealth of expertise in life sciences and biomedicine in the region and we can build on proven success. If we have the best scientists, they will attract the best research teams, the most able students and the leading edge businesses. This leads to more research funding and a spiral of success."

Such success, however, relies on a productive local workforce and this is another area in which the University of Liverpool is taking the lead. The 'Health is Wealth' programme, the brainchild of Alan Moody and former Pro-Vice-Chancellor Julian Crampton, aims to improve the city's health and, in turn, raise its productivity to national levels.

Liverpool has one of the lowest productivity rates in the UK and much of this economic inactivity is down to the poor health of the population. People in Liverpool typically live three years less than the England average – and seven years less than people in Dorset. They are 30% more likely than the England average to die from cancer and over twice as likely to die from chronic liver disease. Nearly a quarter of Liverpool's population has a long-term limiting illness, and in Merseyside as a whole, some 105,000 people claimed incapacity benefit in 2005 – nearly three quarters higher than the national average.

"The Liverpool city region cannot be truly competitive while it continues to shoulder such a burden of ill health and incapacity," claims Alan. "Our people's health and personal wellbeing needs to match the city's thriving economy. We need every citizen to contribute to Liverpool's economic renaissance."

'Health is Wealth' will connect the challenge of poor health with the excellence of health science and the economic power of a large health services sector. There is already a strong platform from which to start – the region has seven teaching hospitals, including one of Europe's largest children's hospitals (Alder Hey), and internationally renowned centres for breast and lung cancer, cardiothoracic services and neurosciences.

With the support of key partners, including The Mersey Partnership, local authorities, the NHS and local businesses, 'Health is Wealth' will establish a Commission of high-profile figures to raise the aspirations and commitment of the city region's people and employers to health and wellbeing.

"The Commission will find new ways of adding value to what's already happening in the region," explains Alan. "It won't take over existing work or have money but will explore ways to get more from what we're doing.

"The rewards could be enormous. Just one individual coming off benefit to become economically active and independent can be worth up to £50,000 per year to the local economy.

"More significantly, we have the potential to create a virtuous circle in which new employment and business opportunities generated through 'Health is Wealth' create jobs which, in turn, create increased independence and improved health, which generates improved productivity, increased business potential…and so on."

It's clear the city's universities have an important role to play in the region's economic resurgence and the University of Liverpool is at the forefront of work in this area.

"We take our place in the community very seriously," says Alan. "The city's future is our future at the end of the day. If the city is economically stable and attracting new people and businesses, the University will also benefit. It's in everyone's interest to work together to achieve this."

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29

Corporate: championing China
Words:
Sophie Wilcockson

For more information visit:
www.xjtlu.edu.cn/
(in chinese only)

championing china

THE UNIVERSITY OF LIVERPOOL'S NEW HIGHER EDUCATION INSTITUTION IN CHINA, **XI'AN JIAOTONG – LIVERPOOL UNIVERSITY (XJTLU)**, WELCOMED ITS FIRST INTAKE OF STUDENTS IN SEPTEMBER.

