Report

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KING'S College LONDON

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Cover
Britain's Daniel Keatings performs on the parallel bars during the Gymnastics qualification event for the London 2012 Olympics. King's is the laboratory operator for the WADA accredited anti-doping laboratory which will operate during the Games.
See page 12
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The King's College London annual REPORT reviews the College's work each year by featuring a sample of the research and teaching currently taking place at King's. It is the Principal's report to the College Council. This edition of the REPORT covers the year 2010-11.

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King's College London is one of the top 30 universities in the world, and is the fourth-oldest university institution in England. It was the *Sunday Times* 'University of the Year' in 2010-11. A research-led university based in the heart of London, King's has nearly 23,500 students (of whom more than 9,000 are graduate students) from nearly 140 countries, and some 6,000 employees. King's is in the second phase of a £1 billion redevelopment programme which is transforming its estate.

King's has an outstanding reputation for providing world-class teaching and cutting-edge research. In the 2008 Research Assessment Exercise, 23 of the College's departments were ranked in the top quartile of British universities, and over half of its academic staff work in departments that are in the top 10 per cent in the UK in their field and can thus be classed as world leading. The College is among the top seven UK universities for research earnings and has an overall annual income of nearly £525 million.

King's has a particularly distinguished reputation in the humanities, law, the sciences (including a wide range of health areas such as psychiatry, medicine, nursing and dentistry) and social sciences including international affairs. It has played a major role in many of the advances that have shaped modern life, such as the discovery of the structure of DNA and research that led to the development of radio, television, mobile phones and radar. It is the largest centre for the education of healthcare professionals in Europe; no university has more Medical Research Council Centres.

King's College London and the NHS foundation trusts of Guy's and St Thomas', King's College Hospital and South London and Maudsley together form King's Health Partners. This Academic Health Sciences Centre is a pioneering global collaboration between one of the world's leading research-led universities and three of London's most successful NHS foundation trusts, including leading teaching hospitals and comprehensive mental health services.

The College is in the midst of a five-year, £500 million fundraising campaign – World questions|King's *answers* – created to address some of the most pressing challenges facing humanity. The campaign's three priority areas are neuroscience and mental health, leadership and society, and cancer.

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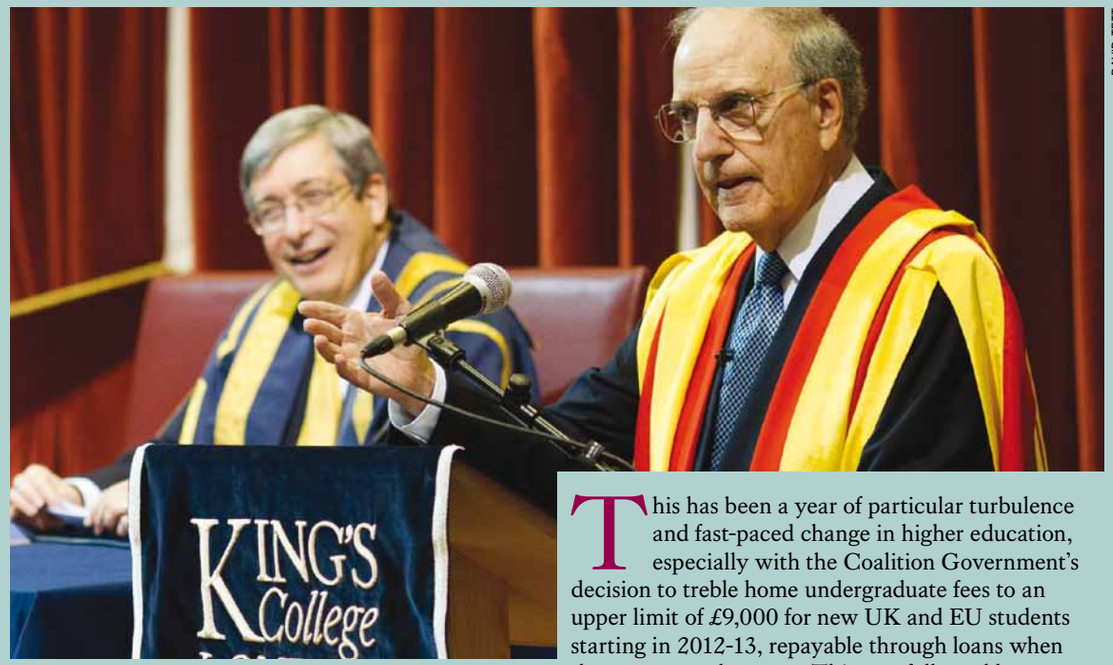
KING'S HEALTH PARTNERS

ED PARK

BELLE MELLOR



DAVID TETT

Enabling change

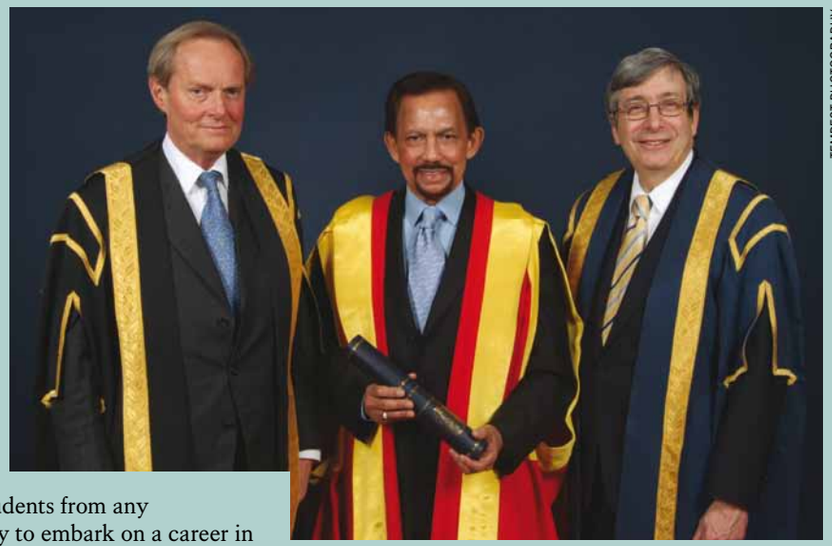
The Principal and President, Professor Sir Richard Trainor, reflects on developments at King's in 2010–11.

This has been a year of particular turbulence and fast-paced change in higher education, especially with the Coalition Government's decision to treble home undergraduate fees to an upper limit of £9,000 for new UK and EU students starting in 2012-13, repayable through loans when they enter employment. This was followed by a White Paper in June 2011 which introduced a much more competitive situation in English higher education by lifting the Funding Council cap on the recruitment of students achieving AAB grades and above at A-Level. In addition, recent decisions about funding derived from the periodic national exercises to assess universities' research quality mean that only those researchers achieving the highest grades will produce any government support for their institutions from 2012. The new fees policy means that King's and other English universities will lose approximately 80 per cent of their current government funding for teaching, and roughly the same proportion of capital funding, and will have to make up this shortfall by charging these higher fees. The College's proposal to charge £9,000 tuition fees from September 2012, along with planned financial support for students and an important range of outreach activities to widen participation by students from poorer households, was approved by the Office of Fair Access (OFFA) in July 2011.

Reinvesting

By 2014-5, King's will be reinvesting 30 per cent of the additional fee income in its widening participation initiatives and financial support packages, and we anticipate that about a third of our home undergraduate students will receive some financial support towards tuition fees or living costs. Some students will not have to pay any tuition fees at all. From its earliest days in the 19th century, King's has pioneered creative ways of widening access to higher education, and this year we have introduced our Enhanced Support Dentistry Programme (see page 6),

Left: **US Senator George Mitchell, formerly President Bill Clinton's Special Envoy for Northern Ireland and President Barack Obama's Special Envoy for Middle East Peace, gave a lecture on the Middle East at King's in October 2011, and received the College's honorary doctorate of laws.**
Right: **An honorary degree of King's was conferred upon His Majesty Sultan Haji Hassanal Bolkiah by the Chairman of the College Council, the Marquess of Douro, in April 2011.**



TEMPEST PHOTOGRAPHY

which will give talented students from any background the opportunity to embark on a career in dentistry, as a companion to our existing highly successful Extended Medical Degree Programme, now in its eleventh year.

Our firm intention is to ensure that, in the future as in the past, no student with the ability to profit from the College's academic programmes will be denied entry because of their personal financial circumstances.

Given the generally very high level of demand for King's undergraduate programmes, we expect to maintain a strong level of applications from well-qualified students from a diversity of backgrounds, despite the higher fees, and we expect to do so in humanities, social sciences and law as well as in natural sciences and health-related disciplines. In particular, we are proposing to recruit 150 extra academics and 2,250 extra students by 2016 in the arts and sciences, particularly in the Schools of Arts & Humanities and Social Science & Public Policy, to ensure that these areas reach critical mass and become self-sustaining in terms of excellent research and teaching. We also hope to be able to make additional proposals for Law.

Adaptations

All English universities, however strong their current positions, need to make major adaptations in order to flourish in this new higher education world. Students paying £9,000 will bring markedly higher expectations to their student experiences. With this in mind, the College is accelerating and intensifying its programme of improvements aimed at students – including better formal and informal student spaces, additional places in halls of residence and curricular changes which will increase students' involvement in research and their access to disciplines other than their major subject. We have already invested some £60 million so far, and further investments of £140 million are planned over the next few years.

CASE

DAVID TETT

Above middle: **Professor Trainor received the Annual Leadership Award of the Council for the Advancement and Support of Education (CASE) in June 2011. Guests at the ceremony included (left to right) Laura Yaffe, CASE Europe Graduate Trainee at King's; Gemma Peters, Executive Director of Fundraising & Supporter Development for King's College London & King's Health Partners, and Professor Marguerite Dupree, wife of Professor Trainor.**
Above: **The Principal presented the annual King's Awards in September 2011, including the award for most innovative teacher to Dr Lea Ann Dailey, Lecturer in Drug Delivery.**

DAVID TETT

DOLLY CLEW

Above left: Professor Trainor with Bernadette Farrell, Lead Organiser of South London Citizens, at the signing of an agreement in May 2011 to work with the Harris Federation of South London Schools in a widening participation partnership.
Below left: Political theorist and activist Professor Noam Chomsky with the Principal and Professor Penny Green at the launch in October 2011 of a new journal, *State Crime*, based at the International State Crime Initiative at King's School of Law.
Above right: The Principal and Professor David Carpenter at the conference in June 2011 in the College's Maughan Library marking the completion of the College's project on the 'Fine Rolls of King Henry III'.
Below right: The Principal at an event in October 2011 to honour former Deans of the College's Institute of Psychiatry, with Professor Gerald Russell (left) and Professor Peter McGuffin (right).

These changes will benefit our postgraduate, as well as undergraduate, students, and here, too, King's global reputation for academic discovery and education means we are able to recruit the best postgraduate students from around the world. The feature on our doctoral students on pages 34-9 describes how the College is creating and nurturing the next generation of research leaders.

Investing in strength

We are mindful of King's need to change as well as its capacity to build on its various major strengths, not least its sound financial position. Again this year the College received a credit rating of 'AA/stable'. While continuing to improve key areas of the College, we shall focus on investing in our strengths rather than in attempting to extend the major fields of knowledge which we pursue. We shall continue to emphasise the distinctiveness of King's, summarised by our mission of 'service to society' which encapsulates our outward-facing, interdisciplinary, problem-solving ethos. We shall also intensify our international efforts, which include important partnerships with universities worldwide (see page 11), and which have led to the recent launches of our institutes for Brazil, China and India and our plans for the launch of a Russian Institute in 2013 (see page 9). So King's will change significantly as well as retain strong continuities as we keep pursuing our goal to be a leading world university

With this in mind, it is good to report that the College has continued to perform well in international league tables, particularly in the *Times Higher Education* survey where in 2011 King's was ranked eighth among UK institutions, 12th in Europe and rose from 77th to 56th position among universities worldwide. King's was also ranked sixth in the UK in the QS Global League Tables, where for the fifth year running we were among the world's top 30 universities. It is particularly pleasing that in the *Sunday Times* 2012 UK league table (published in September 2011) we were ranked third for graduate employment.

DAVID TETT

JODY KINGZETT

Partnership

Partnership in learning, teaching and research continues to be an important theme at King's. A major continuing and developing collaboration is that of King's Health Partners (KHP), which brings together the College and the NHS foundation trusts of Guy's & St Thomas', King's College Hospital, and South London & Maudsley, to enable researchers, healthcare professionals and students to develop world-class treatments for patients locally and worldwide. KHP was accredited as one of the UK's first five Academic Health Sciences Centres in 2009. This partnership is at the heart of our new Women's Health Academic Centre, whose work is described on pages 22-7.

An important London biomedical partnership was confirmed in October 2011 when King's and Imperial College London formally joined the partnership behind the Francis Crick Institute, becoming part of this project to create the world-leading biomedical research institute in central London (see page 10). We were also delighted to learn in August 2011 that our partnerships with the NHS trusts through two of our Biomedical Research Centres and a new Biomedical Research Unit have attracted over £112 million in funding over the next five years from the Department of Health.

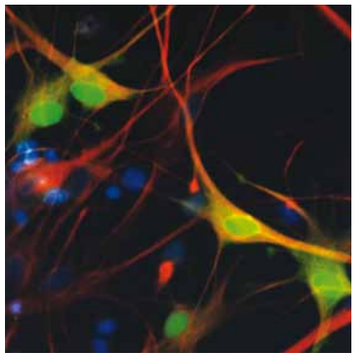
Another particularly significant association in the last year has been that with the Somerset House Trust, as a result of the agreement for King's to extend its Strand Campus into the East Wing of one of London's most beautiful and important buildings. This development is enabling us this month to open a new and fittingly grand home for our School of Law, and, with the Somerset House Trust, to work towards developing a new cultural centre at the Strand.

The close academic-military partnership which enables King's Defence Studies Department to educate Armed Forces personnel at the Joint Services Command and Staff College (JSCSC) in Wiltshire was endorsed in October 2011 when our contract to do so was extended for another 10 years. The unique nature and value of this partnership is described and assessed on pages 28-33.

Meanwhile our alliance with the pharmaceutical giant GlaxoSmithKline means that the College will play a crucial role in the London 2012 Olympic and Paralympic Games, for which our world-renowned Drug Control Centre will operate the WADA-accredited anti-doping laboratory. This and King's other significant contributions to the 2012 Olympics are outlined on pages 12-21.

Finally, I am very pleased to report that partnership with our alumni, friends and supporters has contributed enormously to the success of our fundraising campaign this year, and as a result we are now, as reported on page 10, more than half-way towards reaching our £500 million target. It was a particular pleasure for me to meet King's alumni and friends in the United States in November 2010 to tell them about the Campaign, at a series of topical debates tackling war and mental health issues, and to visit the US again in autumn 2011 to host a lecture given by Sir Deryck Maughan, distinguished King's alumnus and principal benefactor of the College's Maughan Library, at the Yale Club in New York.

NEWS IN BRIEF 2010–11



Stem cell milestone

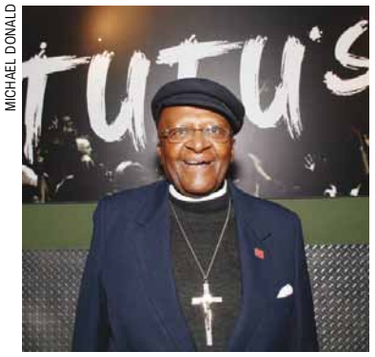
King's stem cell scientists announced in December 2011 that they have submitted to the UK Stem Cell Bank (UKSCB) the first clinical grade human embryonic stem (hES) cell lines that are free from animal-derived products. Known as 'xeno-free' stem cells, these have the potential to become the 'gold standard' lines for developing new stem cell-based therapies. The arrangements under which they are deposited in the UKSCB will ensure they are freely accessible to the wider research community, and the expectation is that they will be grown and processed to provide stem cell stocks that will be used for clinical research and treatment to benefit patients. This first batch of cells is the culmination of nearly 10 years of research funded strategically by the Medical Research Council (MRC) that will keep the UK at the forefront of regenerative medicine.

GREG FUNNELL

Open wide

King's Enhanced Support Dentistry Programme was launched in November 2011. This widening participation initiative in the College's top-ranking Dental Institute is designed to provide additional support to exceptionally able students who would like to enrol on the five-year Bachelor of Dental Surgery (BDS) course, but believe they would be excluded because they anticipate not doing well enough at A-level. At the end of the programme students will receive exactly the same qualification as their peers on the regular BDS course, and will have undertaken the same assessments. However, students on this programme will be given more academic and pastoral support throughout their course, as well as additional financial support.

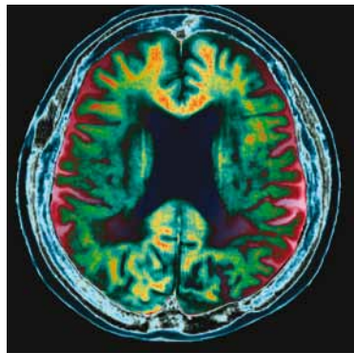
MICHAEL DONALD



Celebrating Tutu's 80th

King's celebrated the 80th birthday in October 2011 of one of its best-known alumni and fellows, Archbishop Emeritus Desmond Tutu. Former principals of the College, colleagues, fellows, alumni and friends, including the Archbishop of Canterbury, Dr Rowan Williams, came together to honour the Nobel Peace Laureate and former Archbishop of Cape Town, who took his bachelor's and master's degrees in theology at King's in the 1960s. 'I credit King's with enabling me to have returned to South Africa with a far greater, proper self-confidence,' Desmond Tutu said. 'What an incredible joy and privilege it is to be back at my alma mater.' The Archbishop visited the recently-refurbished student nightclub at the Strand Campus, Tutu's, which was named in his honour.

ZEPHYR/SCIENCE PHOTO LIBRARY



Alzheimer's pinpointed

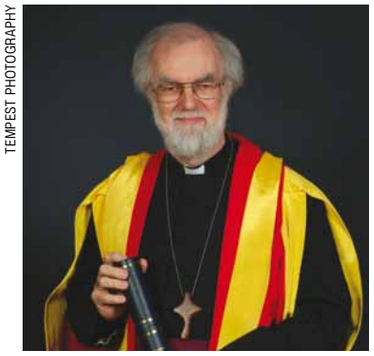
A new advanced computer program being used by King's Institute of Psychiatry can detect the early signs of Alzheimer's disease from a routine clinical brain scan, returning 85 per cent accurate results in under 24 hours. The Automated MRI software compares an individual's brain scan image with 1,200 others showing varying stages of Alzheimer's (thought to be the largest collection of its kind in the world), and calculates the outcome. Although there are 750,000 people with dementia in the UK, early diagnosis of Alzheimer's is difficult, and patients are frequently not treated until their symptoms become stronger.

JOHN GREIM/SCIENCE PHOTO LIBRARY

New drugs from old remedies

A database which will help to develop new drugs from age-old remedies has been created by King's researchers. Listing the chemical components found in traditional Chinese medicines, the Chem-TCM database was released to the market in October 2011, providing a valuable research tool for the pharmaceutical and biotechnology industries, academic researchers, and the medical profession (including the complementary health sector). With funding from Innovation China UK, the creation of the database was a collaborative project between the Institute of Pharmaceutical Science at King's and the Shanghai Institute of Materia Medica (SIMM).

TEMPEST PHOTOGRAPHY



Honorary doctorates

The College has conferred honorary doctorates on eight internationally distinguished recipients. The 2011 King's honorary doctors are: His Majesty Sultan Haji Hassanal Bolkiah, Sultan of Brunei Darussalam; the Most Revd and Rt Hon Dr Rowan Williams, Archbishop of Canterbury (above); Senator George Mitchell, former US Special Envoy for Middle East Peace and crucial participant in the Northern Ireland peace process; Professor Dame Sally Davies, the first woman Chief Medical Officer; Professor Michele Parrinello, internationally distinguished computational scientist; Professor John W Stamm DDS, Dean of the University of North Carolina School of Dentistry; Professor Dame Marilyn Strathern FBA, internationally renowned social anthropologist, and Professor Umberto Veronesi OMRI, leader in academic cancer research and surgery worldwide.

