Whitsun 2007

SCIENCE IN PARLIAMENT

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SCIENCE IN PARLIAMENT

The Journal of the Parliamentary and Scientific Committee.

The Committee is an Associate Parliamentary Group of members of both Houses of Parliament and British members of the European Parliament, representatives of scientific and technical institutions, industrial organisations and universities.

Science in Parliament has two main objectives:
a) to inform the scientific and industrial communities of activities within Parliament of a scientific nature and of the progress of relevant legislation;
b) to keep Members of Parliament abreast of scientific affairs.

The Parliamentary and Scientific Committee

Cash injections into British Energy and MG Rover resulted in the DTI balancing its end-of-year books by raiding the science budget to the tune of £69 million, despite the fact that the science community were told the science budget would be ring fenced when the DTI became responsible for it. That's the bad news. The good news is that the Chancellor announced further growth in the science budget in his Budget speech in March.

According to the World Health Organisation, 10% of medicines available on the internet and up to 50% of those sold in developing countries are counterfeit. Obviously, this can cost people their lives.

There is little evidence that the sale of counterfeit medicines is a significant problem in the UK, although Pfizer has had problems with one of its products. As a result, they have chosen Unichem as the sole distributor of their medicines. GSK already operates a streamlined distribution system of its products, whilst other companies are considering direct-to-pharmacy distribution systems.

Is it the security of their products that is driving this change or the increased profit that can arise from it? Perhaps either the Public Accounts or Health Select Committee can carry out an inquiry in order to answer this question? Certainly, the Government has cut the profits of pharmaceutical companies recently by renegotiating the PPRS.

Remember cold fusion – Stanley Pons and Martin Fleischmann's sensational claims in 1989 that nuclei could be forced to fuse together at room temperature, thereby releasing energy? Well, the subject is very much alive according to an American Chemical Society's symposium, held in Chicago in March, and the fact that responsible Journals are accepting papers on this subject again. But, the sceptics still abound.

On April 26, I was privileged to present prizes to the winning team of the 2007 British Physics Olympiad and the runners up at the Royal Society. We wish the winning team good luck at the International finals, to be held in Istafhan, Iran in July.

Dr Brian Iddon MP
Chairman, Editorial Board
Science in Parliament

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OPINION

A Good Year for Science Education – and better years ahead!

Dr Robert Kirby-Harris
Chief Executive, Institute of Physics

Over this past year there have been a number of significant positive developments in relation to science education: the "Next Steps" review of the Science & Innovation Framework; new programmes announced by HEFCE to stimulate demand for physics, chemistry, engineering and IT; the STEM Programme Report; additional funding made available for high cost laboratory subjects at university; and funding by DfES of the Careers from Science project.

The primary reason for this level of concern and concentration of new initiatives is economic. The UK needs to significantly expand its output of scientifically and technically trained young people if it is to compete in the global knowledge economy – and yet we have seen over a number of years stagnation or relative decline in numbers studying at university and absolute decline in numbers studying post 16 at schools and colleges. Our education system does not seem best placed to fulfil this key role; and along with these "economic system" failings we realise that we are not best serving our young people, especially young women and those from poorer backgrounds and some minority ethnic groups. These problems are particularly acute in physics education, which I will focus on for the rest of this article, but most of what I present will apply equally to chemistry and mathematics (and engineering at tertiary level).

There are a number of causes for this problem residing principally within the secondary system and its interface with higher education. The lead cause, supported strongly by the research evidence, is the profound shortage of qualified physics teachers. The majority of pre 16 physics teaching is being carried out by non specialists, and this is a dominant factor in young people not being enthused to study physics post 16. We need to greatly expand the numbers of qualified teachers, either through increasing the pool of new entrants to the profession or by providing suitable training for non-specialist teachers. The IOP has been working with the Training and Development Agency on a Gatsby Foundation funded initiative to upgrade non-specialist scientists and then support them through initial teacher education and their early years of teaching; and this project has successfully increased intakes by a significant proportion. We are also working with Government and other bodies to develop the physics diploma that would enable existing teachers to become qualified specialists. Continuous professional development and support are also major factors in retaining highly qualified and enthusiastic teachers. The IOP works with schools across UK to support teachers: running networks, providing updating courses, and recently launching a set of CD-ROMs for non specialists teaching in the early secondary years. Government and other organisations also contribute much, but it is clear we need to do far more and act in a more co-ordinated way, including providing significant resources and incentives for teachers and schools.