西交利物

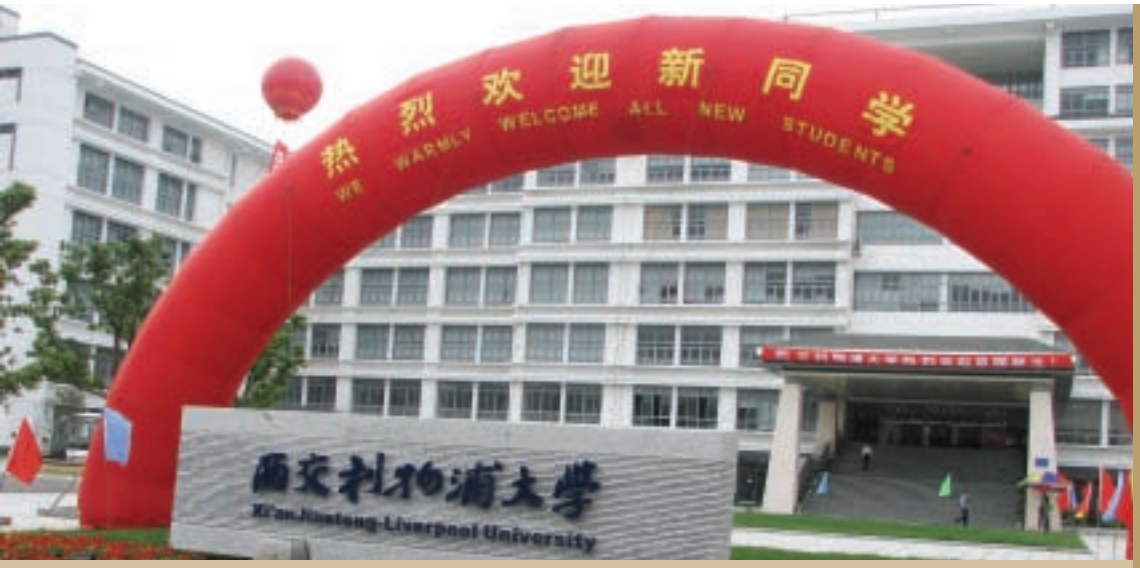
The new university is a collaborative venture with Xi'an Jiaotong University – a Top 10 institution in China – and global education provider Laureate.

It is located near the beautiful Dushu Lake in Suzhou Industrial Park (SIP), which is 70km west of Shanghai. SIP is one of Asia's most successful business parks with an annual industrial growth rate of 25%. Of the 2,100 international organisations at SIP, 53 belong to Fortune 500 companies. The neighbouring area of the Yangtze River Delta, which includes Shanghai, is the fastest developing area in China.

The first university building provides an area of 32,000 square metres, which can accommodate 2,500 students. It is planned to reach a student population of 8,000 to 10,000 in seven years. Students at the new university will be starting degree programmes in Computer Science, Communications, Electronics, e-Business and Mathematics with Finance. Graduates in these fields are urgently needed in China especially in the Yangtze River Delta.

Vice-Chancellor, Professor Drummond Bone, said: "The Chinese Government has given enormous support to our plans. These are exciting times for the University of Liverpool and I am confident our new university will help meet the global demand for highly-trained professionals and cement Liverpool's reputation in China as a world leader in teaching and research."

An advisory committee comprising representatives from major multi-national companies will advise the university on its degree programmes to ensure they meet the needs of global manufacturing and service industries.



浦大学

interview

Professor Michael Fang is a Pro-Vice-Chancellor at Liverpool and the Executive Vice-President of the new university. He has been instrumental in the creation of XJTLU and in helping the University of Liverpool gain the approval of the Chinese Government for the project. For the past 12 months he has been stationed at SIP to oversee the development of the new institution and, in September, saw the first undergraduates begin their degree programmes.

Red Brick spoke to Professor Fang about the build up to the opening and the first few days of term.

What have the last few months been like for you?
It was an extremely busy time. We had only three months after the grant of the licence by the Chinese Ministry of Education to make the university known to the public, recruit students, get the building and laboratories ready and to recruit enough teachers for the students recruited.

What has been your biggest challenge?
To make the university known to the applicants in less than three weeks and to compete with the top Chinese national universities for the best students while charging a tuition fee 10 times higher than those charged by the Chinese national universities.

What has been your proudest moment?
Seeing the smiling students together with their parents queuing to register and my colleagues chatting to them on 14 September. It made me suddenly realise that it is real and a new university is born!

What was the atmosphere like on the first day of term?
On the surface it was very calm and orderly. However, one could feel the excitement: students were eager to find out if the university is different from other Chinese universities and my colleagues, especially those from the UK, were anxious to discover what our students are like.

What are the main differences you have found between university life in the UK and China?
XJTLU is a new type of university which fuses the best features of the Chinese and British Higher Education systems. At XJTLU an academic from the UK would feel completely at home. Our Number One Building is a non-smoking building, which is unheard of in China.

What is your long-term vision for the new university?
A great institution devoted to the advancement of knowledge and to the training of all round high-quality graduates.

LIVERPOOL'S HISTORIC LINKS WITH CHINA

The University of Liverpool's relationship with China dates back to the 19th century.

One of the founders of University College, William Rathbone VI, established trade links with the country and by the 1860s, the Rathbones had become one of the largest China tea importers in the country.