LAURA NGWAZI

Honours

Europe's leading organisation for educational fundraising, marketing and supporter development has honoured the Principal for leadership in the UK's higher education community. The European sector of the Council for the Advancement and Support of Education awarded its annual Leadership Award in June 2011 to Professor Trainor for his 'vision and drive', on behalf of King's and the higher education sector. In January 2011 the New Year's Honours list confirmed that the honorary knighthood awarded last year to the Principal has been made substantive, following his being granted British citizenship (alongside his American citizenship). Professor Sir Robin Murray FKC, Professor of Psychiatric Research at the Institute of Psychiatry, received a knighthood in the 2011 New Year's Honours for services to medicine.

THET/HANNAH MAULE-FFINCH

Students pioneer volunteering scheme

King's Health Partners, in partnership with THET, a specialist international development organisation, are leading a pilot scheme for a new global volunteering programme launched in March 2011 by Prime Minister David Cameron. Funded by the Department for International Development, the International Citizen Service (ICS) programme will give hundreds of 18- to 22-year-olds across the UK the chance to serve in the fight against global poverty. As part of the first year roll-out, some 20 students and young graduates from King's undertook 10-12 week projects in summer 2011 in Sierra Leone, Tanzania, Zambia and Zimbabwe, on activities including training health workers, educating young people on sexual and reproductive health, and researching barriers to health care access.

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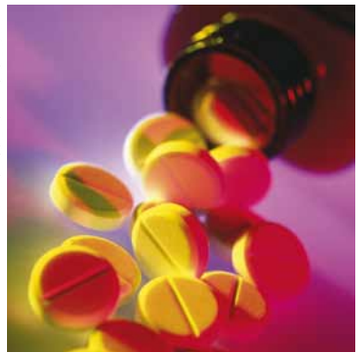


Secrets of paracetamol unlocked

Researchers from King's Wolfson Centre for Age-Related Diseases have discovered how one of the most common painkillers works. Although very widely marketed since the 1950s, exactly how paracetemol relieves pain was unknown. Now a study funded by the Medical Research Council and published in November 2011 has identified that a protein called TRPA1, found on the surface of nerve cells, is a key molecule needed for paracetamol to be an effective painkiller. If researchers can identify other analgesic compounds that use the same TRPA1 pathway to prevent pain signals sent by nerve cells to the brain, they may find a compound that does not have paracetemol's toxic effects.

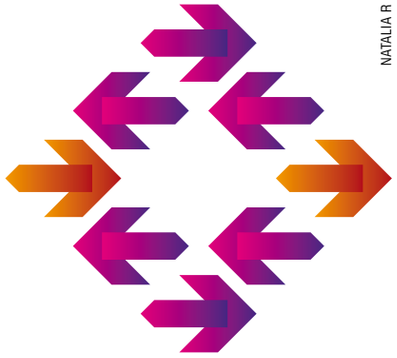
DAVID TETT

Rosalind Franklin Award

Francesca Happé, Professor of Cognitive Neuroscience at the Institute of Psychiatry at King's, was awarded the Royal Society's 2011 Rosalind Franklin Award in July 2011. The award – named after the King's scientist who played a crucial role in the discovery of the structure of DNA – recognised Professor Happé's scientific achievements, her suitability as a role model and her proposal for a series of picture books for 5- to 7-year-olds to raise awareness of women in science. Professor Happé's research focuses on autism spectrum conditions.

Energy management leader

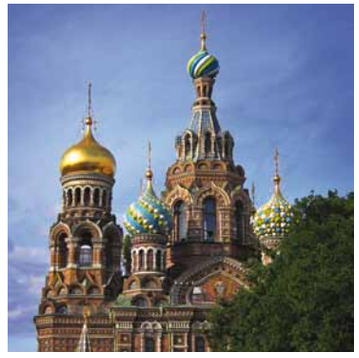
King's is the first university to achieve Energy Management Standard BS EN 16001. Independent external auditors verified the robustness of the College's energy management in three stages over a period of several months and assessed the College's control of its energy use and targets for continuous improvement. King's has been committed to minimising energy consumption for many years, with staff and students now demanding further action beyond legal compliance on issues concerning climate change and security of supply.



Easy access IP

A new initiative which offers university intellectual property licences for free, using quick and simple agreements, was launched in June 2011. The aim of Easy Access IP, in which King's is a founding partner with the universities of Bristol and Glasgow, is to make it easier for industry to work with universities, accelerating the transfer of university knowledge to the best commercial partner who can develop it to benefit the economy and society. The initiative has received an enthusiastic reception from industry and university representatives, and international partners have been recruited to spearhead the concept in North America, Australasia and on mainland Europe. The Easy Access Innovation Summit will be opened by David Willetts MP, Minister for Universities and Science, in February 2012.

NATALIA R



Russia is latest global institute

The new King's Russia Institute, opening in 2013, plans to become the leading international centre for the study of contemporary Russia. The Russia Institute will offer new MA and PhD programmes providing interdisciplinary, balanced, and cutting-edge studies of how Russian society functions and on the country's place and impact in global affairs. It will form part of King's Global Institutes and Centres, alongside the College's Brazil Institute, China Institute, India Institute, Institute of North American Studies, Centre for Middle East & Mediterranean Studies and African Leadership Centre. King's is increasing its capabilities to provide world-leading investigative insights on the BRIC countries, which will be cultural, economic and political powerhouses in the 21st century.

CHRIS CLARKE

Informatics students meet PM

Three second-year King's Informatics students met the Prime Minister at Downing Street in November 2011 as one of the winning teams of a competition for mobile phone applications organised by Silicon Valley Comes to the UK, which brings together students, technology investors and entrepreneurs. The 2011 'appathon' challenged students to program a mobile application based on open government datasets, and the King's app 'PoliticsDirect' was designed by (left to right) George Ing, Christian Clark and Anna Huckerby to give voters more opportunity to contact their politicians and hold them to account. Based on the mobile user's geographical location, it identifies their local MPs, MEPs and councillors, together with information about their voting record and expenses.

King's joins scientific powerhouse

King's and Imperial College London formally joined the partnership behind the Francis Crick Institute in October 2011. The two universities have become part of the project to create this world-leading medical research institute in central London, founded by Cancer Research UK, the Medical Research Council (MRC), the Wellcome Trust and UCL (University College London). The Institute's work will focus on understanding the underlying causes of health and disease and accelerating discoveries made in the laboratory into the clinic.

PAUL GRUNDY

Moving into Somerset House

King's School of Law has now moved into its new home in Somerset House East Wing, where facilities include a Moot Court that will enable students to perfect their debating skills. The refurbished building will also provide a focal point for many of King's cultural activities.

Campaign success

The College's campaign, World questions|King's *answers*, which spearheaded a new era of university fundraising at its launch in 2010, had by the end of 2011 raised £257 million: more than half its total target of £500 million. The College's campaign is the largest for any UK institution of higher education outside Oxbridge, and is addressing some of the world's most challenging problems, particularly in the areas of neuroscience and mental health, leadership and society, cancer and paediatrics.

New heads of School

The College has appointed two new members of its senior management team. Dr Dianne Rekow (above), Senior Vice Provost of Engineering and Technology at New York University (NYU) and Provost of Polytechnic Institute of NYU, became Dean of the College's Dental Institute from 1 January 2012, succeeding Professor Nairn Wilson. Professor Helen McCutcheon (above right), formerly Head of the School of Nursing and Midwifery at the University of South Australia, has succeeded Professor Anne Marie Rafferty as Head of King's Florence Nightingale School of Nursing & Midwifery.

World-leading nursing journal

The *International Journal of Nursing Studies*, edited by Professor Ian Norman and based in the Florence Nightingale School of Nursing & Midwifery at King's, has been ranked as the top academic nursing journal in the world, according to the Thomson-Reuters Impact Factors report for 2010, beating the North American journals that have been traditionally been dominant in academic nursing. This Thomson-Reuters report includes more than 10,000 of the world's most highly cited peer reviewed journals in 238 disciplines from 84 countries, including over 1,300 regional journals.

HERMAN CHAN

Partnerships worldwide

King's international reach is continually being extended through partnerships with prestigious universities around the world to enhance research, enable the transfer of knowledge, and provide opportunities for staff and student exchanges and experience. The College's international partnerships include those with Hong Kong University; the University of North Carolina at Chapel Hill; the University of California, San Francisco; Jawaharlal Nehru University, New Delhi; the National University of Singapore; Renmin University of China, and the University of São Paulo, Brazil.

King's & the OLYMPICS

King's contributions to the London 2012 Olympic and Paralympic Games range from providing the accredited anti-doping lab for the Games, to advising on security and air quality, to reflecting on the physiology of Olympic performance and its cultural heritage – not to mention fielding some medal-ready athletes.

JANE MINGAY/AP/PRESS ASSOCIATION IMAGES

Professor Cowan played a key role in London's successful 2012 Olympic bid.

Intelligence is key to anti-doping

The battle to keep the Olympics and Paralympics dope-free is already well advanced, as Professor David Cowan, Director of King's renowned Drug Control Centre, explains.

If athletes know you have an effective anti-doping programme, it really has a strong deterrent effect,' says Professor Cowan, head of the King's Centre which is the UK's only World Anti-Doping Agency (WADA) accredited anti-doping laboratory. Through an alliance with GlaxoSmithKline (GSK) King's will operate the WADA accredited satellite laboratory for the 2012 Olympic and Paralympic Games.

'Our partnership with UK Anti-Doping is already putting an increasingly effective testing and intelligence programme in place,' Professor Cowan says. 'We have a state-of-the-art facility; we have the best detection systems going; we're right up to date with the science, and our sophisticated laboratory will be packed with highly sensitive and rapid testing equipment and staffed around the clock with over 100 scientists.' They will be carrying out more than 5,000 tests at the Olympics: roughly one for every two of the 10,000 or so athletes expected to take part.

KING'S HEALTH PARTNERS

King's has the UK's only World Anti-Doping Agency accredited laboratory.

Ethical standards

'Our aim is to help ensure that the Games are conducted to the highest ethical standards; to deter drug cheats from coming to London 2012, and to enable athletes to lead healthier lives,' Professor Cowan points out. 'As the science of detecting doping advances, athletes who cheat by using performance-enhancing drugs are devising ever more sophisticated doping regimes. The drugs of choice for cheats cross a range of categories, from anabolic steroids to human growth hormone, and from blood boosters such as erythropoietin (EPO), to beta-blockers and stimulants or diuretics.'

The independent anti-doping facility will be based at one of GSK's UK research and development sites at Harlow, Essex. Professor Cowan played a key role in London's successful 2012 Olympic bid, and has previously been involved in the science of anti-doping across four Winter Olympics, two Summer Olympics and several Commonwealth Games.

The original Drug Control and Teaching Centre at King's was established in 1978, in association with the Sports Council, and was the first ever human sports drug-testing laboratory set up outside an Olympic Games. The need for such a centre had been emphasised during the controversy surrounding the Scottish Football Team at the 1978 FIFA World Cup, when Willie Johnston failed a random doping test and was sent home in disgrace.

Significant firsts

The Centre was heavily used by UK organisations in the run-up to the 1980 Olympic Games in Moscow, and it went on to become a global success. It can claim a number of significant firsts in the development of new tests for prohibited substances, including amphetamines; anabolic steroids; human chorionic gonadotropin (hCG) and dihydrotestosterone. In 2010, working with UK Sport to implement the UK's anti-doping policy in sport, the Centre carried out more than 8,000 tests across over 70 sports. It is now part of the Department of Forensic Science & Drug Monitoring (which Professor Cowan helped to form and headed for more than eight years) in the College's School of Biomedical Sciences.

'The testing of sports competitors for prohibited substances is a challenging area of forensic science,' Professor Cowan says. 'A huge number of prohibited substances need to be detected, and they are often found at very low concentrations. Nevertheless, unequivocal identification is essential, since laboratory findings may be the subject of prolonged and intense legal scrutiny.

'In many cases, the substance taken is detectable unchanged in urine or blood; in other cases, a metabolite or marker substance must be identified. Furthermore, although the mere presence of some banned substances which are foreign to the body constitutes an offence under the rules, some substances, such as testosterone, are also naturally (endogenously) produced in the body. It is particularly challenging to provide evidence of administration of these pseudo-endogenous substances. The latest issues faced by WADA-accredited laboratories include administration of testosterone, EPO, growth hormone administration (all pseudo-endogenous) and blood doping. Future challenges are likely to include genetic manipulation.'

Testing takes place in one of three settings: competition testing (at an event); out-of-competition testing at squad sessions, and out-of-competition testing of individuals at home or a training venue. 'All three methods follow the same basic sample collection procedures, use the same sampling equipment and follow the same standards for testing, as set out in the World Anti-Doping Code,' Professor Cowan explains.

'The Centre receives anonymous pairs of urine samples ("A" and "B") from the competitors. The "B" samples are stored safely while the "A" samples are subjected to various levels and types of test. If any abnormalities are noted, skilled scientific evaluation is used to interpret the resulting data. Between one and two per cent of the samples received by the Centre result in an adverse finding, and in these cases the "B" sample is made available to confirm or refute the finding in the "A" sample. The athlete concerned has the right to be present during the testing of the B sample if they wish.

Professor Cowan (centre right) with Lord Coe, Chair of the London Olympic Organising Committee (centre left); Andrew Witty, Chief Executive of GSK, and analyst Cheryl Rose.

Chain of custody

'The Centre maintains a chain of custody for all the samples it analyses. This shows where a sample is stored at any time and records which members of staff have had access to it, when and why. This is an essential measure to prevent any tampering with samples.'

Does the Centre get it right? 'WADA assures the reliability of their accredited laboratories by blind and double-blinded samples where the laboratory does not even know that they are being tested,' Professor Cowan explains. 'The continued accreditation of the Centre confirms the reliability of its work in helping catch drug cheats. The message to those taking part in the London Olympics is simple: "Cheats Keep Out!".'

Having an outside group pose awkward questions has provided a sanity check.

Securing the Games

Sir David Omand of King's War Studies Department is leading a group of 'critical friends' in providing the Home Office with external validation of the security strategy and concepts of operations for 2012.

Sir David was appointed a Visiting Professor in War Studies when he retired from the Civil Service in 2005, and he now teaches and writes on intelligence and security studies. His book, *Securing the State* (Hurst & Co), was published in 2010. His experience in the Civil Service included being UK Security and Intelligence Co-ordinator in the Cabinet Office, Permanent Secretary of the Home Office, Director of GCHQ and Policy Director of the Ministry of Defence. He was therefore a natural choice to be asked by the Home Office to lead this Group, which consists of senior retired practitioners with wide past experience in major event planning, large scale police and military operations, command and control and crisis management, domestic security and intelligence operations, transport and private sector security.

'The Olympics security programme has its own full internal quality assurance and performance management processes, but having an outside group to examine progress critically and pose awkward questions from a totally independent perspective has provided a sanity check on developing thinking and has helped surface early some issues that needed resolution,' Sir David explains.

Critical friends

According to Robert Raine, Home Office Director for Olympic Security, having an experienced 'critical friends' group has built confidence in the security strategy by stress testing the concept of operations, risk management judgments and security programmes for their likely inter-relationship.

'Discussions with the Group have helped tease out such issues as the relationship between the additional security required specifically for the Olympics and the continuing high level of effort on improving intelligence and security under the government's CONTEST counter-terrorism strategy (for which I was responsible when I was working in the Cabinet Office),' Sir David says.

Drawing on his past experience in the Cabinet Office of being the Government's chief crisis manager for civil contingencies, Sir David has also been helping the Olympic security preparations by facilitating a series of table-top exercises in the Cabinet Office Briefing Room (COBR), involving the main players who will be managing security issues during the Games-time next year.

© POOL/IAN WALTON/EPA/CORBIS

The 2008 torch relay was interrupted by protests against China's human rights violations.

Safe and successful

'Working through a variety of scenarios of potentially disruptive events that might affect the smooth running of the Games is increasing mutual understanding on the part of the different domains that are working together to ensure safe and successful Games,' Sir David says. 'These include LOCOG (the event organisers), London and other local government authorities hosting events, the police service, aviation and transport operators, the immigration and border service, the intelligence community, central government itself, and not least public relations and media handling. Each domain has different responsibilities and accountabilities, and different information requirements from each other, yet have to come together seamlessly on the day.'

Taking the longer, historical view, as would be expected from King's War Studies Department, Sir David has throughout been emphasising Field Marshal von Moltke's dictum that no plan survives first contact with the enemy, but that what matters for success on the day is the quality of personal relationships and mutual understanding that comes from planning intensively together.

Greenest-ever Games?

The London Games are being billed as the greenest ever, putting air pollution firmly in the spotlight in 2012.

The effects of air pollution on athletic performance came to the fore with the Los Angeles games of 1984, where the UK's Steve Ovett collapsed following the 800 metres final with severe respiratory problems, citing air pollution as a major trigger in the exacerbation of his exercise-induced asthma. In 2008, images of smog shrouding Beijing's iconic bird's nest stadium catapulted the issues of air pollution and athletic performance into the mainstream media.

'Athletes are particularly vulnerable to the effects of air pollution as a consequence of their heavy training regimes and because they breathe a lot of air which increases their pollution dose,' says Dr Gary Fuller, who with Dr Ben Barratt and Professor Frank Kelly from King's Environmental Research Group (ERG), has been giving evidence to the International Olympic Committee. 'This is especially true of endurance athletes such as marathon runners and road cyclists.

'London's location on the westerly edge of Europe, with prevalent westerly winds from the Atlantic, means that we are favourably located for air pollution when compared with many recent Olympic venues. However, London is not immune to air pollution problems. Los Angeles-type summertime smogs also affect western Europe. These are caused by pollution from industry and traffic reacting in the atmosphere to create other harmful air pollutants such as ground-level ozone. Summertime smog affects London when Atlantic air flows are halted and pollution from the densely populated areas of southern England and the near continent circulates and reacts in strong summer sunlight.'

Most advanced surveillance

London has the largest and most advanced air quality surveillance systems of any city in Europe. The system is funded by local and central government and run by King's from an operations centre within the ERG at the College's Waterloo Campus; part of the Medical Research Council and Health Protection Agency's Centre for Environment and Health.

Analysis of the wealth of pollution data for London contained in ERG's databases showed which pollutants might affect the Games and also the likelihood that a pollution episode might occur. Pollutants such as nitrogen dioxide mainly affect wide areas of London during the winter, but each week in August there is a 10 to 20 per cent chance of ground level ozone exceeding World Health Organisation Guidelines.

'Summertime smog taking several days to form and the mixture of pollution from London and cities on the near continent means that it is very difficult to manage reactively,' Dr Fuller points out. 'It is, however, clear that peak concentrations of ground level ozone occur in the mid-afternoon: the sunniest and hottest part of the day. Simply starting endurance events in the morning can minimise athletes' pollution exposure. The 2011 cycling trial event also showed how temporary road closures can minimise athletes' exposure to air pollution from traffic.'

Spectators and public

Attention has also focused on the exposure of spectators and the public to pollution. Here, King's is working closely with Transport for London to anticipate any local pollution problems that might be caused by the traffic routing for the Games. During the Games King's scientists will be working closely with the Health Protection Agency (HPA) to assess and manage health risks to both the Olympics and Paralympics. 'We established a strong working relationship with the HPA during the 2006 Buncefield Oil Depot fire and since then we've worked with them in a responsive mode to assess air pollution impacts from major fires and most recently the large fires during summer 2011 riots,' Dr Fuller explains. 'We all hope of course that the weather conditions during summer 2012 do not result in elevated pollution for London during what should be a fantastic Olympic period.'

ANDY WONG/AP/PRESS ASSOCIATION IMAGES

In 2008 smog affected Beijing's bird's nest stadium.

What gives Bolt his lightning?