A second major cause lies with careers advice, which does seem to be very weak and misleading in general. The evidence indicates that physics graduates have excellent opportunities to undertake well paid and interesting work right across the economy, but this message is just not getting through to young people and those who influence them. The Careers from Science project aims to present the reality through a website and marketing materials. Career choices are clearly linked to subject choices and here the relative difficulty of physics is a problem. Recent evidence shows that students of similar ability taking some "soft" subjects gain two grade points over studying physics; this leads to students being steered away from physics because of individual university aspirations and school league tables. This "system failure" needs resolving through weightings or insistence on science performance in the School Accountability Framework, and in the short term students need to be made aware of the lower grade requirements for physics coupled with its higher earning potential.

A third more diffuse cause is cultural. The phenomenon of young people turning their backs on science is not exclusive to the UK, but we do seem to be performing badly even within this more general context. Yet the considerable challenges that the world faces over climate change and sustainable development, and the considerable achievements of science in improving our quality of life and our understanding of the world, should provide the stimulus for young people to study science and consider entering scientific careers. In conclusion, we should be aiming for a stimulating and well taught curriculum, exciting experimental work, and a broad range of relevant enrichment activity beyond the curriculum, within a rational educational system where young people have good information on which to base their choices. With this in place we should be able to increase the numbers of young people taking science over the coming years to the benefit of the economy and broader society.

Science education for all

Jenifer Burden
Co-director, Twenty First Century Science

"Science in schools must maintain its traditional and vital focus on preparing the most interested and talented pupils for science courses at university. At the same time, it must equip *all* students for what has been called "scientific literacy" or "science for citizenship."[1] This is the key challenge for our school science curriculum.

The need for change

After the introduction of the National Curriculum in 1989 the majority of young people aged 14-16 in England and Wales studied a "Double Award" Science course for 20% of their school curriculum, leading to two GCSE grades in Science.

During the 1990s it became clear that making all students follow the same curriculum was turning off too many students, but crucially also failing to provide the depth of challenge needed to stimulate those with a potential interest in more advanced study in science.

This experience reflected the inherent tension between meeting the needs of both our future scientists, and those who will not pursue a science-related career, which becomes more noticeable as students reach the age of 14.[2]

In 2002 growing evidence led the House of Commons Select Committee on Science and Technology Third Report: Science Education from 14-19 to state that: "A new National Curriculum should require all students to be taught the skills of scientific literacy and selected key ideas across the sciences. This core should form the basis of a wider and more flexible range of exam courses, reflecting the diverse interests and motivations of students."[3]

Following a large pilot programme, *Twenty First Century Science*,[4] the science National Curriculum was significantly revised for September 2006. *Twenty First Century Science* is now one of five sets of science GCSE courses available to schools in England and Wales.

Science for all: developing scientific literacy

A key innovation of the *Twenty First Century Science* is the GCSE Science course taken by all students, to develop scientific literacy. Much has been written about how to define scientific literacy, but clearly no-one can be said to be scientifically literate unless they understand some science – "what we know". A broad understanding of the main science explanations provides a framework for making sense of the physical world. However, it is also vital to reflect on the nature of scientific knowledge – "how we know": the practices that produce scientific knowledge, the kinds of reasoning used in developing a scientific argument, and the issues that arise when science is put to a practical use.

Thus the aim of developing scientific literacy "does not mean turning everyone into a scientific expert, but enabling them to fulfil an enlightened role in making choices which affect their environment and to understand in broad terms the social implications of debates between experts."[5] These are important ideas for both the future scientist, and other informed citizens.