The connections were strengthened throughout the 20th century. In 1904, Arthur Bulley, who later established the University's Botanic Gardens at Ness on the Wirral, commissioned the first of many expeditions to collect samples of plants and seeds from China.

Bulley enlisted legendary plant hunter, George Forrest, to visit the Yunnan region where he scaled heights of more than 16,000 feet and explored deep valleys to collect in excess of 30,000 specimens of the most beautiful and rare plant life in the country. These included a unique collection of rhododendrons that continue to thrive at Ness to this day.

In 1896, the University's first formal link, an honorary readership in Chinese, was created. Yet it was almost 30 years before the first Chinese students came here. Through the 1940s and 50s, the number of Chinese students continued to grow and there are now 667 registered students – the largest proportion of overseas students at the University.

In 1944, University students produced the first Chinese newspaper in the UK, *Hua Chow*, and a Chinese Students' Society was formed in 1972.

Academic links with Chinese universities are particularly strong. These include Tsinghua University, Zhejiang University, Shanghai Jiaotong University, Xi'an Jiaotong University, Shenzhen University, Beijing University of Post and Telecommunications, Beijing University of Chemical Technology and Tongji University. Many Liverpool staff hold visiting lectureships at top Chinese institutions including Professor Michael Fang, who is a visiting professor at Beijing's prestigious Tsinghua University.

Liverpool and **Suzhou** have more than just the new university in common – they are both UNESCO World Heritage sites; Suzhou's ancient gardens gained their status in 1997, while Liverpool's famed waterfront and mercantile area was recognised in 2004.

Corporate:
beauty inside and out
Words: Caroline Harvey

For more information visit:
www.liv.ac.uk/artgall

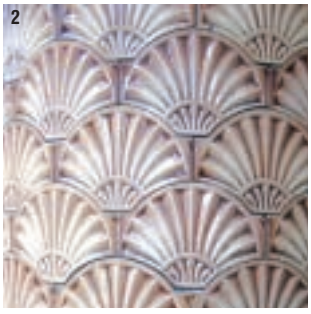
beauty inside and out

THE VICTORIA BUILDING, WHOSE APPEARANCE WAS THE ORIGIN OF THE PHRASE 'REDBRICK UNIVERSITY', IS BEING TRANSFORMED INTO A MUSEUM AND ART GALLERY.

"When you're outside standing in Ashton Street you're not expecting that inside is a beautiful hall decorated with tiling... The building has got terrific architectural features... We want people to come in and explore it."

Matthew Clough
Director of the art and heritage collections

1 View west from the first floor gallery, showing the entrance hall and fireplace
2 Detail of the decorative tiles covering internal pillars, entrance area
3 Vew down from half landing, main staircase
4 Artist's impression of the new glass lift in the bell tower



In the days when wooden ships crammed with sugar and spices would end their journey in Liverpool's docks, those whose bellies were full from the profits were determined to leave behind a legacy.

Their dream was of an English version of Florence, where rich men would be educated, and cultured men too, so they set about constructing fine libraries and museums. Among these grand architectural statements, aiming to demonstrate the city's sophistication through stone and brick, was a building that still sits proudly on the top of Brownlow Hill today.

In the century since the Victoria Building was completed, thousands of students have wandered its corridors, studied in its library and looked up at the clock tower to check the time. Now, thanks to a £7.5 million University of Liverpool project, it will begin to inspire people from all walks of life – from children to pensioners, entrepreneurs to tourists.

The building, whose appearance was the origin of the phrase 'redbrick university', is being transformed into a museum and art gallery.

"When you're outside standing in Ashton Street you're not expecting that inside is a beautiful hall decorated with tiling," says Matthew Clough, director of the University of Liverpool's art and heritage collections.

This idea of discovery is central to the project. "The building has got terrific architectural features but you have to wander around to find things. We want people to come in and explore it," explains Matthew. "Connected to that are the collections which many people won't have seen before."

These include around 6,500 items of fine decorative arts and many thousands of museum objects, which the University has amassed over decades of research. They will be exhibited over three floors.