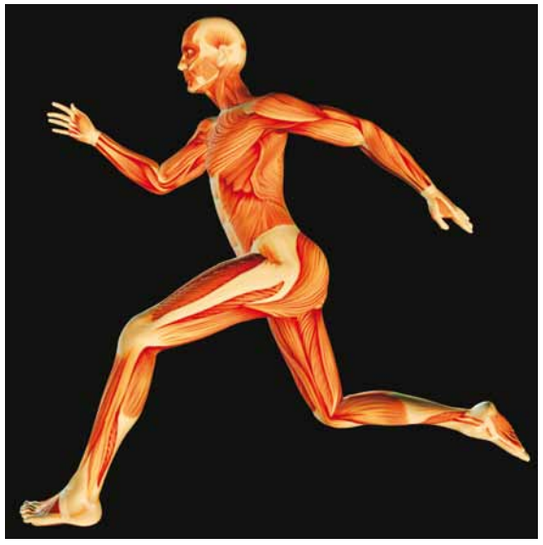
How is it that that the world's top sprint athletes are able to run at the speeds they do? Steve Harridge, Professor of Human & Applied Physiology and Director of the Centre of Human & Aerospace Physiological Sciences at King's, considers the mechanics of muscle.

RYAN REMIORZ/THE CANADIAN PRESS/PRESS ASSOCIATION IMAGES

Usain Bolt covers more than 10 metres a second.

Usain Bolt's world record for the 100 metres currently stands at a staggering 9.58 seconds – averaging less than one second for every 10 metres covered. The many factors that go into the making of an Olympic sprinter range from the genetic to the biomechanical to the psychological. 'Physiologists are particularly interested in the skeletal muscles of these individuals, since to obtain these speeds athletes must ultimately be capable of generating very high power outputs,' Professor Harridge explains.

'Muscles are essentially biological machines that use tiny molecular motors, called cross-bridges, to generate force and create movement. The power that muscles can generate is a combination of the force of contraction and their speed of movement. Muscles are made up of thousands of cells which can broadly be separated into fast and slow types, and each of us has a mixture of these fibre types in their different muscles. Type 1 fibres are slow contracting (often referred to as slow-twitch) with good endurance, whilst Type 2 fibres are fast contracting (fast-twitch) with poor endurance. It is thus not surprising that sprinters generally have muscles which are dominated by Type 2 fibres. These fast fibres can be further characterised into two sub-populations: Type 2a and Type 2x. The Type 2x fibres, which are less common, are those that contain the fastest cross-bridges. It is subtle differences in their molecular properties which determine the speed at which these motors can turn over and which define the type of fibre.'



PASIEKA/SCIENCE PHOTO LIBRARY

Muscles are biological machines that use tiny molecular motors.

Genetic component

Are athletes born or made? 'The reality is that there is a large genetic component which determines whether an individual is a fast runner – or a good slow (ie marathon) runner,' Professor Harridge says. 'It is in fact extremely difficult to switch a fibre from fast to slow or vice versa. The switch between the fast sub-types (2a and 2x) seems to occur quite readily, although not necessarily in the direction one might think, since strength and power training can, paradoxically, have the effect of switching 2x fibres to the slower 2a type.'

Although an individual may not be able to switch types of fibre, he or she can increase muscle power and sprint performance through training. 'In addition to improving the co-ordination and synchronisation of the different muscles (technique), working out in the gym and lifting weights stimulates muscles to grow. Larger muscles are stronger and can produce more force – and thus generate more power. It is this aspect of training that can be augmented by the taking of illegal substances, such as anabolic steroids (synthetic derivatives of testosterone), which help to promote muscle growth.'

Professor Harridge's research is focused on understanding the mechanisms by which human muscles adapt and respond to different physiological challenges. He is particularly interested in the behaviour of ageing muscle.

Carrying the torch

The Olympic flame and torch relay are 20th-century inventions with somewhat dubious antecedents, as Dr Uta Balbier, an expert in sport history, explains.

The Olympic flame is one of the strongest symbols of the modern Olympic Games, and its entrance into the stadium, delivered by the last in a relay of runners, is the highlight of every opening ceremony. Although, however, these customs combine several elements that were present at the ancient Games at Olympia, neither the Olympic flame nor the torch relay were known to the ancient Greeks.

'Although the symbol of fire, for example, was present at Olympia (where flames burned on the altars of several goddesses during the Games), this was in order to honour the gods, rather than the event,' Dr Balbier points out. 'And although messengers were sent out to announce the Olympic truce in the ancient world, a relay was never organised for the Games.'

Ancient and modern

The first Olympic flame was lit during the 1928 Summer Olympic Games in Amsterdam and burned at the entrance of the main stadium throughout the Games. The torch relay was invented for the 1936 Games in Berlin. 'Carl Diem, Secretary General of the Organising Committee, had the idea of lighting a flame at the original site in Olympia and transporting it to Berlin via a torch relay, symbolising the supposed connection between the ancient and modern Games,' Dr Balbier explains. 'From an ideological perspective it also emphasized the connection between the Nazi regime and the ancient world. Torches and flames were also core assets of the National Socialists' cultural political performances.'

These symbols did, however, outlast the Nazis and, ever since, the flame has been lit using the sun's rays and a parabolic mirror at the site of the temple of the goddess Hera in Olympia, in a ceremony with 11 women representing the vestal virgins. 'At the last London Games, in 1948, the flame was carried the 3,160 kilometres from Olympia to the Wembley Stadium by 1,416 runners. In sharp contrast to the 1936 relay, which was accompanied by local protest in Yugoslavia and Czechoslovakia, it was conceptualised as a relay of peace. The first runner, Corporal Konstantin Dimitrelis, symbolically took off his uniform before carrying the flame, symbolising the ideal of the Olympic truce. The route highlighted the crossing of national borders, accompanied by local festivities to celebrate the return of peace to Europe.' The classical form of the torch used in 1948 has reappeared in other Olympic torch designs since.

Political struggles

Later relays have not been so peaceful and are often accompanied by political struggles and local protests. 'Before the 1972 Olympics in Munich the Organising Committee provoked uproar in the Communist world by its idea of carrying the flame through Eastern Europe,' Dr Balbier says. 'In 2008 the relay was accompanied by several protests against China's violation of human rights. But for 2012 hopes are high again that the relay will fulfil the Olympic vision of international peace and unity and that during the relay the local, national, and international dimensions of the Olympic Games will blend.'

Dr Uta Balbier is Co-ordinator of the King's Institute of North America Studies, and teaches American history and sport history as part of King's MA in American Studies. Her prize-winning book, *Cold War in the Stadium: German Sports 1950-1972*, was published in German in 2007.

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Lighting the Olympic flame in London 1948.

King's has some of the top student athletes in the country, including some who are hoping to be selected for the 2012 Olympics.

Olympic opportunities

King's students get the chance to be part of London 2012.

The Olympic values of respect, excellence, friendship, courage, determination, inspiration and equality are at the heart of student experience, points out Holly Walsh, Vice-President for Student Activities & Facilities in King's College London Students' Union (KCLSU). 'We're using the Olympic legacy to increase participation in and awareness of the huge range of activities KCLSU has to offer – not only sports projects, but also in the areas of arts and culture; volunteering and skills development, and sustainability.'

King's has some of the top student athletes in the country, including some who are hoping to be selected for the 2012 Olympics. Eleven students have been selected to receive in-depth support and advice through the Kinetic Elite Athlete Scheme, which provides help in the areas of nutrition, strength and conditioning, and training and sports massage, as well as financial assistance for their kit and their entry to national and international competitions.

At a less competitive level, KCLSU's participation in the national Gold Challenge enables students to try out Olympic or Paralympic sports as an opportunity to raise money for charity, including charities connected with the College. The Coaching Education Programme allows 25 aspiring student coaches to gain a UKCC level 1 qualification in a number of different sports and in return they each contribute 20 hours of coaching to the King's community.

'We've also set up a special pot of funding for students to apply for to run their own Olympic-inspired projects,' Holly explains. 'These could be around any of the areas we have identified and may range from sports coaching in local schools, to perhaps environmental work in the community. It's an opportunity for students to come up with their own ideas and, with assistance from KCLSU and the Mayor's Office, to link them officially with the Olympics through the national Inspire programme.'

King's athletics stars

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↑**KATHERINE GRAINGER (right) became the first British woman to win medals at three consecutive Olympic Games when she gained a silver medal in the quadruple sculls in Beijing, in 2008. Two of her team-mates then were King's graduates: Frances Houghton (BA Hispanic Studies 2003) and Annabel Vernon (MA International Relations 2007).**

Katherine has also won the World Rowing Championships six times and was awarded an MBE for services to sport in 2006. 'I'm planning to complete my PhD, on the sentencing of homicide, in 2012, so along with the London Olympics it's going to be a busy and exciting year!' Katherine comments.

↓ANTONIO INFANTINO, runner, is a third year undergraduate on the *Religion, Philosophy & Ethics* BA at King's. His major achievements are as national champion over 60 metres, 100 metres and 200 metres in the UK School Games, and as Commonwealth Youth finalist at 200 metres. In 2012 he aims to win the British Universities and Colleges Sport (BUCS) 200 metres in the Olympic Stadium.

→RYAN CHAMBERLAIN, one of the KCLSU Elite athletes, completed his MA in *Science & Security* at King's. He took up rowing two years ago, shortly after losing his left leg when a drunk driver struck him while he was cycling in Bolivia. He won a silver medal as a member of the adaptive mixed four at the 2010 World Championships and is preparing for the trials in spring 2012 which will determine who will row at the 2012 Paralympic Games.

MICHAEL DONALD

→MARY COHEN is taking a break from her King's medical degree to concentrate on her fencing, and hopes to be part of the women's epée team in London 2012. Now 25, Mary was a member of the British under-17 team and won the British Senior Championships when she was 20 and again in 2011. She is preparing for international competitions in Qatar, Budapest, Barcelona and Paris. She describes her sport as 'a mixture of boxing and dancing'.

↓ZOE LEE is currently researching for her PhD in the Geography Department at King's. She won the rowing B final in the Great Britain final trials in 2010 and came sixth in the A final in 2011. She also won the elite pairs at Henley Women's Regatta in 2010 and the elite eights in 2011. She stroked the eight that came fourth at the European Championships in summer 2011 and came first at the World University Games in 2010.

Women's health MATTERS

Women worldwide suffer from poorer health than men but receive a smaller share of health-care resources. Now a new Women's Health Academic Centre at King's has been launched to redress this balance. Professor Lucilla Poston, Head of the Centre, describes its work.

Women's health should be a priority for the 21st century. Not only do women constitute more than half the world's population, but they also play a critical role in the health of the next generation, both through giving birth and through nurturing and education. Never before have we been so aware of the vulnerability of the developing fetus and the extent to which the future health of the next generation is dependent on the mother's wellbeing. When the conditions in the womb are less than ideal, as a result of the mother's ill health, poor nutrition, or even excesses in the mother's diet, this can increase the risk of many disorders in the child, both in infancy and in later life. These risks include a heightened susceptibility to cardiovascular disease, diabetes and obesity.

Furthermore, death among mothers remains extraordinarily high worldwide; and because of this the United Nations Summit of 2010 launched a global strategy for women's and children's health. Recent figures suggest that the UN's Millennium Development Goal of reducing the maternal mortality ratio by three-quarters by 2015 is unlikely to be met: more than 350,000 women die annually from complications during childbirth, and every year more than a million children are left motherless. The irony is that most of these deaths (the majority of which occur in developing countries) are avoidable.

Neither is pregnancy in developed countries as safe as it should be. Socio-demographic inequalities remain a major factor in unequal rates of infant mortality, premature birth and low birth-weight. The obesity epidemic takes its toll, too: putting pregnant women and their unborn children at risk of a range of complications as well as increasing the risk of obesity in the child as s/he grows to adulthood.

GREG FUNNELL

Cohesive strategy

Women's health is a priority area for research at King's. Over the last two years we have developed a cohesive strategy which brings together all our health professionals who care for women, as well as researchers investigating disorders at different stages of a woman's life – from fertility, through to problems encountered at the time of the menopause. Together with experts on health service policy and those who teach and train our students, these are the staff who populate the King's Health Partners Women's Academic Health Centre, who aspire to provide the best clinical outcomes for women in our care, through the dedication and skill of our multidisciplinary workforce, and to tackle the origins, treatment and prevention of many of the health issues specifically pertinent to women.

Providing a better quality of care for our patients and women worldwide means that we need to establish the scientific evidence to support changes in healthcare provision. This is only achievable through research carried out to the highest standards and in an orchestrated programme. Each of our research groupings works towards creating a potential change in healthcare, which is then evaluated by our experts in healthcare policy and practice. This makes for optimum efficiency in our research and increases the likelihood that it can be speedily translated into effective treatments for patients.

Pre-eclampsia

One of our largest research groupings, *Pregnancy, Fetal Wellbeing and Childbearing*, provides good examples of the way we choose research pathways that can improve health and care. We focus our research on disorders in pregnancy that compromise the health of the mother and her developing child, including the common disorder pre-eclampsia:

DAVID TETT

Above left: The Centre brings together researchers and health professionals caring for women.

Above: A cohesive strategy for the different stages of women's lives benefits patients such as these from four generations of a south London family.

TRADITION

King's and its constituent colleges have a long tradition of helping to better the lives of women, going back to the early 19th century.

Dr John Blundell of Guy's Hospital used human-to-human blood transfusion in the 1820s and 30s to treat haemorrhage after birth.

Dr John Lever of Guy's in 1843 was the first to describe the presence of protein in the urine, which is a crucial indication, with high blood pressure, that a pregnant woman is at risk of eclampsia: still, with pre-eclampsia, a major area of research at King's.

Dr John Braxton Hicks, a physician at Guy's in 1872, identified the contractions of the uterus before birth which are still known by his name.

Florence Nightingale, founder of the first professional school of nursing – at St Thomas' Hospital in 1860 – discovered that puerperal fever, which struck so many women after childbirth and often led to their death, was associated with lack of cleanliness in the wards. She was a pioneer of statistics and data in health care, and this evidence-based observation saved thousands of lives.

a condition that can cause kidney or liver damage, blood clotting problems and seizures and is potentially life-threatening. It complicates one in 20 pregnancies and causes the death of some 70,000 women worldwide every year. Diagnosis of pre-eclampsia is made on the basis of raised blood pressure and protein in the urine, but these simple diagnostic criteria belie a complex disorder which can affect many organs and may even lead to death. Mothers' deaths from pre-eclampsia and eclampsia (fits or seizures) are estimated to run as high as between seven and 25 per cent of pregnancies in many African nations.

Women who survive pre-eclampsia recover after delivery, probably because the placenta plays a critical role in the condition. Unfortunately there is no cure other than delivery, and, as pre-eclampsia can develop at any time after about 26 weeks of pregnancy, many infants are delivered prematurely

Below: The Chief Medical Officer, Professor Dame Sally Davies (centre), at the inaugural event for the Centre in September 2011, with (left to right) Professor Robert Lechler, Executive Director of King's Health Partners; Marie McDonald, Clinical Director of Women's Services, Guy's and St Thomas' NHS Foundation Trust; Diana Hamilton-Fairley, Consultant in Obstetrics & Gynaecology, Guy's and St Thomas'; and Professor Lucilla Poston.

JODY KINGZETT

to save the mother's life. Fetal development may also be compromised, so the baby may also be small for its gestational age as well as premature. Babies born to women with pre-eclampsia have a three to 10-fold increased risk of death and are at high risk of infant ill health and developmental problems. In addition infants who have a low birth weight have a greater risk of developing cardiovascular disease and diabetes.

One of the problems with this disorder is that there is no test to identify mothers at risk of developing it. This is a particular problem amongst first-time mothers, because history from a previous pregnancy can give some insight into the risk of pre-eclampsia. By knowing who is at risk, clinicians and midwives can look out for the disorder, provide important close surveillance, and also prescribe low doses of aspirin which afford some modest protection. Because of this, much effort has been spent in trying to identify women who are most likely to develop this disorder and, recently, researchers in our group have developed a prototype test that utilises a combination of clinical factors to predict the likelihood of developing pre-eclampsia.

Simple questions

These are determined by asking simple questions, such as the woman's own health history and that of her family, her diet and her weight. The study found that five per cent of women developed pre-eclampsia, and of these up to two thirds could be recognised as high-risk using a combination of clinical risk factors including high blood pressure; high body mass index; a family history of pre-eclampsia or coronary heart disease, and early bleeding in pregnancy. One of the important factors was found to be the mother's own birth weight. If she herself was born with a low birth weight, the risk of pre-eclampsia was greater.

The researchers proposed a framework for specialist referral using these factors, along with an ultrasound scan, that was able to identify half of the women who developed pre-eclampsia and went on to have a premature baby. This simple test will enable first-time mothers, who would otherwise not be identified as high-risk, to receive the appropriate care to prevent or detect pre-eclampsia before severe complications develop. The findings have been published in the *British Medical Journal* and, in collaboration with commercial partners, the group is now assessing the role of specific blood biomarkers which, if added to the risk factor test, would be likely to improve identification.

PARTNERSHIP

The Women's Health Academic Centre is a Clinical Academic Group of King's Health Partners (KHP) – a pioneering collaboration between King's College London and three of London's most successful NHS Foundation Trusts: Guy's and St Thomas'; King's College Hospital, and South London and Maudsley. KHP combines the best scientific research, clinical excellence and teaching to improve health and medical care and treatment for patients in London and worldwide. It is one of only five Academic Health Science Centres in the UK accredited by the Department of Health.

The UK's first woman Chief Medical Officer, Professor Dame Sally Davies, gave the keynote speech at the inaugural event for the new Women's Health Academic Centre in September 2011, at Guy's Hospital. 'It's exciting to see that the traditional boundaries of care provision, science, experimental medicine, the social sciences and mental health have been spanned to reduce the burden of disease in women and to develop pathways towards lifelong health,' Dame Sally said. 'I hope we will soon see the benefits for women not just in this inner-city population but across the UK and worldwide, through research and education.'

King's awarded an honorary doctorate of medicine to Dame Sally in November 2011. The award recognised her major role in achieving a step change in the volume and quality of 'translational' medical research in the UK, enabling basic scientific research to be translated quickly and efficiently into medical practice and beneficial outcomes for physical and mental health.

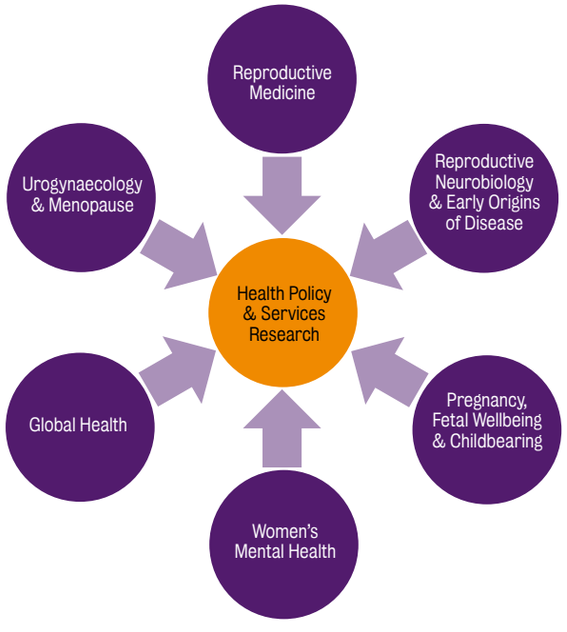
KING'S HEALTH PARTNERS
Pioneering better health for all

Left: Safe pregnancy and childbearing is a key aspect of women's health.
Below: Research through the life course. Research groupings in the Women's Health Academic Centre.

The development of reliable tests like this requires the careful study of thousands of women, some of whom develop pre-eclampsia. This is only achievable by painstaking collection of data from women studied throughout pregnancy, and the collection and storage of hundreds of thousands of blood samples. The study which underpinned these advances is the Screening for Pregnancy Endpoints (SCOPE, called MAPS in the UK) study, *www.scopestudy.net*. Led by Professor Robyn North at King's, SCOPE also involves the Universities of Manchester and Leeds in the UK, the University of Auckland (New Zealand), the University of Adelaide (Australia) and University College Cork (Ireland). It was funded by several organisations including the Foundation for Research and Technology, New Zealand; Tommy's, the baby charity, and Guy's and St Thomas' Charity. The prospective cohort study of women defined as healthy, in their first continuing pregnancy (amongst whom the majority of pre-eclampsia cases develop) started in November 2004, and recruitment closed in March 2011. Overall, some 5,660 women participated, providing, at different stages of pregnancy, some 900,000 specimens including plasma, serum and urine. Together with the comprehensive biographical, medical and other data contributed by these participants, this collection constitutes a unique pregnancy biobank, which allows detailed phenotyping (ie a recording of the characteristics, morphology, development and biochemical or physiological properties) of health in early pregnancy and the outcome of pregnancy. It is a resource which also offers great potential for developing tests for other common complications of pregnancy, such as pre-term labour, and these studies are now underway.