Take as an example the recent public concern regarding potential risks from the MMR vaccine: what might be important knowledge and understanding for a concerned parent making this choice for their own child? A basic understanding of the functioning of the immune system is clearly required. But it was not a public lack of understanding of the immune response that precipitated the significant rise in parental concern and subsequent drop in measles vaccination uptake in 1998.[6]

More important in this case is some understanding of methods of data collection and limitations of any data, the distinction between a correlation and a causal relationship, the process of peer review, an appreciation of the regulation of medicine production, and an awareness of the need to balance benefits against risks. These are some of the ideas about the nature of science that students explore in the new GCSE Science course. Far from "dumbing down" of science these ideas can be complex and sophisticated, and are as crucial for future scientists as they are for the general public.

Science for the next generation of scientists

In the new curriculum most students are still expected to study science for 20% of their curriculum time. Thus alongside their GCSE Science course a student usually selects from a range of additional science courses. These courses are designed to be worthwhile in their own right, but also to prepare for more advanced study in academic or vocational science programmes.

For example, GCSE Additional Science provides an introduction to more theoretical ideas and concepts in biology, chemistry, and physics. This course reintroduces some of the intellectual challenge that was lost in the previous "one-size-fits-all" National Curriculum, and provides a stronger

basis than before for progression to Advanced Level science.

Alternatively, learning in the GCSE Additional Applied Science course focuses on the mastery of technical skills and the use of these to solve problems well suited to young people who want to see more immediate practical uses of the knowledge and skills they learn. Students can build on their learning in this course to take science A-levels but are more likely to take an advanced applied or vocational course after the age of 16. Finally, students with a strong interest and aptitude in science may study three separate GCSEs in Biology, Chemistry, and Physics, which incorporate both the Science and Additional Science courses, plus further more specialised material.

This range of curriculum options provides all students with a grounding in scientific literacy, and appropriate routes to meet individual needs for future scientific study.

REFERENCES:
[1] House of Lords Select Committee on Science and Technology, Third Report (2000).
[2] Millar R and Osborne J (Eds) (1998) Beyond 2000: Science education for the future. London: Nuffield Foundation.
[3] House of Commons Select Committee on Science and Technology Inquiry into Science Education from 14-19 Science and Technology Committee, Third Report (2002).
[4] Commissioned by the Qualifications and Curriculum Authority (QCA) the Twenty First Century Science pilot involved over 75 schools from 2003-2006 (http://www.21stcenturyscience.org).
[5] European Community (1995) White paper on education and training: Teaching and learning – Towards the Learning Society (White paper). Luxembourg: Office for Official Publications in European Countries. Paper presented at the National Association for research in Science Teaching (NARST), St Louis, 26-28 March.
[6] In 2005-2006 84% of children in England had received the MMR vaccine by their second birthday (NHS Immunisation Statistics, England: 2005-06, Department of Health). The World Health Organisation recommends a 95% uptake in order to prevent outbreaks of the disease.

The Unkindest Cut!

Neil Roscoe
Head of Education, Institute of Biology

In a recent survey of school teachers and technicians conducted by the Institute of Biology, 60% of respondents believe that more practical dissection should be done in Science classes. Furthermore, 85% consider that the amount currently being done has declined compared to the levels in 1986 (when the National Curriculum and compulsory Science education in schools was first introduced.)

The reasons for the decline are difficult to quantify, but there are several possibilities. They include: perceived concerns around health and safety regulations and confusion over what is actually allowed; the high numbers of Science teachers working outside their degree specialism (and perhaps lacking the necessary biological skills) and the ease with which staff can now simply screen demonstrations using interactive whiteboard technology, rather than doing the real thing. Couple all this with the bad press the practice has encountered from those who are opposed to animal testing and it is easy to see how dissection in particular has suffered a multiple whammy in recent years. Should we be prepared to see this educational tool die out, or has the world moved into a technological age with simulations which no longer require it?