Though most of the Victoria Building will remain the same, some construction work will be needed to make it more accessible to the public and to conform to modern legislation. Three large ground floor windows on the east side will be lengthened to create two doors and a display window in between, guarded by the statue of Christopher Bushell, a former vice president of the University College Liverpool, as it was then, that currently stands inside.

Other work includes opening up some of the archways on the ground floor so that visitors will have a clear view of all the treasures inside, such as the unusual tiled fireplace and war memorial. The biggest job will be the installation of a lift inside the bell tower. It will travel through a glass shaft so that the people inside it will get glimpses of architectural features they would otherwise miss.

Corporate:
beauty inside and out
continued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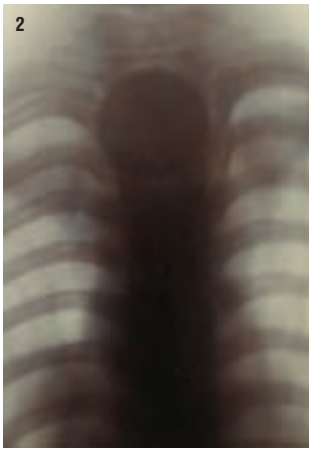
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1 Pre Columbian funerary vessel from Latin American Studies
2 Early X-Ray of a child who swallowed a penny (successfully removed)
3 Python skeleton
4 Bottled specimens from the Zoology Collection

"In a building like this which has such a strong identity, modern interventions like the lift are always going to look like interventions. There will be no attempt to imitate what the original architect, Alfred Waterhouse, did," says Matthew.

"I don't think Waterhouse would have a problem with what we are doing. He was a very pragmatic architect. He would have been far happier to see the building being used."

He would not be the only one. The project means that from 30 June 2008, the general public will have access to artworks and artefacts that, due to the current University Gallery's limitations, they will never have seen before.

When they enter the building on the ground floor, passing the new reception and shop, they will be faced with exhibits displayed in unusual ways – with the porter's cubbyhole and noticeboards transformed into showcases.

Offices to the east of the first floor, with their wonderful high ceilings, granite pillars and enormous windows, will be turned into galleries for the University's collections of ceramics, silver and studio-size sculpture. The current doors will be made into archways so that visitors standing below can look up and get a peek at what more there is to discover.

"In the current gallery you don't get the full hit but here there is more space. We have a very good collection of early English and Chinese ceramics from when the Georgians were obsessed with drinking tea. We also have items linked to the same theme like tea caddies and tea tables," reveals Matthew.

Cases on the side walls will display silver, mainly late 18th and 19th century commemorative items, like cups, plaques and meat dishes. The oldest objects in the silver collection are a pair of marrow spoons from around 1690 and a bleeding bowl of 1694.

There is also a two foot high candelabra epergne, made by Edward Barnard & Sons in 1836, that was presented to the University by Liverpool merchant William Rathbone to celebrate its centenary.

Many of the items in the University's collection have been bequeathed to the institution in this way. They include Sir Sydney Jones's fine furniture, ceramic collection and glassware from the 18th and 19th centuries donated, along with 19 Abercromby Square and his Sefton Park residence.

The main space in the Victoria Building will include a gallery devoted to the 19th century wildlife painter John James Audubon, watercolours and temporary exhibition space.

A fundraising campaign to raise £2.1 million towards the restoration of the Victoria Building is now underway.

Generous support has already been received from the Estate of Miss Marian Thomason (a graduate of the University), Jenny Rathbone, the Friends of the University, the P H Holt Charitable Trust, and a number of other donors.

For further information about the fundraising campaign, please contact Kate Robertson on
+44 (0)151 794 2133
or email: **kate.robertson@liv.ac.uk**.

This will be a great improvement on the current gallery, in a terraced house on Abercromby Square, where it is difficult to regularly change displays.

Says Matthew: "The new space will give us the potential to change displays more often. In the current gallery we can't do that too easily because we end up having to re-drill the walls. Here we will have a hanging system that will allow us to change them more regularly."

Even though work has not yet begun on the building, there are already plenty of treats to discover. At several levels on the curved staircase, which is impressively decorated with thousands of tiles – some patterned, some glazed, some bare – are plaques dedicated to benefactors of the University.