Although pre-eclampsia often presents no symptoms, the risk of maternal death or serious illness as a result of the condition going undetected is low in developed countries, where regular blood pressure monitoring (one of the easiest methods available to detect it) is the mainstay of antenatal care. However, monitoring of blood pressure is often not available in many rural African clinics, since staff are not adequately trained, and blood pressure monitors are expensive and easily broken.

In another study, funded by the Gates Foundation, the group has been investigating whether the introduction of cheap, simple-to-use, automatic blood pressure monitoring devices in health care clinics in rural Africa will affect the detection rates of high blood pressure in pregnancy; the rate of referrals to hospital, the diagnosis of pre-eclampsia and ultimately the outcomes for the mother and baby. Phase 1 of the project is evaluating the effect of the introduction of the automated blood pressure monitor into rural clinics to assess the impact of referrals for, and diagnoses of, pre-eclampsia. To date, the blood pressure device has been validated for use, and negotiations have been conducted with a number of companies (such as Microlife and Nessei) in developing their existing devices to suit this environment. The study is up and running in Ethiopia and will shortly begin in Tanzania.



If you wish for PEACE understand WAR

Captain Basil Liddell Hart's dictum is the unofficial motto of King's War Studies Group. In July 2011 King's renewed its contract to generate this understanding through its provision of academic support to the UK's Armed Services at the Joint Services Command and Staff College (JSCSC) at Shrivenham, Wiltshire. Professor Matt Uttley, Head of the Defence Studies Department at the JSCSC, reflects on a decade of partnership.

JEREMY CLIFTON-GOULD/SERCO

King's makes a major contribution to the UK Armed Services' requirement for more focused, effective, mentally agile, politically and globally astute staff officers.

NARESH VERLANDER

The JSCSC moved into its new, purpose-built headquarters in Shrivenham, Wiltshire, in 2000.

What are the special features of military education at the JSCSC?

The JSCSC is acknowledged internationally as an example of 'best practice', with a model of professional military education that is the envy of many foreign armed services. This reputation and status stem from the co-location of intermediate, advanced and higher staff training and education at a single site; from a Private Finance Initiative (PFI) framework which provides first-class support facilities and long-term contractual stability to the JSCSC enterprise; and from the embedded academic-military partnership with King's, which contributes research-led education and the seamless integration of an MA programme within the syllabus.

The King's/JSCSC partnership is unique among international staff colleges because university academics are involved in all aspects of the course design, development, delivery and validation of military education. Our embedded academics work alongside the military Directing Staff in delivering the full range of joint and single-service command and staff training courses, mostly at the postgraduate level, and we are represented on all the JSCSC key committees.

How has King's role in the provision of UK military education evolved?

The JSCSC academic-military partnership builds on King's long-standing commitment to the education of the professions and of service to wider society. The renewal of the contract in 2011 actually reflects the latest phase in the consolidation of a relationship between the College and the UK Armed Services that stems from the mid-1990s. Before 1997, the Department of War Studies sent staff to teach at the then single-service staff colleges for the Royal Navy, Army and Royal Air Force, offering on-site 'upgrade packages' for selected officers on the one-year advanced staff courses, leading to the award of a King's MA in *Defence Studies*.

In 1997, these staff colleges merged at a common site at Bracknell in Berkshire, and the on-site Defence Studies Department (DSD) was established, which included academics from the Civil Service Department of History and International Affairs (previously located at the Royal Naval College Greenwich) and eight King's academics at the new interim JSCSC sites. In August 2000, the JSCSC moved to its new purpose-built facility at Shrivenham, and King's began to provide full academic support under contract to the facilities management company Serco. At this point DSD became a separate academic department of King's, and provision of professional military education to the Armed Forces became its core business.

Since 2000, the academic-military partnership forged with the Ministry of Defence (MOD) and Serco in the delivery of research-led education at the JSCSC has achieved high levels of national and international acclaim.

PAUL GRUNDY

What are King's responsibilities?

In addition to teaching across the full range of JSCSC courses with a throughput of approximately 3,000 students per annum, King's takes responsibility for accreditation of the academic components of JSCSC courses where required, most notably the MA in *Defence Studies*. This master's course runs parallel with the one-year *Advanced Command and Staff Course* (ACSC): the JSCSC's largest course, which is taken by some 300 selected British and overseas officers in their mid- to late-30s each year. The College also accredits the Defence Studies elements of the *Air, Land and Maritime Intermediate Command and Staff Courses*.

In all, some 57 per cent of the ACSC's 4,725 graduates since 1997 have also graduated with the *Defence Studies* MA, demonstrating that JSCSC courses can be delivered to meet both exacting MOD requirements and the world-class academic standards required by King's.

How do officers individually, and the Armed Forces as a whole, benefit?

The DSD makes a major contribution to the UK Armed Services' requirement for more focused, effective, mentally agile, politically and globally astute staff officers. Our strategy is to develop and apply innovative teaching techniques, inform academic and policy debates and forge new UK military education partnerships. We take pride in the recent description by Air Marshal Sir Stuart Peach, the new head of the UK's new Joint Forces

The Department has played a unique role in the development of a generation of military professionals.

Command, of the quality of the JSCSC graduates as 'phenomenal'.

Sir Stuart's description is echoed by responses to the recent Postgraduate Taught Experience Survey. One student described the MA as 'an excellent environment for developing intellectual and research skills, as well as an opportunity for new knowledge'; while another noted that it was a place where 'the academic elements run concurrent to the taught professional modules as part of ACSC, with military and academic staff running syndicate room discussions together, which is useful as it brings balance'.

What are the characteristics of the JSCSC/King's partnership?

A core strength of the King's academic-military partnership is the agility with which it meets evolving professional military education requirements and combines them with the rigour and teaching support required of a Russell Group university. During the first 10 years of the JSCSC partnership, King's academic provision has adapted to new MOD requirements that have included provision of an MA in *International Security & Strategy* at the Royal College of Defence Studies (RCDS) in Belgravia. We have also provided academic support to intermediate-level Army education, and professional development support to senior warrant officers.

What are the most recent developments and initiatives?

A notable innovation has been the recognition of intermediate command and staff education at Shrivenham for National Qualifications Framework (NQF) credits at Level 7 (ie master's degree level). This enables part of officers' command and staff education to count towards their studies for the highly-regarded web-delivered master's degree in *War in the Modern World*, offered by the King's Department of War Studies.

The creation in 2009 of a sister course, the online MA in *Air Power in the Modern World*, for suitably qualified RAF officers and civilian students, demonstrates DSD's ability to produce bespoke and fully-integrated postgraduate level academic support and its unique role in the development of a generation of military professionals from the Army, Navy and Royal Air Force as well as their counterparts from over 90 different countries.

The innovative nature of the DSD's partnership with the MOD, and the excellence of the results achieved, was recognised in 2003 in the award of the Queen's Anniversary Prize for Higher and Further Education, which reflected the achievements of the War Studies Group as a whole, and in particular the Defence Studies Department's work at the JSCSC. The robustness of the King's model is also born out in extensive and diverse indicators that include detailed student and staff internal validation; frequent MOD and MA external examiners' audits; external scrutiny by bodies including the National Audit Office and international staff college benchmarking exercises.

How do you see the future of this partnership?

The JSCSC is the UK's intellectual hub for the command and staff training and education of the military profession. The significance of the King's academic-military partnership was eloquently summarised in a speech by Lieutenant General Andrew Graham, Director General of the Defence Academy from 2008 to 2011. Speaking to the Sandhurst Foundation on 5 June 2010 General Graham said: 'The value of education is difficult to quantify. But without reflective, educated leaders ... the ability to come to reasoned responses to unpredictable situations will be stunted; the capacity to think beyond experience, plan beyond tenure and avoid failures of imagination will be constrained. The tactical level of thinking will become the dimension of choice, leaving the strategic dimension with its characteristics of time, scale, breadth and choice to our adversaries.'

With the impending absorption of the JSCSC into the MOD's new Joint Forces Command, an adaptive learning organisation which analyses and educates in the changing character of conflict will remain fundamental for the inculcation of the 'conceptual component' in the UK military profession in an age typified by uncertainty, complexity, ambiguity and volatility.

The renewal of the JSCSC academic support contract to 2021 marks a new and exciting phase in the unique role of King's in UK professional military education. Understanding of the nature and character of conflict is an enduring requirement for the military profession and King's welcomes the opportunity to remain in the vanguard of providing education in the business of peace and war over the coming decade.

● *For further details of King's partnership at the JSCSC, contact Sarah Somers on 01793 788181 or email SSomers.jscsc@defenceacademy.mod.uk*

ZALMAI/GETTY IMAGES

Developing our DOCTORAL STUDENTS

ED PARK

King's global reputation for academic discovery and education means it can recruit the best postgraduate research students from around the world. Professor Eeva Leinonen and Professor Vaughan Robinson describe how the College is nurturing the next generation of research leaders.

Joshua Johnston

Responding quickly to forest fires, and measuring their carbon emissions, should become easier as a result of Joshua Johnston's research. A Forest Fire Analyst with the Canadian Forest Service, full-time PhD student Joshua is exploring the potential of the New Infrared Sensor Technology (NIRST) which is on board the Aquarius/SAC-D satellite, launched by NASA in June 2011 as part of a programme to help answer fundamental questions about how the planet works and how it may change in the future.

'I'm developing a set of algorithms tailored to this instrument to detect and monitor forest fires,' Joshua explains. 'If it's successful, this will provide a low-power, low-cost tool for remote forest-fire sensing. I've benefited from an overwhelming wealth of knowledge and experience within the Environmental Monitoring & Modelling Research Group in the Geography Department at King's, led by some of the world's leading experts on thermal remote sensing of high temperature fires.' When he has completed his PhD Joshua hopes to apply his knowledge in further research for the Canadian Forest Service.

The number of doctoral students at King's has grown by nearly 30 per cent in the last three years. Around one in 10 of the College's students is now studying for a PhD, and the College is one of the UK's top universities for doctoral students.

'We want to expand this number still further, reflecting the important role that doctoral students play in a research-intensive university,' says Vice-Principal (Education) Professor Eeva Leinonen. 'PhD students participate not only through their own research, but also through their contribution to the research culture, their publications and the way in which they inspire undergraduates to consider a career in research.'

The College has already increased and diversified its doctoral programmes, and new global institutes such as the King's Brazil, China and India Institutes; the Institute for North American Studies; the Centre for Middle East & Mediterranean Studies and the African Leadership Centre, and the Russia Institute will take this process still further in the next few years.

'Because King's is one of the world's leading research-intensive universities, our doctoral students are supervised by academics who are national and international leaders in their field,' Professor Leinonen adds. 'Supervisors here seek to ensure that their PhD students are taken to the research frontier in their disciplines and also that they are provided with the personal skills to succeed in life. In addition, we offer a superb location in the heart of London, and provide a welcoming and supportive environment which enables research to flourish.'

Supervising world-wide excellence

The quality of supervision is key to doctoral students' success, as Professor Vaughan Robinson, Director of the Graduate School, explains. 'Because our academics are leading experts in their fields and have a global perspective they can also offer students contact with the best research internationally. In addition, joint PhD programmes with selected research-intensive university partners around the world allow some King's students to spend time abroad experiencing a different country's research culture, with input from supervisors both here and from the partnership university, leading to a degree jointly awarded by both institutions.'

King's current joint programmes include those with Hong Kong University (in Arts & Humanities, and Social Sciences) and with the National University of Singapore (in Social Sciences, Natural & Mathematical Sciences, and Arts & Humanities). Other links include those with Stuttgart University and with Humboldt University, Berlin.

Heart of London

King's is London's most central university, and gains a huge advantage from its location in the heart of the capital. As one of the world's few truly international cities, London offers a uniquely cosmopolitan, international and innovatory ambience, welcoming students from all over the world and offering them a global perspective.

'The College's PhD students also benefit in a very direct way from easy access to the UK's leading cultural, scientific and academic institutes, archives and collections,' Professor Leinonen points out. 'King's is surrounded by world-class libraries in London, while the College's library itself holds some unique collections, including the Liddell Hart Centre for Military Archives, and the historical library of the Foreign and Commonwealth Office, which records five centuries of the UK's interactions with the world.'

King's campuses are within a few minutes' walk of the country's seat of government in Westminster, the financial and business quarter in the City of London,

Suzanne Bench

Moving from a critical care unit to an in-hospital ward may mark an improvement in a patient's health, but it can nevertheless be stressful for patients and their relatives. Through her PhD thesis, critical care nurse Suzanne Bench is testing whether an information pack designed for this situation can help patients understand their experience and progress, and improve their psychological well-being.

'I was keen to obtain my PhD from a Russell Group university, and King's has an excellent reputation for research,' she says. 'My goal is to have a clinical academic career, combining clinical practice, education and research, and enabling me to pursue my passion to develop nursing practice in critical care.'

When she first registered for her PhD in 2007, Suzanne studied half-time and worked half-time as a lecturer in critical care nursing. Thanks to funding from the National Institute of Health Research and the Florence Nightingale School of Nursing & Midwifery at King's she is now studying full-time.

Alex Strick van Linschoten

Who were the Taliban before 9/11? Understanding the Taliban in this period – not just in a political sense, but also in terms of their religious beliefs and cultural identity – is the goal of Alex Strick van Linschoten's PhD in the Department of War Studies at King's.

Alex finalised and e-submitted his PhD application in 2008 from a little room in the heart of the old city, in Kandahar, southern Afghanistan. Using the Taliban's writings from the period before 9/11 as sources, together with several years' worth of field interviews inside Afghanistan, he has published three books while doing his PhD: *My Life with the Taliban; Poetry of the Taliban*, and *An Enemy We Created*.

'King's War Studies Department has a very high reputation in the academic community, in part on account of the quality of senior staff members they can offer as supervisors,' Alex says. 'I was also attracted by the flexibility to conduct large amounts of fieldwork, which is essential to any researcher attempting to get to the bottom of a specific place.' After completing his PhD in 2012 he plans to continue to work on longer-length book projects, perhaps expanding to other places besides Afghanistan. 'There is also a great amount of work that still needs to be done relating to the Taliban and other Islamist groups in south Asia,' he points out.

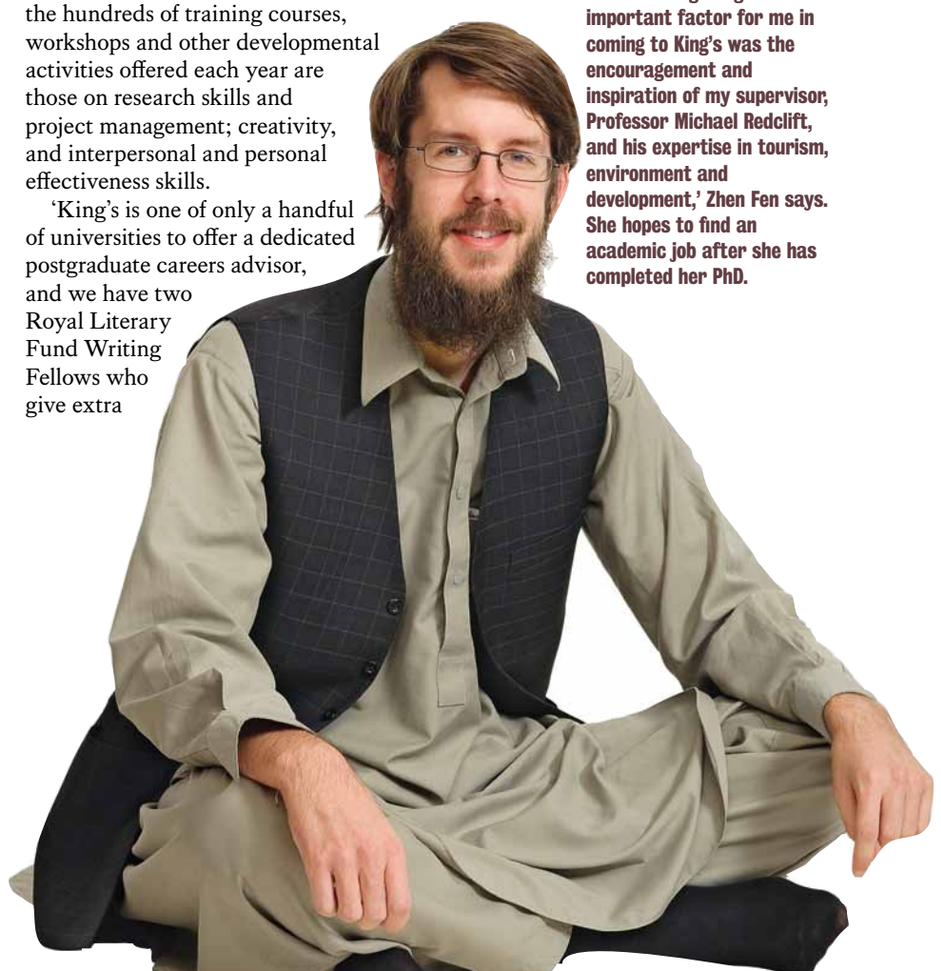
and the legal world in the shape of the Inns of Court and the Royal Courts of Justice. The College works in partnership with some of London's and the world's leading hospitals (Guy's, St Thomas', King's College Hospital and the Maudsley), and also enjoys close links with the capital's cultural institutions, including the South Bank Arts Centre, the National Theatre, Shakespeare's Globe Theatre, the National Film Theatre and the British Museum.

Growing graduates

In addition to the opportunities and support that King's PhD students receive in their departments and subject-areas, the College also takes every opportunity to enhance their experience on a College-wide basis through its Graduate School.

'Improving the experience of researchers at King's and their leadership and employability skills is the aim of the Graduate School's Researcher Development Programme,' explains Professor Robinson. 'Among the hundreds of training courses, workshops and other developmental activities offered each year are those on research skills and project management; creativity, and interpersonal and personal effectiveness skills.

'King's is one of only a handful of universities to offer a dedicated postgraduate careers advisor, and we have two Royal Literary Fund Writing Fellows who give extra guidance on how to write an effective and persuasive PhD. Our travel grants enable doctoral students to spend time working with researchers in one of King's partner universities worldwide, and a new conference travel fund has in the last year provided financial support to 35 students who gave papers at international conferences.'



Shen Zhen Fen

Different Chinese and Western models of nature are the focus of Shen Zhen Fen's PhD on ecotourism. Zhen Fen first came to King's in 2007 to do a master's degree in *Tourism, the Environment & Development*, and stayed on to do a PhD on how traditional Chinese philosophy and ecological modernisation have differently affected urban ecotourism in China. She is assessing these different conceptual approaches through a comparison of two wetland parks: one on the Chinese mainland and the other in Hong Kong. 'The most important factor for me in coming to King's was the encouragement and inspiration of my supervisor, Professor Michael Redclift, and his expertise in tourism, environment and development,' Zhen Fen says. She hopes to find an academic job after she has completed her PhD.

Special graduate lounges and study zones around the campuses give research students the chance both to socialise and to study intensively, while the attractiveness of studying at this level at King's has recently been enhanced by the increased number of scholarships on offer. 'External bodies are keen to invest in the exceptional talent King's is able to attract,' Professor Robinson explains, 'and we've now established funding agreements for this purpose with organisations connected with Africa, China, Egypt, Iberia, Latin America, Mexico, and the United States.'

Feedback

'Feedback is a crucial part of our strategy for positioning the College as a global leader in doctoral training,' Professor Leinonen comments. 'National surveys provide a vital tool for the College to identify how we want to develop, and so we were delighted that the UK-wide Postgraduate Research Experience Survey drew a very positive response from King's students in spring 2011. Nearly 88 per cent of our students reported that their experience had met or exceeded their expectations. We're very pleased to note an increase in satisfaction in the last three years with all aspects of supervision, skills and development, intellectual climate, information on goals and standards and professional development and careers advice.'

THEMED SCHEME

The unique theme-based approach of the King's Interdisciplinary Social Science Doctoral Training Centre (KISS-DTC) has recently been successful in attracting a multi-million pound award to support postgraduate studentships and training in this area.