One, to cotton broker George Holt, features his side profile as well as some three dimensional sailing ships. It was created by Sir George Frampton, who also sculptured the Peter Pan statue in Kensington Park from which the one in Sefton Park was cast.

Perhaps the biggest surprise in the Victoria Building is the Medieval-style hall on the second floor. Tate Hall, named for the sugar baron Henry Tate, who donated a large sum of money to the building's construction, was originally the library and has more recently been used for students' exams.

The pitched ceiling is held up by thick wooden beams emblazoned with the University crest and hanging down are wrought iron pendant lights which are due to be refurbished. When the building is reopened in 2008, the hall will house an impressive collection of objects gathered from many different University departments, known as the Heritage Collections.

Some items have played a key role in the University's history. Dr Robert Minnitt, Honorary Lecturer in Anaesthesia from 1933-1947, pioneered the use of gas and air in childbirth. Some of his equipment will be showcased.

"I'm very interested in getting people face to face with objects. It's hard to imagine someone walking round the hall and not finding at least one thing they've not seen before and find interesting," explains Matthew.

Construction work on the Victoria Building is due to start in November 2006. The current gallery will shut in July 2007.

"There will be at least one major exhibition in 2008. We've got some exciting plans that we will be revealing shortly," Matthew discloses. "The new gallery will be a major legacy project for the Capital of Culture, opening right in the middle of the year. I hope it will provide something very valuable and important for the city."

THE VICTORIA BUILDING AND WATERHOUSE

The striking red brick building on Brownlow Hill was constructed as a symbol of the city's commitment to education. Completed in 1892, it replaced University College Liverpool's previous premises in a former lunatic asylum in the quadrangle behind.

At that point the institution was just 10 years old and did not have the power to confer degrees. For that it had to look to Victoria University in Manchester.

From the outset, the University College had managed to recruit many notable scholars and had received plenty of financial support from wealthy local people. Some of these donations funded the construction of the Victoria Building, after which the phrase 'redbrick university' was coined.

The architect behind the eye-catching design was Alfred Waterhouse, the son of a wealthy mill owner born in Aigburth, Liverpool, in 1830. Educated at the Grove School in Middlesex and apprenticed to North West architect Richard Lane, he had spent his youth travelling round Europe before setting up his own practice in Manchester.

His work was in great demand, as grand public buildings had become popular, and he received many commissions during the High Victorian years. As well as the Victoria Building, Waterhouse designed Manchester Town Hall (completed in 1877) and the former North Western Hotel (1871), next to Lime Street Station. He became most well-known for the Natural History Museum (1881) in London with its rounded arches and spired towers. Waterhouse won the commission after the original designer died and he created one of Britain's most striking examples of Romanesque architecture. He refused to limit himself to a single architectural style, instead becoming an expert in both Gothic and free Renaissance traditions and favouring simple, yet bold, ornamentation. President of the Royal Institute of British Architects from 1881-1891, Waterhouse died in Berkshire in 1905, two years after University College Liverpool was granted a charter to become a fully fledged university.

The Victoria Building continued to be used, but new buildings sprang up around the top of Brownlow Hill over the following century to cope with the increasing numbers of students. From 1903-1913, the undergraduate population rose from 638 to 1,178, compared with 15,000 today.

Until recently, students have continued to sit their exams in Tate Hall within Waterhouse's Grade II-listed building and the offices used as overflow for University departments awaiting new premises.

Medicine: tackling child oral health
Words:
Joanna Robotham

For more information visit:
www.liv.ac.uk/luds

tackling child oral health

EXTRACTING SEVERELY DECAYED TEETH FROM THE MOUTHS OF CHILDREN AS YOUNG AS THREE YEARS OLD IS AN ALL TOO FREQUENT OCCURRENCE FOR DENTAL PROFESSIONALS THROUGHOUT THE NORTH WEST.

University dentists are working with parents from disadvantaged communities across Merseyside where the incidence of tooth decay in children is highest, with the aim of establishing twice-daily toothbrushing in their children by the time they reach 18 months.

The poor state of children's oral health is borne out by some worrying statistics. A total of 48% of five-year-olds in the region have experienced tooth decay compared with the national average of 39%, and in some areas, such as Knowsley, the figure has reached a worrying 65%.

The statistics highlight the need to establish a good dental hygiene routine at the earliest age possible and the University of Liverpool's School of Dental Studies is leading several major clinical initiatives and research projects to help tackle dental health problems and improve long-term dental care in young children.

Professor Cynthia Pine, Dean of Dental Studies at the University, commented: "Having to remove several teeth from the mouth of a very young child because they are so severely decayed is a depressing prospect many clinicians here have to face on a regular basis. This is particularly upsetting because dental caries is an entirely preventable disease and, while some suffer severe effects, many young people today are growing up with healthy mouths. Tooth decay in children has become a major health disparity linked to frequent intake of sugary foods and drinks and irregular brushing with a fluoridated toothpaste.

"We are trying to reverse the trend through a number of research and clinical initiatives. We want to prevent tooth decay at its earliest stages by helping to establish a twice-daily toothbrushing habit for children and by developing other preventative regimes."

Liverpool is part of a global initiative to encourage parents to establish regular toothbrushing and oral hygiene in their children from six months of age. University dentists are working with parents from disadvantaged communities across Merseyside where the incidence of tooth decay in children is highest, with the aim of establishing twice-daily toothbrushing in their children by the time they reach 18 months. The two-year project will investigate the best methods of communicating oral hygiene advice to parents via medical centres and immunisation programmes.

Dr Angela Ashcroft, project co-ordinator, said: "Establishing a brushing regime with a child can be difficult for some parents when their time is consumed by other family and work responsibilities. Previous studies have demonstrated the strong impact parental attitudes towards sugar-snacking and toothbrushing have on the long-term oral health of their children from the child's first years. This project aims to help parents realise the benefits of their personal intervention in their child's daily tooth care regimes so the risk of developing tooth decay is limited from the earliest stages possible."

Several initiatives to reduce tooth decay in teenagers are also underway. The University is co-ordinating ground-breaking clinical trials to develop treatment to prevent tooth decay in teenagers who wear orthodontic braces. Young people with fixed orthodontic braces are more susceptible to a build-up of dental plaque around the brace which can result in decay and the appearance of white spots on the teeth once the brace is removed. The University is just one of three centres in the world to use a revolutionary diagnostic technique called Quantitative Light-induced Fluorescence (QLF) which detects areas of demineralisation (decay) on the teeth before they are visible to the naked eye.

In a new research project, a total of 90 participants aged 13 and over will be screened using QLF and given one of three special fluoride toothpastes – each with a different fluoride content – to treat the areas at risk in order to prevent the build-up of decay. The study, led by Professors Neil Pender and Sue Higham, will investigate which toothpaste is the most effective and results will be used by a major pharmaceuticals company to manufacture new treatments for preventing tooth decay for orthodontic brace wearers.

Neil said: "It is difficult enough for a child to accept wearing braces, let alone for them to have to keep the teeth clean enough to avoid damaging marks left when the braces are taken off. Techniques such as QLF can help to reduce the chances of permanent damage by making early changes visible."

The clinical and research programmes have been supported by the establishment of an Oral Health Suite in the Dental School, created especially for children. The modern multidisciplinary facility, which opened in June, comprises three new surgeries with facilities for 'conscious sedation', which is particularly suited to children. This is specifically designed as an alternative to general anaesthetic to relax young patients with 'dental anxiety' and improve their response to treatment.

Areas of specialist dentistry including orthodontics will also be catered for in the suite, with treatments available for children born with cleft lip and palate. A quiet area has been created away from surgeries so children can get advice on general oral hygiene and toothbrushing. Research activity will be enhanced with the appointment of a new Chair in Child Dental Health who will undertake several studies relating to child oral health, including an international project to understand and manage abnormalities that can occur in the development of teeth.

Professor Pine added: "Our Oral Health Suite will not only provide children in Merseyside with the most specialist treatments available but will also enable our students to be trained with the most advanced clinical skills required by the dentists of tomorrow."

Social and Environmental Studies: Impacts 08
Words: Dave Chadwick
Illustrations: Adrian Bradbury

For more information visit:
www.impacts08.net
www.liverpool08.com

researchers go 'live' in unique Capital of Culture programme

As Liverpool gears up to become European Capital of Culture, a groundbreaking 'real time' research programme will place the city at the forefront of cultural regeneration studies on a global scale.