The Economic and Social Research Council (ESRC) awarded the College £5.2 million in January 2011, after the awarding committee was impressed with the 'strategy and vision' behind the King's bid, and singled out the 'very strong inter-disciplinary focus' of the Centre for particular praise.

Rather than conventional disciplines or departments, the KISS-DTC is organised around 15 cross-cutting research themes in the broad domains of health; regulation and public services; social change, and security. These themes reflect areas of established research excellence at King's and the College's long-standing commitment to interdisciplinary ways of working.

'This latest award doubles the number of ESRC studentships we can provide to support doctoral study in the social sciences at King's,' points out Professor Ben Rampton, Director of KISS-DTC. 'It represents a huge vote of confidence in our approach to social sciences. As well as studentships, ESRC funding will enable us to run a programme of placement and knowledge-exchange with organisations across the public and private sectors. We'll also be running a collaborative suite of advanced doctoral training courses and summer schools with learned societies and other universities, including the College's international partners.'

PLASMONICS

ancient nanotechnology for the future

Light illuminating a glass-air interface from within the glass passes through more efficiently where the gold nanostructure is present.

Physicists at King's are learning from the ancient techniques used for colouring glass to develop cutting-edge optical technologies. Professor Anatoly Zayats describes how.

CVMA/ENGLISH HERITAGE

Since the time of the Romans, master craftsmen have used ultrafine particles of silver and gold to introduce colour into their glassware. Probably the most famous example of this technique is the British Museum's Lycurgus Cup, which dates from the fourth century AD. When illuminated from inside, the cup appears red, since red light can most easily pass through the billions of gold nanoparticles incorporated into it. When illuminated from outside, however, it is greenish, since it is green light that is most efficiently scattered from the minute particles of gold.

The bright colours of the stained glass of medieval cathedrals and castles have also remained vibrant despite the passing centuries, while paintings produced in this period have become dull and dingy. This, again, is because the bright green, orange and red colours are produced by gold and silver nanoparticles within the glass. Depending on their size and the proportion of silver and gold, these particles can be made to resonate at different wavelengths of light, with the colour of the glass depending on the wavelength concerned.

Now I and my team at King's are studying how the interaction of light with nanostructured metals, which created the colouring of this ancient glass, can be used to develop cutting-edge optical technologies. These technologies can be harnessed for faster computers, for speed-of-light information processing, for the ultrasensitive sensing of biological and chemical molecules, and for the creation of new advanced materials with optical properties not available in nature.

Left: **The bright green, orange and red colours of mediaeval stained glass are produced by gold and silver nanoparticles in the glass.**
Right: **A laser beam superimposed on an artistic impression of organic molecules. The colour of laser light slightly changes when it is scattered from the molecules, and this provides a molecular 'fingerprint', which can be used to identify a substance from a single molecule.**
Below: **The fourth-century AD Lycurgus Cup in the British Museum. When lit from outside it is greenish, but appears red when lit from within, because of the effect of minute particles of gold in the glass.**

Knowledge and control

In the past, the optical properties of metal nanoparticles and nanostructures were deployed without knowledge and without control. Today, scientists are learning how to control the size and shape of metal nanostructures with high precision, and how to use sophisticated nanofabrication techniques (such as electron or focused ion beam lithography), or chemical self-organisation methods, to fabricate

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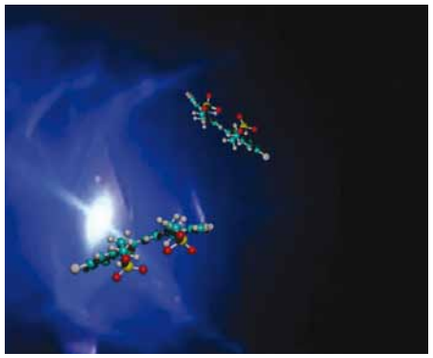
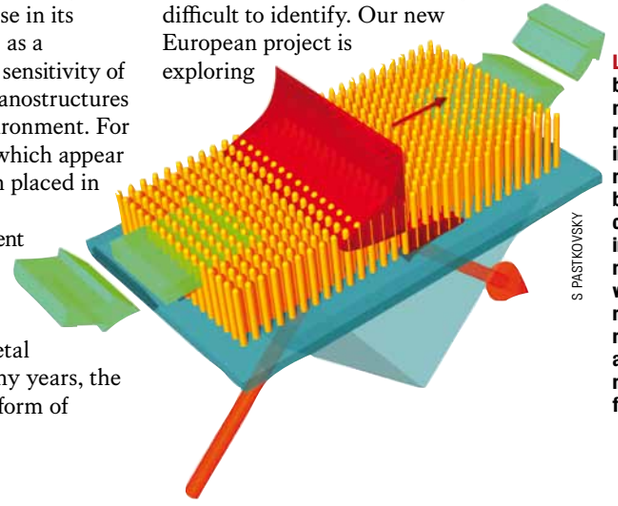
COURTESY D. MCHUGH AND G. WURTZ



nanostructures with features more than 1,000 times smaller than the thickness of human hair. This enables researchers to achieve full control over light interaction with these nanostructures and to design at will the optical properties required for various applications.

Light resonates with metal nanoparticles because there are many free electrons present in metal. Of all metals, gold and silver are the best conductors of electricity (for example, the cable you buy for your HD television and home cinema will be gold-plated). An electric field of light forces the electrons in metal to move together, creating a so-called 'plasmon': a collective of billions of electrons vibrating in rhythm with each other. It is plasmons that influence the scattering and absorption of light and lead to the colourful effects in stained glass. As a result of the coupling between electrons in metal and light, light is trapped at the surface of the metal, leading to a significant increase in its intensity near the metal, and, as a consequence, to a very strong sensitivity of the optical properties of the nanostructures and particles to the local environment. For example, gold nanoparticles which appear green in air become red when placed in water.

This sensitivity to environment can be deployed to increase the performance of biosensors and chemical sensors. While sensing with unstructured metal films has been known for many years, the use of nanostructures (in the form of plasmonic crystals, periodically structured metal films, or plasmonic metamaterials consisting of tiny metal particles spaced at small distances and arranged in certain way) enables us to increase the sensitivity by several orders of magnitude and to tailor the response of the nanostructure to be sensitive to a particular biomolecule. We are now developing new ultrasensitive biosensor substrates based on plasmonic nanorod materials, capable of detecting small molecules that are usually extremely difficult to identify. Our new European project is exploring



S PASTKOVSKY

Left: **A biosensing chip based on plasmonic metamaterial. Gold nanorods are arranged in a lattice with nanoscale distances between them. Light is coupled to a guided wave in this plasmonic metamaterial layer, which does not exist in naturally occurring materials. Biomolecules are pushed through the nanorod forest with the flow of the liquid.**

DETECTING BOMBS REMOTELY

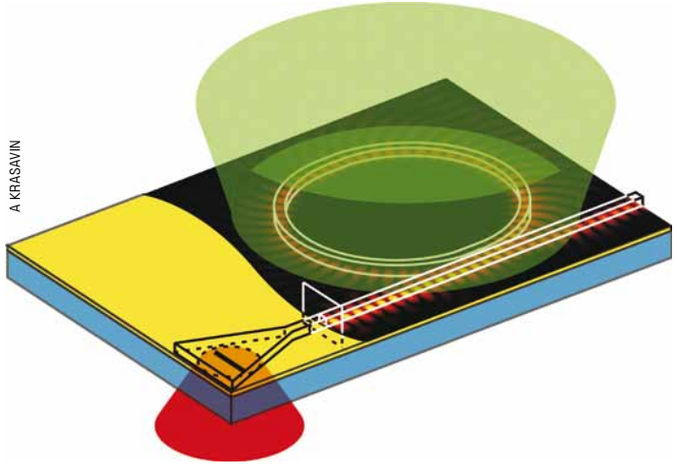
King's scientists are participating in an EU-funded project to develop sensors capable of detecting hidden explosives. By detecting the chemical traces of explosive vapours in the air, the sensors will provide early warning to security services and protect vulnerable urban populations from the threat of improvised explosive devices (IEDs), often used by terrorist organisations.

Developed in response to the London bombings of 2005, the project Bomb Factory Detection by Networks of Advanced Sensors (BONAS) brings together King's specialists in physics and nanomaterials with colleagues across Europe. The consortium represents the entire chain, from basic research to field deployment, so that the networks can be used by security services as soon as they are built.

The King's team is focusing on a technique called Raman scattering, which uses lasers to identify the chemical fingerprints of explosives in the air, by detecting tiny changes in the colour of light when it interacts with molecules.

'If you shine a laser on to a molecule, you can measure the Raman response,' Professor Zayats explains. 'At the moment we can do this down to a single molecule, but the signal strength is too weak for applications outside the research lab.' The team will employ metal nanostructures in order to enhance the signal, so that a sensor can be developed to warn when the concentration of key chemicals in the air reaches a certain threshold.

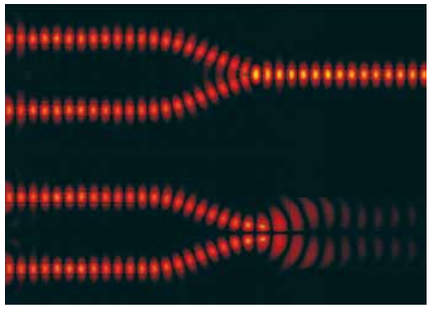
Once the network is fully developed, Professor Zayats hopes that security forces will be able to identify a bomb inside a building or vehicle using sensors monitoring the chemical composition of molecules in the air outside. The sensors, specifically designed to be sensitive and easily hidden, could also be installed in a network to protect high profile public buildings, in order to provide an early warning for police if any traces of explosives are detected. 'Once the project is finished it will require minimum effort to make it available to the police and security agencies,' Professor Zayats says.



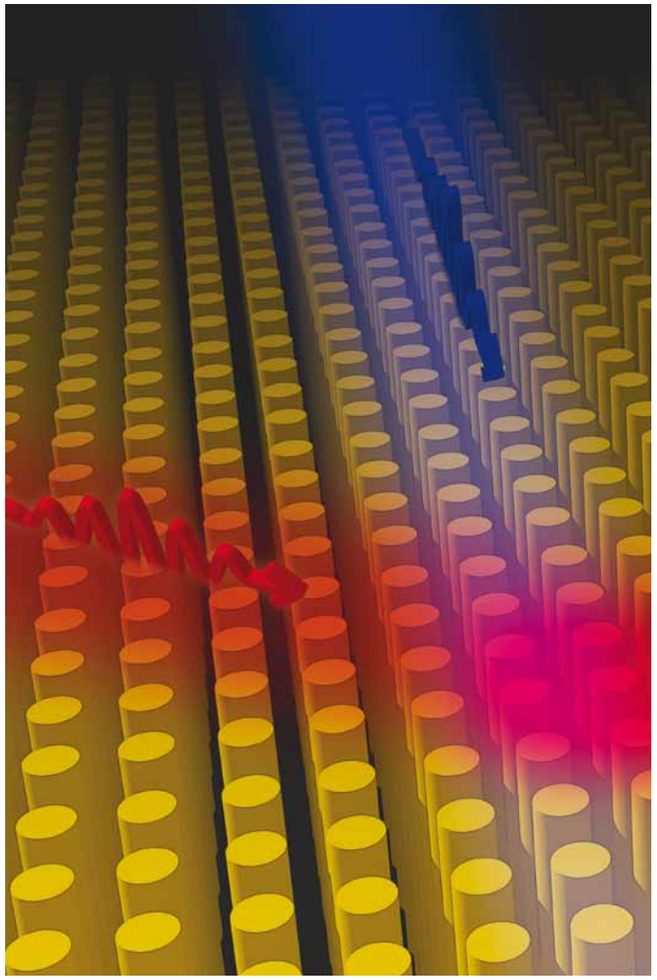
A KRASAVIN

Left: An active waveguide ring resonator for nanophotonic circuitry. Light can be squeezed in nanoscale metallic waveguides with dimensions similar to the dimensions of electronic circuits. Shining light on the ring controls the propagation of the signal in the neighbouring waveguide.

Below left: Plasmonic waveguides can route the optical signals in the required direction. They have the potential to replace electronic circuits in the computers of the future.
Below right: Plasmonic metamaterial provides the possibility of designing the interaction between light beams of different colours.



R MCCARRON



R MCCARRON

the opportunities of plasmonic structures for detecting hazardous materials such as explosives.

Squeezing light

The field enhancement described above is associated with trapping light at the surface of metal. We use this effect to develop new ways in which metallic nanostructures can be deployed to achieve optical signal manipulation on the nanoscale: something that is otherwise impossible. Usually, light cannot be squeezed to dimensions much smaller than the wavelength of light because of diffraction. But by coupling light to metal stripes or to a metal nanoparticle chain, we can take advantage of the fact that light cannot escape metal because it is coupled to electrons within it. Using gold nanostructures, we can squeeze light to dimensions 100 times smaller than is possible with conventional optical components. This field of research has several main fields of application, including information technologies and high-density data storage.

The opportunity to guide light in metallic nanostructures is attractive for the development of integrated photonic chips, where information would be transmitted and processed in the same way as is done now with electronic chips. Doing this optically increases the speed of information transmission almost to the speed of light, and in addition may lead to a reduction in the consumption of energy. The way to achieve this in the optical domain, with components of sizes comparable to the sizes of modern electronic components, is by using plasmonic nanostructures. This also provides the possibility of sending both optical and electronic signals along the same circuitry in the computer.

If combined with conventional optical devices, metallic nanostructures improve the efficiency of light-emitting diodes and lasers, photo-detectors and solar cells. In all these applications, energy consumption will be reduced.

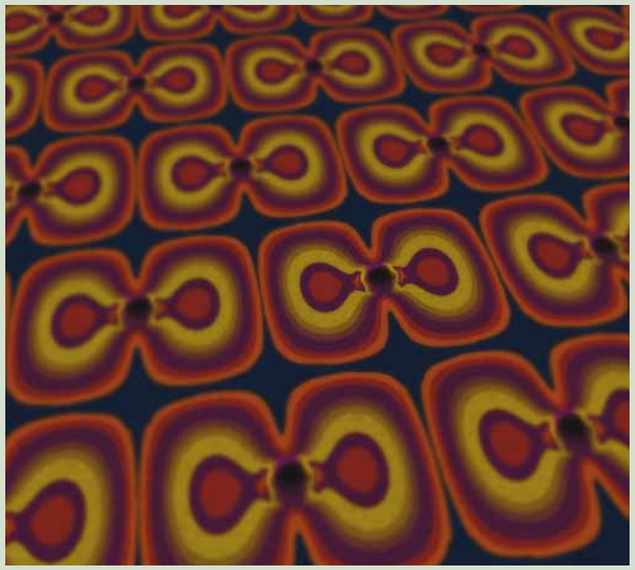
Computing at the speed of light

While in many cases individual nanostructures can provide very attractive effects, their combination together in more sophisticated structures, called metamaterials, provides even more astonishing opportunities for light manipulation. Naturally-occurring materials consist of atoms. Metamaterials consist of nanostructures (in many cases metallic ones) which are larger than atoms but much smaller than the wavelength of light. By designing the constituent nanostructures and the way they are put together, we can engineer the optical properties of metamaterials that do not exist in nature.

Metamaterials pave the way to many previously unimaginable applications, such as invisibility cloaks, the negative refraction of light, and flat lenses for super-resolution imaging. Now we are working on designing some even more intriguing properties of metamaterials, the so-called nonlinear optical properties, so that they can help to increase the interaction between light beams. Usually, if you send two beams of light they will pass through each other without even noticing. In nonlinear materials the beams may interact but this interaction is very weak. By designing metamaterial properties we can achieve very strong nonlinearity, so that one beam of light can efficiently switch the other, thus providing a route to controlling one optical signal with another optical signal, and opening the way to practical optical computers.

A TOUCH OF GOLD

Professor Zayats and his team have found that covering glass with a film of gold means that more light can be transmitted through more angles, reducing the amount that is reflected back. 'This could change the way we watch flat-screen TVs or view light-emitting diodes (LEDs) in watches and alarm clocks,' Professor Zayats points out. 'Currently, because the light is generated from within a layer of active material inside the glass, these must be seen head-on for a clear perspective. Our research shows that by applying a very thin layer of gold over the glass and controlling the thickness of the thinnest part of the layer, the interaction of the light and electrons can be engineered on the nanoscale to increase the transmission of light through the glass. Light is then passing through the glass even when not viewed straight on, and at a greater intensity.' This discovery may also be appropriate to many other applications, such as chemical and bio-sensing, and integrated photonics.



D O'CONNOR & R MCCARRON

Electromagnetic field distribution in the array of nanoscale holes in a gold film.

1861

James Clerk Maxwell's greatest year

In 2011 King's marked the 150th anniversary of two milestones in the career of one of the world's greatest physicists.

Alexander Stoddart, Sculptor in Ordinary to Her Majesty The Queen in Scotland, described his approach to monumentalising Maxwell through his Edinburgh statue of the physicist in a lecture at King's in May 2011.

MURDO MCLEOD

Below: Maxwell as a young man holding the wheel which he used to develop his theories about light and colour.

SCIENCE PHOTO LIBRARY

James Clerk Maxwell was Professor of Natural Philosophy at King's from 1860 to 1865. Stimulated by his contact with London scientific and intellectual life, Maxwell's five years at King's represent perhaps the most productive period of his career, and 1861 saw not only the publication of his first paper on electromagnetic theory, but also the first photograph created according to Maxwell's three-colour method, with photographic pioneer Thomas Sutton of King's.

Born and brought up in Kirkcudbrightshire, south-western Scotland, Maxwell was educated at Edinburgh and Cambridge universities and then held the Chair of Natural Philosophy at Marischal College, Aberdeen, from 1856, where he worked on an explanation of the structure of the rings of the planet Saturn. His appointment to King's in 1860 was one of a series of daring and inspired appointments of young scientists by the College in the 19th century, also including Charles Lyell in geology, John Frederic Daniell in chemistry, Charles Wheatstone in physics and Joseph Lister in medicine.

Equations

Through his four-part paper, beginning with 'On Physical Lines of Force', published in the *Philosophical Magazine* in 1861, Maxwell demonstrated that magnetism, electricity and light are different manifestations of the same fundamental laws. His 1865 paper, 'A Dynamical Theory of the Electromagnetic Field', published in the *Philosophical Transactions of the Royal Society of London*, described these, as well as radio waves, radar, and radiant heat, through a unique and elegant system of four partial differential equations, which paved the way for current technologies in radio, television, telephone and information exchange. 'We have strong reason to conclude,' Maxwell wrote in this paper, 'that light itself – including radiant heat and other radiation, if any – is an electromagnetic disturbance in the form of waves propagated through the electro-magnetic field according to electro-magnetic laws.'

Albert Einstein, whose work on relativity and quantum theory was inspired by Maxwell's discoveries, described how these equations produced a change in the conception of reality which was 'the most profound and the most fruitful that physics had experienced since the time of Newton'. 'One scientific epoch ended and another began with James Clerk Maxwell', Einstein remarked.

Photography

Maxwell's paper, 'Experiments in Colour, as perceived by the eye' (published in the *Transactions of the Royal Society of Edinburgh* in 1855) confirmed the three-component theory of vision which proposes that all the colours of nature can be counterfeited to the human eye by mixing red, green and blue in proportions which stimulate the three types of receptor cells in the eye. This method remains the foundation of both chemical and electronic photographic processes. Building on the idea of using a triangle for representing colour vision, first proposed by the physicist and physician Thomas Young some 50 years before Maxwell, and on unsuccessful experiments by James David Forbes, who taught Maxwell as Professor of Natural Philosophy at Edinburgh University, Maxwell verified the three-component theory, giving it proper mathematical expression, and provided a simple and reliable mathematical recipe for combining colours. He also demonstrated that the third primary colour must be green when lights are mixed (although it is yellow when pigments are used).

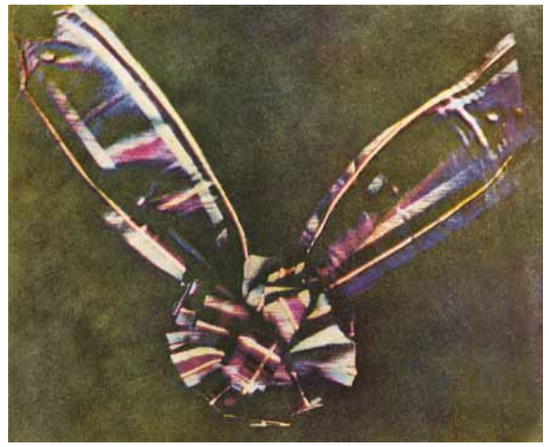
Maxwell was awarded the Royal Society's Rumford Medal for his work on colour and colour-blindness in 1860, and invited to give a lecture at the Royal Institution on this topic on 17 May 1861. Seeking a way to demonstrate the three-component principle for this lecture, Maxwell suggested that if three black and white photographs of the same scene were taken through red, green and blue filters, and transparencies made from them projected through the same filters and superimposed on a screen, the result would be an image reproducing all the colours in the original scene: in effect, the first colour photograph.

Colour separations

Following Maxwell's instructions a set of three 'colour separations' of a tartan ribbon were prepared by Thomas Sutton, lecturer in photography at King's. A graduate and wrangler of Cambridge University, in 1859 Sutton had developed the earliest panoramic camera with a wide-angle lens, capable of capturing an image in a 120 degree arc, while in 1861 he produced the single-lens reflex camera which for the first time enabled the photographer to see exactly what would be captured by the film. He was also the founding editor of *Photographic Notes* and compiler of the first English *Dictionary of Photography*.

King's was in fact a notable early pioneer in the study of photography. Sutton's predecessor from 1857 to 1860, Thomas Frederick Hardwich (author of *A Manual of Photographic Chemistry, Theoretical and Practical* (1855)) was Britain's (and perhaps the world's) first university lecturer in the subject, and King's professors dominated the Photographic Society of the time. The great Charles Wheatstone, Professor of Experimental Philosophy at King's, who was the inventor of the stereoscope and had a strong interest in vision and photography, was a Vice-President. Hardwich was a Council member, and the Secretary was Philip Henry Delamotte, King's Professor of Landscape Drawing & Perspective from 1855 and Professor of Fine Art from 1879, who photographed the building of the Crystal Palace at Sydenham. In 1857 the Society's journal reported that 'a glass house, with a large commodious developing room, in connection with a chemical laboratory' had been built at King's that year.

As Maxwell noted, the results of the three 1861 colour separations were in fact imperfect because of the insensitivity of 1860s photographic materials to red and green light. Later researchers have demonstrated that the 'red' and 'green' images were

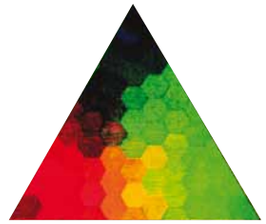


$$\nabla \cdot \mathbf{D} = \rho$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$$

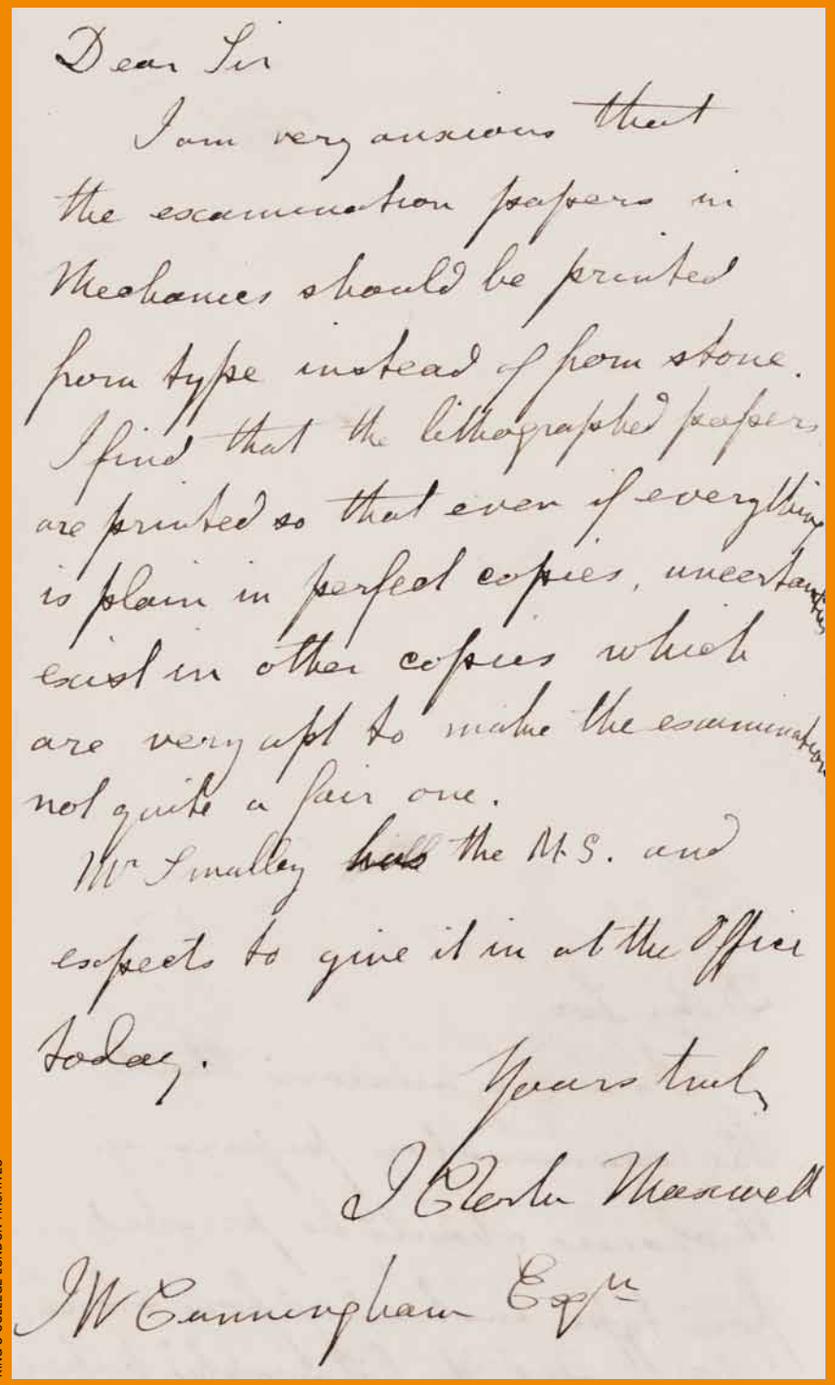


Above: Maxwell's original version of the colour triangle. This arrangement is based on the additive combination of three primary colours at its corners.

Top: This image of a tartan ribbon, directed by Maxwell and prepared by Thomas Sutton of King's, is the world's first colour photograph.
Above: Maxwell's formulation of his theory of electromagnetism was a turning point in the history of science. His equations present a universe of electromagnetic phenomena in a few lines of elegant mathematics.

Maxwell was intensely creative during the years he was at King's as Professor of Natural Philosophy from 1860 to 1865.

A letter from Maxwell to the College Secretary, John Cunningham, dated 5 December 1862, asking for examination papers to be typeset rather than lithographed. '[E]ven if everything is plain in perfect copies, uncertainties exist in other copies which are very apt to make the examination not quite a fair one,' he pointed out.



Dear Sir

I am very anxious that the examination papers in Mechanics should be printed from type instead of from stone. I find that the lithographed papers are printed so that even if everything is plain in perfect copies, uncertainties exist in other copies which are very apt to make the examination not quite a fair one.

Mr Smalley has the M.S. and expects to give it in at the Office today.

Yours truly

J Clerk Maxwell

J W Cunningham Esqre

KING'S COLLEGE LONDON ARCHIVES

in fact created by light from the blue-ultraviolet region of the spectrum which was not adequately blocked by the filters. Maxwell's method was not followed through to produce practical results until some 30 years later.

At King's

Maxwell was intensely creative during the years he was at King's. Living and working in the capital gave him the chance to attend lectures and discussions at the Royal Society (then housed in Somerset House, next door to King's in the Strand). He was also within easy reach of the Royal Institution, where he was able to meet Michael Faraday – the scientist he admired above all others.

As well as developing his electromagnetic and colour theories, during these years Maxwell also extended his statistical theories on the nature of gases. He conducted experiments for the Electrical Standards Committee of the British Association for the Advancement of Science, developing the standards for measuring electrical resistance, and producing a report on 'The Elementary Relations between Electrical Measurements'.

Besides lecturing, Maxwell gave weekly evening talks to artisans: a part of his official duties as a professor at King's, and one which appealed to Maxwell as an enthusiastic supporter of working men's education.

Cyril Domb, former James Clerk Maxwell Professor at King's, has demonstrated conclusively that there was no foundation to the rumour, published in FJC Hearnshaw's 1928 history of the College, that Maxwell was asked to leave King's because he could not keep order in his classes. When Maxwell tendered his resignation in 1865, the Council elected him an honorary fellow of King's and forwarded to him 'their best thanks for the services which he has rendered to the College and ... their high appreciation of his talents and attainments'. Maxwell did, however, find he was short of time to pursue his scientific research, and in 1865 he left London and retired to his Scottish estate. In 1871 he was appointed the first Cavendish Professor of Natural & Experimental Philosophy at Cambridge.

Maxwell is commemorated at King's in the building named after him at the Waterloo Campus; by the Clerk Maxwell Chair of Theoretical Physics (currently held by Professor John Ellis FRS) and by a plaque at the Strand Campus. The Maxwell Society organises regular public lectures, and the College Archives hold three of his notebooks.

Illustration for a leaflet for secondary schools, produced by King's to celebrate the Maxwell anniversary.

BELLE MELLOR

LEGACY

The legacy of Maxwell's work can be seen in many areas of research at King's today, from telecommunications to medical imaging. A four-week series of events in May 2011 celebrated his achievements at King's, with a particular emphasis on the theme of light, and speakers including Maxwell's biographer, Basil Mahon; Professor John Ellis (Clerk Maxwell Professor of Theoretical Physics at King's); Professor Frank James of the Royal Institution; William Ayliffe (Gresham Professor of Physic); Alexandra Loske of the University of Sussex and Professor Julian Stallabrass of the Courtauld Institute.

Alexander Stoddart, Sculptor in Ordinary to Her Majesty The Queen in Scotland, described his approach to monumentalising Maxwell through his Edinburgh statue of the physicist, while Dr Dominic ffytche, of King's Institute of Psychiatry, discussed Maxwell's conclusion that the colours we see are not real but related to 'a cause residing in the eye of the observer'.

DIGITISING culture

King's is home to Britain's only academic department in the frontier-breaking area of digital humanities. Professor Andrew Prescott, who takes up the headship of the Department in 2012, describes the opportunities and challenges.

Early British place names can now be explored in detail thanks to the digitisation of the 14th century Gough map.

BODLEIAN LIBRARY, OXFORD

As a Curator in the Department of Manuscripts at the British Library until 2000, Andrew Prescott acted as co-ordinator for digital projects including *Electronic Beowulf*. From 2000 to 2007 he was Director of the Centre for Research into Freemasonry at the University of Sheffield, and until 2011 he was Director of Research at the Humanities Advanced Technology and Information Institute at the University of Glasgow.

The recent change in name of King's Centre for Computing in the Humanities to the Department of Digital Humanities reflects the fact that King's was the first institution in the world to recognise this as an academic discipline in its own right.

DDH runs MA programmes in *Digital Humanities*, *Digital Culture and Society* and *Digital Asset Management* (in collaboration with the Centre for e-Research at King's). It also hosts the long-standing PhD programme in the Digital Humanities: the first established in the world.

In 1996, the British Academy held a conference on the theme of 'Information Technology and Scholarship in the Humanities and Social Sciences'. Introducing the conference, the distinguished philosopher, Sir Anthony Kenny, urged speakers to find examples of original scholarly work in the humanities which could not have been done without a computer. Many contributors to the 1996 workshop found it difficult to respond to Sir Anthony's challenge, and Sir Anthony reflected that 'the promise once held out by enthusiasts for computing in the humanities remains largely unfulfilled'.

Sixteen years later, can we make a more confident response to Sir Anthony's challenge? Humanities scholars in all disciplines now have access to a formidable array of online resources. In the past, searching through printed periodicals for relevant article publications was a time-consuming task; today, online periodical archives allow hundreds of academic journals to be rapidly searched. Securing copies of rare printed books previously required expensive trips to far-flung libraries; nowadays packages such as ProQuest's *Early English Books Online* and Gale's *Eighteenth-Century Collections Online* give scholars all over the world online access to facsimiles of virtually every book printed in the English-speaking world up to the year 1800.

New academic discipline

The study of the intersection between computing and research in the humanities has given rise to a new academic discipline known as digital humanities. The National Endowment for the Humanities in the United States has recently established an Office for the Digital Humanities. In Britain, the Arts and Humanities Research Council (AHRC) has identified 'Digital Transformations' as one of its priority research themes. Google has donated $1 million to various digital humanities projects. Recent articles on 'Humanities 2.0' in *The New York Times* have described how 'Members of a new generation of digitally savvy humanists argue it is time to stop looking for inspiration in the next political or philosophical "ism" and start exploring how technology is changing our understanding of the liberal arts. This latest frontier is about method, they say, using powerful technologies and vast stores of digitized materials that previous humanities scholars did not have'.

In 2010, King's hosted the Digital Humanities conference: the leading international academic conference in the field. King's is Britain's leading centre for the digital humanities and home to Britain's only academic department of the digital humanities. Sixty-five per cent of the research work of the Department of the Digital Humanities (DDH) was regarded as world-leading or internationally excellent in the last Research Assessment Exercise. At any one time, DDH is typically involved in about 30 major research projects, undertaken in collaboration with scholars in disciplinary areas ranging from classics to the history of medicine. DDH has generated over £17 million in research grants over the past nine years, from such sources as the AHRC, the Leverhulme Trust and the Andrew W Mellon Foundation.

WELLCOME TRUST LIBRARY

Digital consultancy

Through the King's Digital Consultancy Service, DDH has offered advice on digital policy to bodies including the Nobel Foundation and the governments of Israel, Denmark and Ireland. DDH projects foster cultural industries in the UK and beyond. For example, the AHRC-funded *Out of the Wings* project provides an online resource allowing English-speaking theatre professionals to draw on the rich theatrical traditions of the Hispanic world. The virtual environment of *Out of the Wings* contains details of plays written in Spanish in different periods and countries, as well as information about authors, sample translations, synopses, performance histories and many other tools for use by performers. An active programme of promoting performances of plays from the *Out of the Wings* database is an integral part of the project.

Theatre is an area where digital reconstructions can be particularly valuable. A member of the academic staff of DDH has recently produced a digital reconstruction of Dublin's Old Abbey Theatre which provides new insights into such events as the riot at the premiere of Synge's *Playboy of the Western World*.

Questions and answers

But the question posed by Sir Anthony Kenny in 1996 still remains. Are these new tools and resources changing humanities scholarship? Looking at the DDH portfolio, some answers are beginning to emerge. Scholars working in the digital humanities have a more direct relationship with their source materials, and thus a new understanding of their possibilities. For many years, historians of medieval England using letters of the royal chancery relied on printed summaries known as calendars. These calendars were not only extremely expensive to produce, but more importantly scholars also became reliant on these summaries and rarely looked at the full texts. Digital publication has made it feasible to produce new calendars of unpublished sections of the medieval royal archives. The recently completed *Fine Rolls of Henry III* project makes available for the first time calendars of royal documents relating to a formative period of English government. Moreover, because these calendars are linked to images of the original rolls, historians are not reliant on summaries of the texts. This approach is now being extended to the Gascon Rolls, documenting English rule in southwestern France.

Projects such as that on the Henry III *Fine Rolls* are opening up the country's rich cultural heritage to new

Opposite left: *JAINpedia* is a searchable online database of cultural artefacts for the Jain religion.
Below left: Hispanic play texts available through the *Out of the Wings* project enable new performances like this one of *Las Brutas* by Juan Radrigán.
Below right: *Mapping Medieval Chester* makes it possible to digitally explore this city on the (often troubled) border between England and Wales.

SARAH AINSLIE

BRITISH LIBRARY

audiences. However, the most important changes in humanities scholarship over the past 40 years have been the development of new subject areas and theoretical approaches. Humanities scholars have become preoccupied with such new themes as the study of gender or the impact of colonialism. New themes such as space, the body and the public sphere have become very important. The cultural and ideological contexts of new media such as film or television have been explored. The most innovative achievements of digital humanities occur when digital projects intersect with these new theoretical concerns.

THE BODLEIAN LIBRARIES, UNIVERSITY OF OXFORD

Islamic science

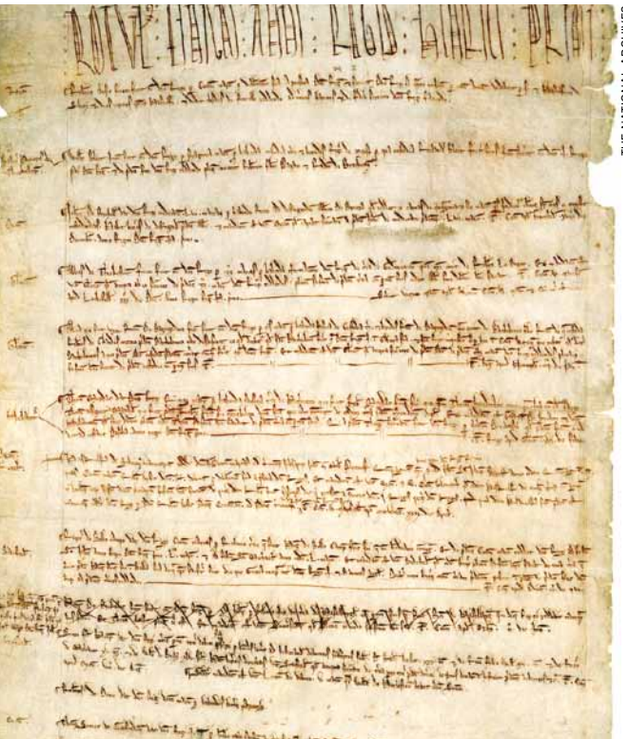
One of the key texts of modern humanities scholarship is Edward Said's exploration of prejudiced Western ideas of the East, *Orientalism*. A rich counterpoint to Said's book is provided by the Wellcome Library's collection of Arabic manuscripts, which documents the great contribution of medieval Islamic science to modern medicine. In a joint project between the Bibliotheca Alexandrina, the Wellcome Library and DDH, launched in July 2011, some 1,200 of these Arabic manuscripts are being made available online.

Western preconceptions of the East are also being probed and challenged by other DDH projects, such as *Inscriptions of Roman Tripolitania* which maps editions of Roman inscriptions from Western Libya onto Google maps and provides English translations of them.

Linguistic geographies

Another major overarching theme of modern humanities scholarship has been the invention of national identity. A recently launched DDH project, undertaken with the University of Oxford and Bodleian Library, allows the user to explore place names on the Gough Map, one of the earliest maps of Britain, illustrating the linguistic geographies of an emerging British identity.

The negotiation of Scottish identity is essential in understanding British national identity. *The Paradox of Medieval Scotland,* a project between DDH, the University of Glasgow and University of Edinburgh, records all known inhabitants of Scotland between 1093 and 1286 and thus provides a remarkably detailed view of a formative period in Scottish and British identity.