Impacts 08 – The Liverpool Model will assess the long-term cultural, social, economic and environmental benefits flowing from Capital of Culture status.

Where traditional research has focused on capturing statistical data after the event, *Impacts 08* aims to deliver qualitative and quantitative information as Liverpool's festival year unfolds. This 'live' dimension will enable organisers to adjust and fine tune elements of the programme throughout the year, resolving potential issues before they escalate into major problems.

The Capital of Culture experience will not only have a profound effect on Liverpool's physical appearance, but also its sense of identity and self-belief – intangible factors that cannot be evaluated using numbers and formulae.

"This is where *Impacts 08* will play a critical and unique role," explains programme director, Dr Beatriz García, from the School of Sociology, Social Policy and Social Work Studies. "There is no doubting the value of traditional, statistically-based measures of economic factors, such as job creation, tourist numbers and inward investment levels.

"However, we will carry out these measures as part of a broader, longitudinal research programme that incorporates a range of other factors that are equally important in obtaining a

full understanding of the impact of major events such as the Capital of Culture year."

These additional factors include changes to the physical environment of the city, including construction work, public space, and transport infrastructure, which relate directly to economic considerations.

Equally essential to *Impacts 08* are social and cultural dimensions. But, where the two are conventionally treated as parts of the same whole, Beatriz and her team believe each should be studied as a separate entity.

"In a social context, we are looking at the effect of income, poverty and deprivation on accessing the changes and developments that Capital of Culture status entails," explains Beatriz.

"This is about assessing how the economic impact is distributed in terms of ethnic diversity, educational and income groups. For example, if there are issues around poverty, we can look at what sort of opportunities are available with a view to introducing new or innovative ways of doing things.

"The cultural impact is about issues of identity and how groups understand themselves in terms of image and sense of place – effectively, what it means to be Liverpudlian and how people perceive their city," says Beatriz.

"We also need to assess how arts groups communicate with one another, with other groups in the UK, and in Europe, because it is important to understand how Liverpool fits into the world picture. This is a key goal that our programme must achieve."

So how is this mass of research data to be captured, collated and communicated?

Hard economic facts and figures, such as job creation, inward investment and the construction of new buildings can be handled using established statistical measures, then related to the Culture Company's key objectives. However, the nature of longitudinal research requires the interpretation of contextual information that cannot be expressed numerically.

"For example, sometimes job creation isn't sustainable, but if it is accompanied by a greater sense of cultural identity, the broader enterprise can be seen as worthwhile," explains Beatriz.

In addition, these elements sometimes help to promote positive change in other areas, such as tolerance of other social or ethnic groups and a greater 'feel good' factor as a result of a stronger sense of belonging to a community.

"Because these issues can't be quantified, we are asking broader questions that help us to assess whether the cultural regeneration programme has been beneficial, using focus groups, interviewing and participatory mapping techniques," says Beatriz.

Participatory mapping has been defined as a new sort of community-based cartography which recognises the spatial and environmental knowledge of local people and transforms this into more conventional forms.

"This process allows us to engage participants in the research process, giving them more control in defining what really matters to them in their lives," explains Beatriz. "By doing this, we gather valuable information about an individual's relationship with their city, that can be related to ethnicity, age, income levels and geographic locations, as well as their interaction with politicians, artists, and education and community leaders." The significance to the success of the festival year of carrying out 'live' research cannot be overstated.

"It is critically important that we can inform Liverpool City Council and the Culture Company of any issues that are emerging in terms of strengths and weaknesses," says Beatriz. "This means we are able to have an impact on things as they happen, so we can influence the process itself by enabling the key decision makers to take account of any changes as the programme goes ahead.

"This has never happened before because measures have not been put in place early enough. This aspect makes our research programme extremely challenging, but also highly constructive."

Once the festival year is over, the framework and methodology of *Impacts 08* is replicable, so that other major regeneration initiatives across the UK and Europe, including the London Olympics in 2012, can benefit.

red brick

THE UNIVERSITY of LIVERPOOL

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