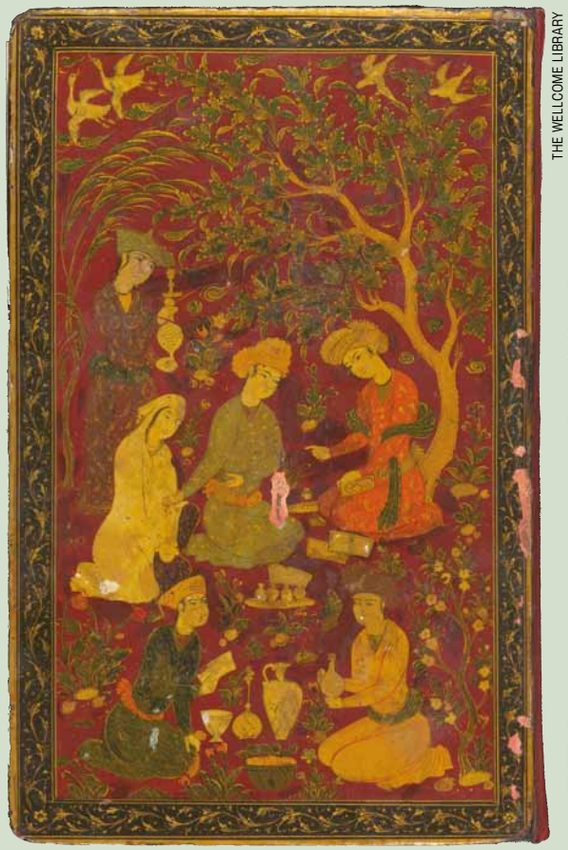


THE NATIONAL ARCHIVES

Prosopography

Similarly, the *Prosopography of Anglo-Saxon England* records all the known inhabitants of England from the late sixth to the late 11th century, and gives new insights into the formation of English identity and the impact of the Norman Conquest.

In literature and history, it is usually the successful man or the famous text which is remembered. Yet it is often the humble person or the forgotten text which turns out to be the most interesting. The great achievement of humanities scholarship in recent years has been in reminding us not be blinded by power and success. By recording the humble millers of medieval Scotland or the women of Anglo-Saxon England, by showing us the interest of inscriptions in Libya or the significance of Arabic medical manuscripts, the digital humanities projects at King's offer us new ways of seeking out the humble and the forgotten, and challenge glib grand narratives. In these ways, digital humanities research not only takes humanities scholarship into new areas, but also reaffirms and renews the fundamental mission of the humanities.



THE WELLCOME LIBRARY

Opposite above: This image of a man identified as 'Ælfwine' from the *Caedmon* manuscript in Oxford's Bodleian Library appears on the banner of the *Prosopography of Anglo-Saxon England* database.
Opposite below: The digitised 'Fine Rolls' of Henry III are a rich source of information about 13th-century England.

Left & below left: The digitisation of the Wellcome Library's Arabic manuscripts is enabling this collection of historical medical texts and images to be consulted online.
Below: *The Clergy of the Church of England Database, 1540-1835*, is the most comprehensive collection of evidence about the careers of Anglican clergy in England and Wales.

BRITISH MUSEUM

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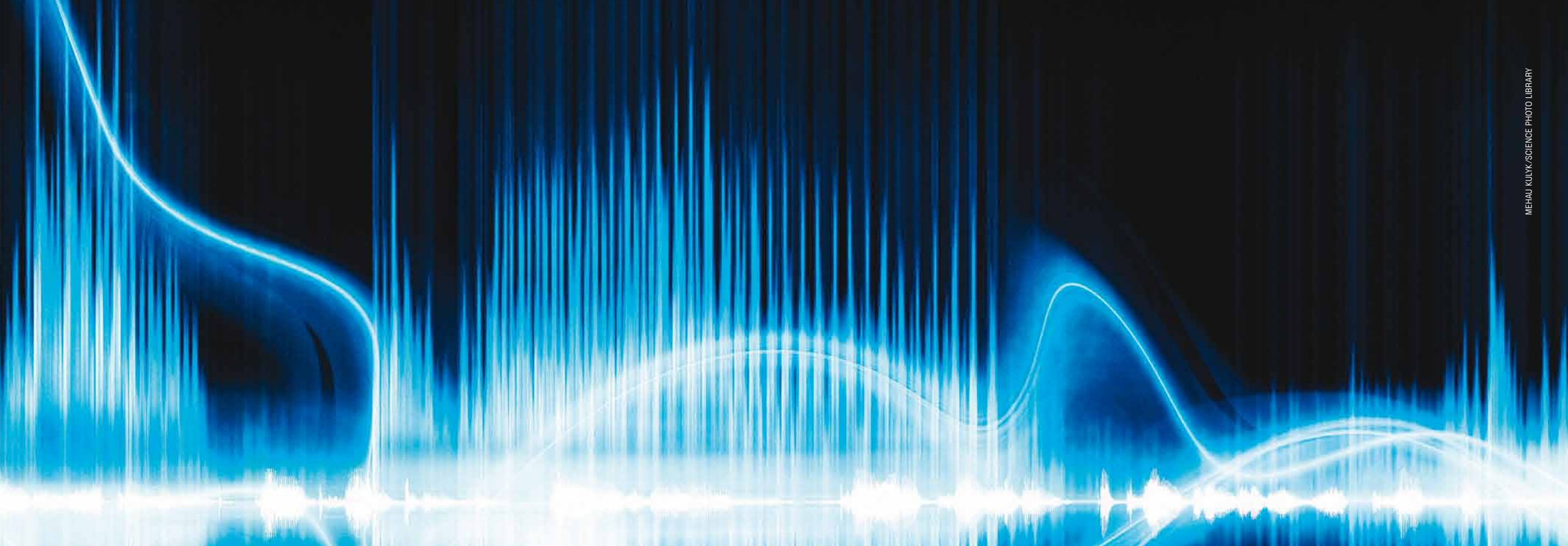


MEHAU KULYK/SCIENCE PHOTO LIBRARY

The way we WHIRR

The stories behind the headlines are not always straightforward – but sometimes the headlines themselves can help to progress research, as shown by Professor Brian Millar's work on the sound of the dentist's drill.

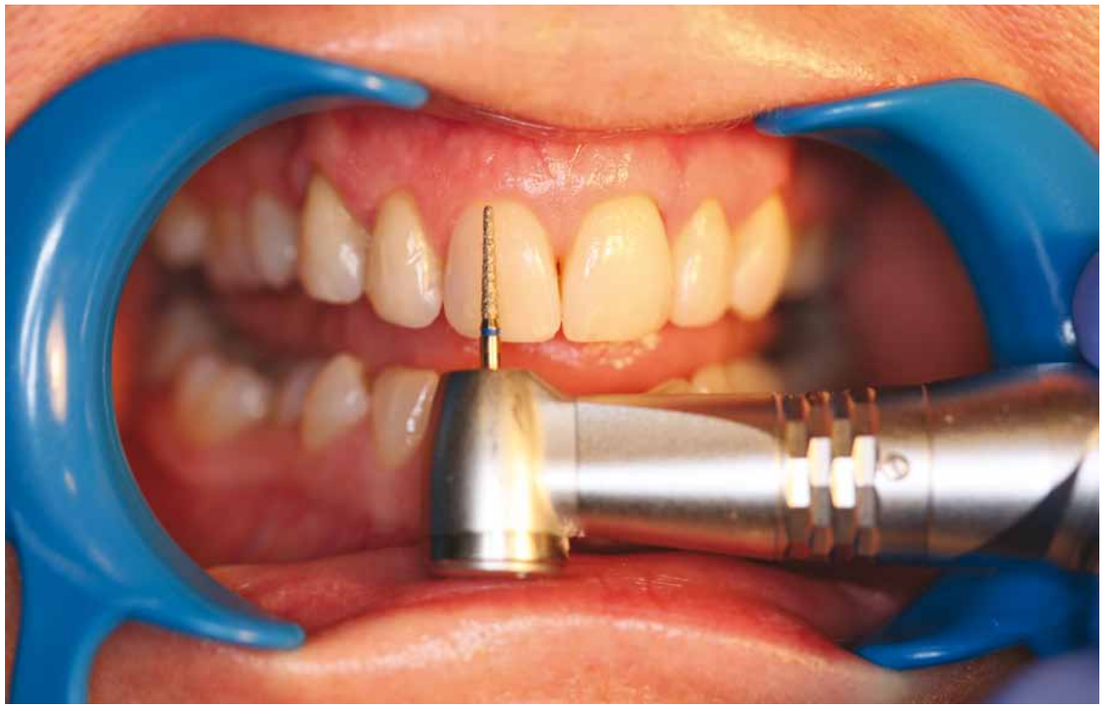
One Sunday morning in early 2011 Professor Brian Millar awoke to find his phone red-hot with calls from journalists. Luckily not on a topic of interest to the *News of the World*, the calls instead resulted from a press release issued by King's Public Relations Office about an invention Professor Millar had been working on, to blank out the noise of the dental drill and so make a visit to the dentist much less stressful for patients: especially the estimated 12 per cent who are categorised as 'extremely phobic' in the recent UK Adult Dental Health Survey about dental treatment.

Within days, Professor Millar had taken part in some 40 radio, television and press interviews, and had dentists ringing to find out when they could buy the device and potential funders asking to develop his invention commercially. As a result, he and his colleagues from South Bank and Brunel universities geared up their prototype and research in earnest, and they now have companies interested in the manufacture and in the global marketing and distribution of their device, with a launch planned at the International Dental Show in March 2013.

'Bad' and 'good' noise

The story began in the early 1990s, when Professor Millar read about Lotus cars trying to reduce 'bad' or unwelcome noise (such as tyres on tarmac, and wind around door mirrors) and enhance 'good' noise (such as the roar of a powerful engine and exhaust) inside their cars. 'This made me think about how we might reduce dental drill noise, while still allowing patients to hear the other sounds in the surgery, and in particular the voice of the dentist,' he explains. 'I did some work on this with Ken Rotter, a specialist in Engineering Systems at South Bank, and we got some promising results, but at that stage we couldn't get computers to process the noise fast enough.' Dr Mark Atherton (later of Brunel University) then joined the team, bringing his expertise in hearing aids and acoustics.

Meanwhile Digital Signal Processors (DSPs) were improving and, by coincidence, while on a visit to India, Brian met the leader of the research team at Texas Instruments specialising in DSPs. 'I told him what we needed and we soon had a new high-speed DSP. I also obtained some funding from W&H who make top quality dental drills. This enabled us to fund



One picture is worth a thousand words: this photograph, taken by Professor Millar, illustrated the story.

SUNSCREEN FROM CORAL?

AIMS (AUSTRALIAN INSTITUTE FOR MARINE SCIENCE

Coral, such as this on Australia's Great Barrier Reef, produces natural sunscreen compounds to protect itself.

Another King's news story which may lead to a research development contract is the discovery of how coral produces natural sunscreen compounds to protect itself from damaging UV rays, which could form the basis of a new type of sunscreen for humans.

As part of their research on the Great Barrier Reef, Dr Paul Long of King's Institute of Pharmaceutical Science and colleagues from Australia and the USA noticed that the algae on which the coral depends, and the fish that feed on the coral, also benefit from this sunscreen protection, which is clearly passed through the food chain. 'We're very close to being able to reproduce this compound in the lab, and eventually we might be able to create a sunscreen for human use, perhaps in the form of a tablet, which would work in a similar way,' Dr Long says. The coral compounds could also perhaps be used to develop crop plants capable of withstanding harsh tropical UV light, to benefit Third World economies.As a result of the publicity gained from the news story, the team is now discussing a contract with Johnson & Johnson to develop and commercialise their research.

a PhD student, Erkan Kaymak, who moved the research on, and we managed to silence the drill in a test environment.'

Difficult to cancel

Drill noise is particularly difficult to cancel, because it is instantly recognisable, high-pitched, includes many frequencies, changes as the drill is used, and varies in amplitude. Both Professor Millar and his colleagues were busy with teaching and other research, and Professor Millar was also developing King's distance learning in dentistry and other areas, and so it took 15 years to achieve a 30 decibel reduction in the noise of the drill, to one ten-thousandth of its original noise.

'Then the recession hit. There was no money around in the dental industry, and, bizarrely, no dental company seemed interested, despite us being convinced it would be a sound investment. So we put the prototype device on the shelf,' Millar says. 'But then I wrote a short article in January about it for our Dental Institute magazine, and the King's Press Office picked this up and wanted to release it to the media. "Could you suggest a picture to illustrate the topic?" they asked. Inevitably, the media wanted something overnight, and I was unable to find a suitable image with full publishing consent. However, with the help of my wife, I lined up her smile and a dental drill – and snap ... So the press release went out with the picture, and then the phone rang all day!'

Millar and his colleagues have now developed a low-cost device, which works with all types of dental drill and features electronic and other sound-cancelling components, which they anticipate will run via an MP3 player, enabling other, pleasanter, sounds to be added. The next stage is to refine the components and design; test the device on students and colleagues, and then test it on patients (both phobic and non-phobic ones). 'Soon the device should be in many dental surgeries,' Millar says, 'giving much-needed help to people whose fear of visiting the dentist stops them from seeking the oral healthcare they need.'

Other applications for the technology are under consideration, such as for cancelling noise when using a mobile phone in busy surroundings and possibly for the treatment of tinnitus.

STUDENT DIARY 2010–11

Ryan Wain reflects on his second year as President of King's College London Students' Union (KCLSU).

I have to repeat the caveat that often accompanies the annual report from KCLSU: 2010-11 has been a fantastic year for King's students and there are far too many achievements, activities and successes to cover here. So I must offer an unreserved apology to those who, despite their brilliance, do not feature on these pages.

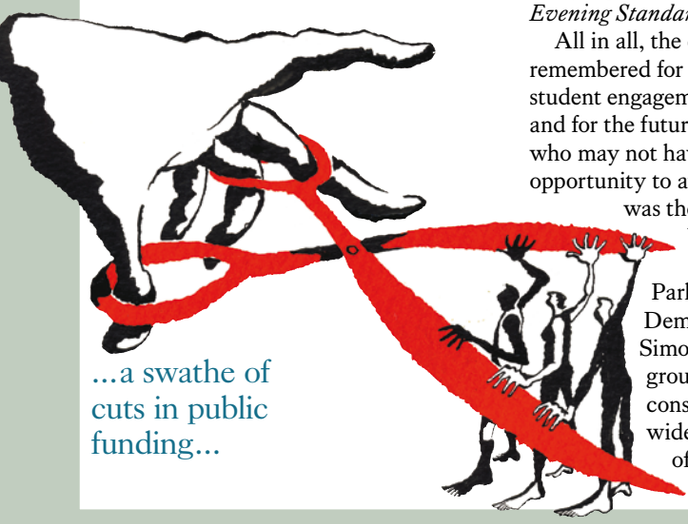
There is perhaps no better place to begin than with the events which rocked the foundations of further and higher education: the debate surrounding the public funding of higher education. Lord Browne's report proposed that fees for domestic students should be trebled to £9,000 per annum, and offset with a swathe of cuts in public funding. As always, King's students approached the issue sensibly, paying homage to the notion that academia is a 'marketplace of ideas' and, through a series of debates and Student Council meetings, developed a policy on the issue that was both fair and impactful, providing the bedrock for KCLSU's most successful and high-profile campaign in its 100-year history.

...to forge a lasting link with a senior Member of Parliament...

Well-oiled campaign

On 11 November 2010, King's students, regardless of party-political allegiance, led London into the largest student demonstration in recent history. Fifty thousand people took to the streets. However, thanks to their professional approach to campaigning, the work of our students had begun well before this and they saw the demonstration not as an end in itself but as part of a well-oiled campaign. Through visits to King's alumni, the students sought to convince them that these measures were haphazard and needed to be discussed further. Students also engaged with local schools, trade unions and professional bodies. At one stage, in an attempt to divert the media spotlight from the negativity following the aftermath of the events around the Millbank Tower, a large number of King's students 'invaded' the tube, dressed as monkeys and bears, but carrying a serious message. The London *Evening Standard* loved it!

All in all, the campaign will be best remembered for the impact it had on student engagement, both within King's and for the future generations of students who may not have otherwise had the opportunity to attend university. KCLSU was the only student union in the UK to forge a lasting link with a senior Member of Parliament. The Liberal Democrat Deputy Leader Simon Hughes appointed a group of King's students as consultants for his work with widening access. The effects of their input will be felt for many years.



...a swathe of cuts in public funding...

Of course, 2010-11 was more than just a year of political hot potatoes, with students acknowledging that life must go on and all still subscribing to the King's adage that 'the best learning takes place outside the classroom.' Our footballers excelled, our netballers entertained and our volleyball team were party to one of the most exciting comebacks in the illustrious history of student volleyball.

'In the service of society'

Likewise, our students embodied the College's operating philosophy, 'in the service of society', with eight student groups successfully receiving funding from the KCLSU Community Engagement Fund, set up to encourage activities in and around the local London boroughs. In total, 42 student groups carried out either regular or one-off student-led volunteering projects with a community partner, ranging from our highly impressive Bangladeshi Society, who collaborated with local Bangladeshi youths in a series of events to celebrate their heritage and culture, to our Debating Society. The latter, operating under a national structured programme called 'Debate Mate', was able to inspire school-age students from disadvantaged backgrounds to get involved with debating (which, as one member put it, was the equivalent of convincing a child that sprouts were no bad thing). Their results were impressive, with many pupils commending their down-to-earth approach and acknowledging that they have instilled in them a flair and passion for the art of debate – something which will prove invaluable when it comes to university applications.

Last year, 170 students took part in KCLSU's volunteering impact assessment, with very positive results. Reflecting the tremendous work our students do, we received £6,500 from the Big Lottery Fund for volunteer training next year. Student societies proved to be as successful as ever, with record numbers visiting our Welcome Fair. In total, 6,935 students joined an activity group (almost a 20 per cent increase on the previous year).

...one-off student-led volunteering projects...

BELLE MELLOR

Culture shock

It was a particularly impressive year for our African and Caribbean Society (ACS), who were recognised both by KCLSU and by the National African and Caribbean Company as Society of the Year. The ACS's *Culture Shock* event showcased the culture and talents of members through drama, fashion, poetry, song and dance, with all profits going to charity. Like many of our societies, the ACS struck up positive relationships with many national and local charities: they worked with the African-Caribbean Leukaemia Trust, the Sickle Cell Society, the Young Educational Learning Programme and the Kenyan Orphan Project. The *Culture Shock* itself was a hugely successful show attended by more than 800 guests, and it further engaged the community by enabling children from local schools to see the show and, during rehearsals, experience university life.

King's students were once again recognised as achievers above and beyond their chosen courses of study. Wanting to certificate the work which takes place outside the lecture theatre, KCLSU launched the Lion Award, with our inaugural scheme proving to be a roaring success. Professor Eeva Leinonen, Vice Principal (Education), presented successful students with the award,

which was delivered by key partners (including Deloitte and King's Business) and covered areas ranging from leadership to commercial awareness. The award will, we hope, become part and parcel of student life at King's, and will further enhance the employability of students.

Sporting prowess

King's students also further demonstrated their sporting prowess, with many achieving fantastic results in their areas of expertise. As ever, for those students lacking in sporting ability, the notion of 'social sport' and a belief in simply 'taking part' was high on the agenda.

King's rose in the British Universities and Colleges Sport (BUCS) league to 42nd position – our highest ranking position since the creation of BUCS, and one which could not have been achieved without the sweat and tears of all our teams (thankfully, there was limited bloodshed). There was also a record-breaking crowd as King's Rugby team secured a very exciting victory over our fierce rivals UCL. And in the College's Macadam Cup (which includes football, netball, rugby, hockey, darts, fencing, tennis, squash and ultimate frisbee) King's non-medics secured a never-before-seen win over their medic rivals.

Meanwhile three of our elite athletes have had notable successes. Zoe Lee has been training with the GB Rowing senior squad with three athletes who have recently won a silver medal at the World Cup. Ryan Chamberlain has been in Munich winning a bronze medal with the GB Paralympic rowing crew, and Antonio Infantino has won the Hertfordshire Athletic Championship 200 metres sprint.

Leadership

Equally impressive amounts of effort and engagement have been dedicated to student leadership. KCLSU's springtime elections saw two part-time Trustee positions and four full-time Officer positions up for grabs.

The competition was fierce and the campaigning exhilarating. Over 4,000 voted, and, with 10 candidates running for President alone, the electorate had plenty of choice. Clever campaigns and a good use of much-adored *X Factor* judges secured victory for our new President Hannah Barlow and for Vice-President for Student Activities & Facilities, Holly Walsh. Fran Allfrey was elected as our new Vice-President for Student Media & Engagement, and Simisola Smith as Vice-President for Academic Affairs: the first international student ever to be elected a KCLSU Officer.

...the competition was fierce...

...three athletes who have recently won a silver medal...

This is KCLSU's first all-female team, and it marks an exciting chapter in our history. As someone who has served in an Officer role for two years, I want to offer my own vote of thanks in these pages: to the Principal, his team across the College and to you, the engaged alumni, student or staff member. Without you, my fellow students and I would not belong to the most diverse, exciting and rewarding academic community in the UK.

ACKNOWLEDGEMENTS

We are grateful to all those who have generously supported the College over the last academic year. Support from individuals, grant-making trusts and other organisations has opened up new areas for clinical and academic research, established scholarship opportunities for our students and created new academic posts and better facilities. We thank all our supporters (including those who prefer to remain anonymous) who are helping us to fulfil our vision for the College. In particular, we warmly acknowledge the exceptional support of those listed here.

Sackler Institute for Translational Neurodevelopment

Thanks to a generous donation from the Dr Mortimer & Theresa Sackler Foundation, the Sackler Institute for Translational Neurodevelopment is being created at the Institute of Psychiatry, Europe's premier mental health and neurosciences research centre. The Institute will be directed by the Dr Mortimer D. Sackler Chair in Translational Neurodevelopment, a post established with a significant endowment from the Sackler Foundation. The Sackler Institute is being set up to harness the scientific and clinical expertise within King's Health Partners to develop better understanding of the causes of neurodevelopmental disorders and deliver new clinical treatments to patients tailored to their differing needs across the lifespan.

The Institute will bring together researchers from across basic and clinical science departments of King's Health Partners to promote excellence in neurodevelopmental science, and the Chair will establish the critical mass of researchers and clinical-scientific partnerships to lead the world in this important field.

PAUL GRUNDY

The Sackler Institute is being created at the Institute of Psychiatry at King's.

Action Medical Research
Alexander von Humboldt Stiftung Foundation
Alicia Koplowitz Foundation
The ALS Association
Alzheimer's Society
The Andrew W Mellon Foundation
Aplastic Anaemia Trust
Dr David Appleyard AKC
Arthritis Research UK
Association for International Cancer Research
Asthma UK
The Atlantic Philanthropies Ltd
The Rt Hon Sir Robin Auld FKC
Avantha Group
Mr David & Mrs Ellen Bletsoe
Big Lottery Fund
Breakthrough Breast Cancer
Breast Cancer Campaign
British Heart Foundation
British Lung Foundation
Professor George Brownlee
Professor Robert Brownlee
Dr William Brownlee
Calouste Gulbenkian Foundation
Cancer Research UK
Carnegie Corporation of New York
Charles Wolfson Charitable Trust
CHDI Foundation, Inc
Mr Christopher Cheng
Professor Teresa Cheng FKC
Dr Jack Cohen
Cicely Saunders International
Mrs Maryann Cochrane
Mr Ian Creagh
Mr Mike Dalgleish
Department of Health
Diabetes UK
Diana, Princess of Wales Memorial Fund
Dimbleby Cancer Care
Dr Joan Dodd
Mr Bill Dodwell
The Marquess of Douro OBE &
The Marchioness of Douro OBE
Dystrophic Epidermolysis Bullosa
Research Association
Edmond J. Safra Philanthropic Foundation
Epilepsy Research UK
European Foundation for the Study of Diabetes
Professor Sir Lawrence Freedman KCMG CBE FKC
Fight for Sight
Foundation Open Society Institute
The John & Lucille van Geest Foundation
GE Healthcare
GlaxoSmithKline Research & Development Ltd
Mr John Graham
Guy's & St Thomas' Charity
Lord Harris of Peckham FKC & Lady Harris
Mr Stephen Harrow AKC FKC &
Professor Jennifer Harrow
Heart Research UK
Heathside Charitable Trust
Mr John Henderson AKC
Henry Schein Inc
The late Revd Dudley Heryet AKC
Histiocytosis Research Trust
The late Mrs Linda Howle
Hughes Syndrome Foundation
Miss Marytka Jablkowska for '2 Wheel Appeal'

Annual Fund

The Annual Fund has supported projects that have enhanced research and teaching and transformed students' experiences at King's, and we are extremely grateful to those who support it.

Thanks to the generosity of King's alumni, staff and friends, the Annual Fund has enabled a variety of activities around the College to flourish. Annual Fund grants make a significant and immediate impact by facilitating projects that would not otherwise be possible and in turn help King's to continue attracting the best and brightest students and academic staff.

The Fund is helping King's to respond to the increasing need for a more efficient mental health service with an innovative course entitled 'Extreme Psychiatry'. This module, offered to medical students on their Psychiatry rotation, combines conventional teaching methods and role-play with professional actors performing a range of symptoms that might manifest themselves in patients with mental illnesses such as dementia and schizophrenia. The role play is intended to help students to identify and learn how to react to mental illnesses and encourage them to build empathy with patients, whilst carefully considering issues of diagnosis, management, ethics and law.

The Annual Fund has also supported extracurricular activities around the College in 2011. A recent grant to King's College London Boat Club has allowed them to purchase eight new rowing machines for their indoor rowing suite at Guy's Campus and is helping to generate a healthy and supportive club atmosphere. The improved facilities have made it easier for members to train together as a crew and help novice rowers master the basics and perfect their rowing technique without having to be on the water.

King's students have continued to excel in the performing arts, as the King's Players (a KCLSU society) put on their own production of Richard Brinsley Sheridan's *The Rivals* at the Camden Fringe Festival. A grant supported the production costs of this performance and every aspect, from acting to stage direction to lighting and wardrobe creation, was managed by a member of the student society. The King's Players were extremely grateful to have the opportunity to realise their creative vision for this production which was very well received by the audience and critics alike.

This is just a small selection of the many activities that have benefitted from grants in the last year. The Annual Fund has supported projects that have enhanced research and teaching and transformed students' experiences at King's, and we are extremely grateful to those who support it.

The Annual Fund supported a student performance of *The Rivals* at the Camden Fringe Festival.

VOLKER STEGER/SCIENCE PHOTO LIBRARY

Medical, nursing and midwifery students can practise their clinical skills on a childbirth manikin, thanks to a grant from the Annual Fund.

The Stavros Niarchos Scholars' Fund

Hellenic Studies at King's has a long-standing tradition of excellence, achieving a reputation for world-class teaching and research.

The Stavros Niarchos Foundation is continuing its generous support of scholarships available to PhD students pursuing any aspect of Hellenic Studies at King's. The first Stavros Niarchos Scholar has just begun the second year of his PhD studies and aims to reshape our understanding of the reception of major Latin poets in modern Greece with his illuminating research project. A second exceptional scholar has recently been appointed and as his studies progress it is anticipated that his research will make a significant contribution to the field of Hellenic Studies. Hellenic Studies at King's has a long-standing tradition of excellence, achieving a reputation for world-class teaching and research. The College's profile in this area has been further enhanced as a result of the prestigious scholarships supported by the Stavros Niarchos Foundation, which have in turn helped the College to continue to attract outstanding researchers in Hellenic Studies from across the globe.

TASSOS PAPACOSTAS

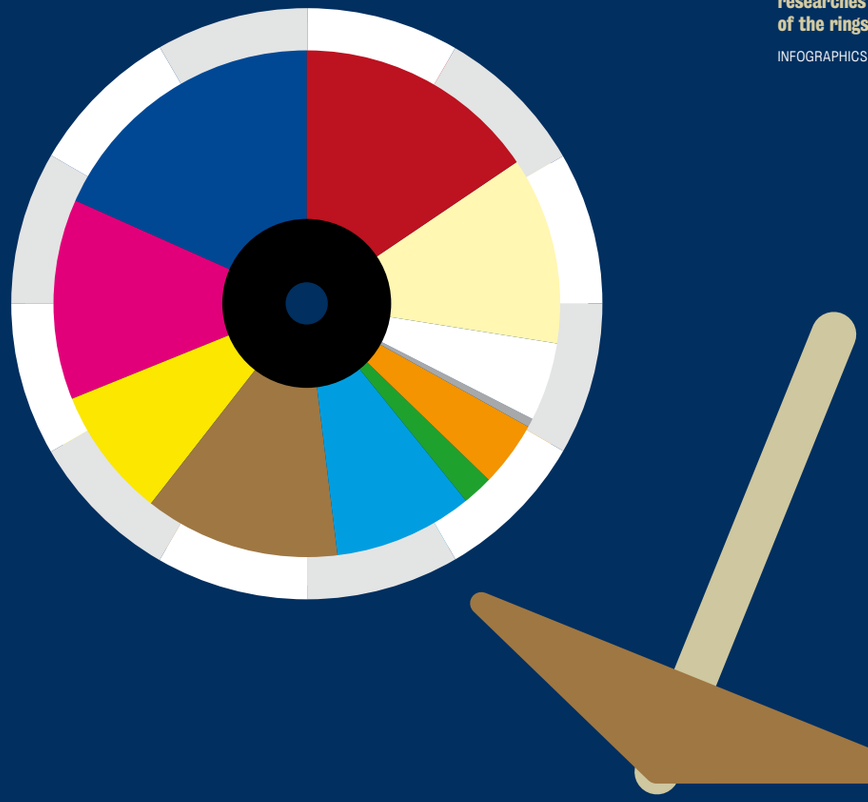
Mosiaic from San Vitale, Ravenna. Scholarships from the Stavros Niarchos Foundation support Hellenic Studies research.

Jacobs Foundation
Juvenile Diabetes Research Foundation
Juvenile Diabetes Research Foundation International
Mr Neil Kaplan CBE QC SBS
Kay Kendall Leukaemia Fund
The late Mr John Kelly
Professor Anne Kenshole
Kidney Research UK
King's College Hospital Charity
King's College Hospital NHS Foundation Trust
King's Medical Research Trust
Leukaemia & Lymphoma Research
Dr Bertrand Leung
A G Leventis Foundation
The Leverhulme Trust
Mr Martin Lewis
Mr Terence Lo
The London Law Trust
Dr Zudong Liu
March of Dimes
Ms Val Martin-Revell
The Maudsley Charity
Dr Barrie Morgan FKC
Motor Neurone Disease Association
The J P Moulton Charitable Foundation
Mr Donald Nappin
National Association for Colitis and Crohn's Disease
National Institute on Allergy & Infectious Diseases
The late Revd Elisabeth Neale
Oak Foundation
Miss Mary O'Rourke
Mrs Elizabeth & Mr Daniel Peltz
Prostate Cancer Charity
Psychiatry Research Trust
Dr Maurice Rothschild
Royal College of Physicians
Mr Conor Quigley
Ms Francesca Quint AKC
Mr Andrew Robson
Rosetrees Trust
Dr Shafik & Mrs Nadia Sachedina
The Dr Mortimer & Theresa Sackler Foundation
Mrs Lily Safra FKC
Santander
Dr Angela Scott
Society for Mucopolysaccharide Diseases
South London & Maudsley NHS Foundation Trust
Stavros Niarchos Foundation
St Christopher's Hospice
St Thomas' Lupus Trust
Stroke Association
Teenage Cancer Trust
The J H Templeton Foundation
Dr Geoffrey Thomas
The late Miss Norah Thomas
Tommy's, The Baby Charity
Professor Sir Richard Trainor KBE FKC &
Professor Marguerite Dupree
The Waterloo Foundation
Water Research Foundation
Wellcome Trust
Mr Christopher Wiscarson FKC &
Mrs Gillian Wiscarson
Maurice Wohl Charitable Foundation
The Wolfson Foundation
Mrs Esther Wong & Family & Friends
Mr Dawson Woo
Mr Dieter Yih FKC
The late Mrs Leonora Yonge

Facts & figures

These diagrams were inspired by the researches and discoveries of James Clerk Maxwell, including his colour top; a drawing in his notebook in the King's College Archives; his original version of the colour triangle, and his researches on the composition of the rings of Saturn.

INFOGRAPHICS: PETER GRUNDY

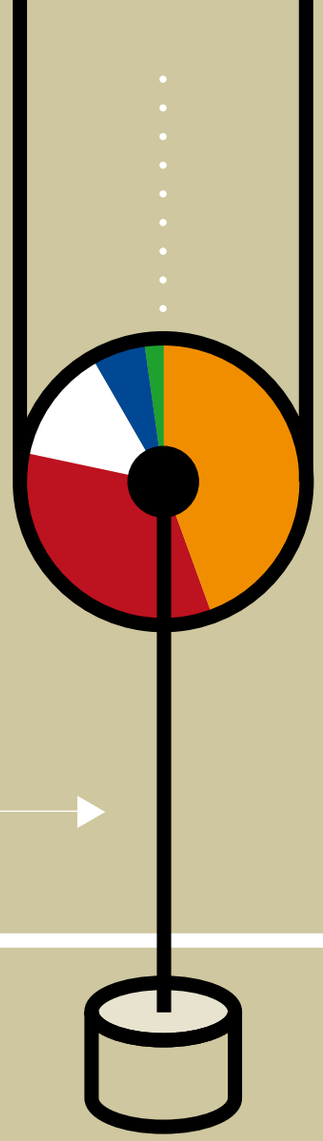


STUDENTS IN SCHOOLS OF STUDY 2010–11

School	Campus	Number of students				
		Undergraduate	Graduate		Total	% of total
			Taught	Research		
Arts & Humanities	Strand	2431	764	486	3681	15.7%
Biomedical Sciences	Guy's, Waterloo	2217	353	231	2801	12.0%
Dental Institute	Guy's, Denmark Hill, Waterloo, St Thomas'	792	267	59	1118	4.8%
English Language & other centres	Strand	186	16		202	.8%
Institute of Psychiatry	Denmark Hill	79	554	328	961	4.1%
Kings's Learning Institute		158	275	4	437	1.9%
Law	Strand	1152	864	84	2100	9.0%
Medicine	Guy's, Denmark Hill, St Thomas'	2252	332	308	2892	12.4%
Natural & Mathematical Sciences	Strand	1383	416	160	1959	8.4%
Nursing & Midwifery	Waterloo	2332	559	63	2954	12.6%
Social Science & Public Policy	Strand, Waterloo	1511	2257	499	4267	18.3%
Total graduate students				**8879**		**38%**
Grand total		**14493**	**6657**	**2222**	**23372**	**100%**

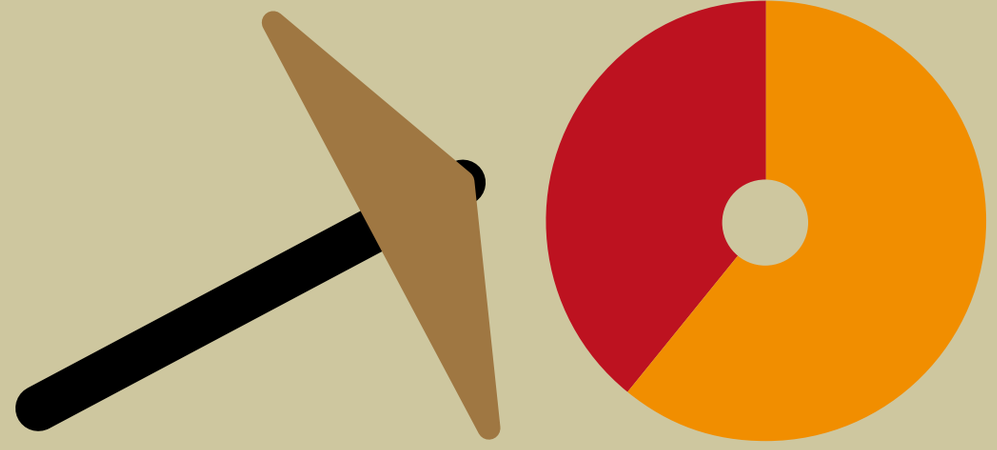
STUDENT NUMBERS BY AGE 2010–11

Age	Number of students				
	Undergraduate	Graduate		Total	% of total
		Taught	Research		
20 and under	10350	43	2	10395	44.5%
21 to 29	2746	3945	1268	7959	34.1%
30 to 39	848	1659	617	3124	13.4%
40 to 49	433	779	217	1429	6.1%
50+	116	231	118	465	2%
Grand total	**14493**	**6657**	**2222**	**23372**	**100%**



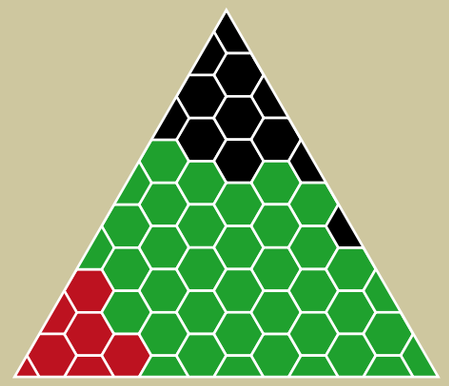
STUDENT NUMBERS BY GENDER 2010–11

Gender	Number of students				
	Undergraduate	Graduate		Total	% of total
		Taught	Research		
F	9177	3847	1199	14223	60.9%
M	5316	2810	1023	9149	39.1%
Grand total	**14493**	**6657**	**2222**	**23372**	100%



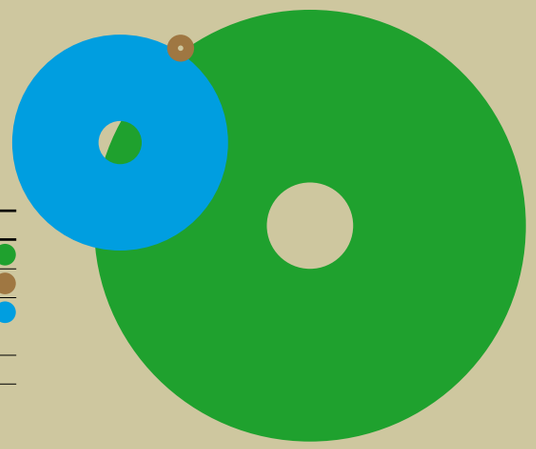
STUDENTS' COUNTRY OF DOMICILE 2010–11

Domicille	Number of students	% of total
UK	16729	71.6%
European Union	2492	10.7%
Other countries	4151	17.8%
Total	**23372**	**100%**



STUDENTS IN HALLS OF RESIDENCE 2010–11

Accommodation	Number of students	% of total
King's students in College residences	2390	80.1%
King's students in Liberty Living accomodation	45	1.5%
King's students in University of London intercollegiate residences	548	18.4%
Total	**2983**	**100%**



STAFF NUMBERS 2010–11

Type of staff	Number of staff	% of total
Academic and research staff	3015	50.7%
Other staff	2932	49.3%
Total	**5947**	**100%**

Finances

INCOME & EXPENDITURE

for the year ended 31 July 2011

King's credit rating was confirmed by Standard & Poor's as 'AA/stable' for 2011.

	2010–11	2009–10
	£000	£000
Income		
Funding body grants	147,211	151,889
Tuition fees and education contracts	130,746	118,400
Research grants and contracts	147,099	144,053
Other operating income	93,561	87,090
Endowment and investment income	5,493	6,613
Total income	**524,110**	508,045
Expenditure		
Staff costs	307,698	314,928
Other operating expenses	152,600	146,679
Depreciation	23,946	23,476
Interest payable	12,361	12,499
Total expenditure	496,605	497,582
Surplus on ordinary activities	27,505	10,463
Taxation	2	2
Surplus after depreciation of assets at cost and tax	**27,503**	10,461

VISITORS TO KING'S 2010–11 INCLUDED:

- HRH The Duchess of Gloucester
- Prime Minister of the Bahamas, The Rt Hon Hubert Alexander Ingraham
- President of Liberia, Ellen Johnson-Sirleaf
- Former Prime Minister, Sir John Major
- MPs and peers from the All-Party Parliamentary Group for Dentistry
- Writer, Polly Toynbee
- Health Minister, Lord Howe
- President of the World Bank, Robert Zoellick
- Former Poet Laureate, Andrew Motion
- Nobel Laureates, Sir Tim Hunt and Professor Christiane Nusslein-Volhard
- Author, Sir Terence Pratchett
- Mayor of London, Boris Johnson
- HM Ambassadors Alan Charlton (Brazil), Frances Guy (Beirut) and John Jenkins (Baghdad)
- Director of the Wellcome Trust, Sir Mark Walport
- Broadcaster, David Dimbleby
- HRH Prince El Hassan bin Talal of Jordan
- BBC Presenter, Dara O Briain
- Commander of the International Security Assistance Force in Afghanistan, General David Petraeus
- Children's author and campaigner, Michael Morpurgo
- First official British astronaut selected by the European Space Agency, Major Tim Peake.

ALFREDO FALVO