Dissection of whole organisms carried out in school Biology classes in Britain is now less common due to ethical concerns surrounding the fact that these organisms are specifically bred for the purpose. It is easy to have sympathy with this stance, but I would contend that whole organism dissection (particularly the rat) remains educationally valuable. Many Biology teachers would agree. Nowhere else can students get a sense of wonder in how all the systems of the body fit together.

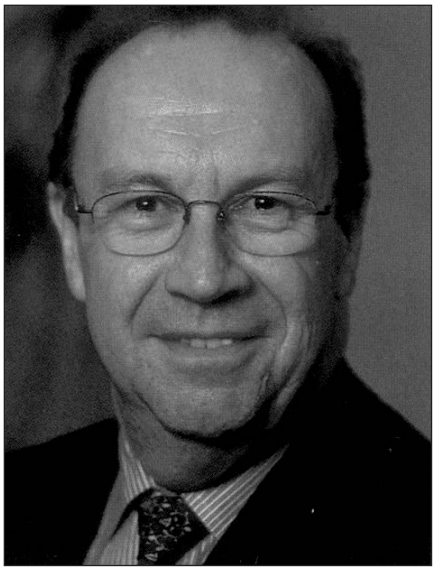
Individual organ dissection survives in British schools today because it is less controversial. The animal has been killed anyway for food, so this removes the difficulty that it has been bred specifically to be dissected. Popular choices for this kind of practical include: pigs' hearts; lambs' kidneys and bulls' eyes. A "pluck" (heart and lungs of a sheep) is also useful when teaching mammalian ventilation.

Having said that, dissection is obviously not for every student and it remains best practice to allow students to opt-out of these kinds of activities as some students object on ethical or religious grounds or are simply just squeamish. Teachers should also always give students the opportunity to debate the issues and offer useful alternative activities to learn the same content. The survey suggests most staff do this.

Clearly in the survey the majority of teachers believe more dissection work should be done. This is hardly surprising because the "wow factor" and potential to inspire students with this skilful practical activity really should not be underestimated. The possibility that by being "switched on" by dissection classes at school might lead a student into a medical, bioscience or other scientific career further down the line, is unproven but likely. This is why we should seek to encourage the dissection of at least individual organs in Biology classes wherever practicable.

Foresight brings clarity to the future

Professor Brian Collins
Chief Scientific Adviser to the Department for Transport (DfT) and Professor of Information Systems at Cranfield University



Transport is integral to many of the things we do as a society. It affects practically every aspect of modern life whether it's getting a child to a doctor's surgery for an inoculation, or developing inter-modal transport hubs to oil the wheels of industry and drive economic growth.

So in my job as Chief Scientific Adviser to the Department for Transport (DfT), I am involved in tackling a tremendously broad spectrum of issues.

Since October 2006 when I took up the part-time post (in addition to my responsibilities at Cranfield University), I have really enjoyed the sheer scope of the work. Indeed, this is one of the highlights of my career and a great opportunity to get involved in a host of fascinating new technology and policy developments.

My key responsibility is making sure that the DfT's work in science, engineering and technology is well directed and that policy is based on good science.

Within that, there are a lot of issues that are relevant to what we are trying to do across the department. Part of it is to make sure that the passenger gets the best travel experience possible, no matter whether it's for business or pleasure, short hop or long haul. Part of it is making sure that we reduce the environmental impact of transport in the future.

At the same time, we have to make sure that transport does not present a barrier to economic growth. And we also have to ensure that transportation is safe and secure.

That last point on its own covers a whole range of issues ranging from countering terrorism on the one hand to addressing privacy concerns on the other.

This is an area I've been involved with extensively anyway as a member of the working group on the Royal Academy of Engineering's report on privacy and surveillance and the challenges of technological change.

Clearly, all these issues represent significant policy challenges. At the same time though, it means that there are lots of "big issue" concepts to get involved in.

For example, we've recently seen the publication of the Stern Review on the impact of climate change and we've had the Eddington Report looking at the long-term links between transport and the wider economy.

On top of that we have had the Foresight Project on Intelligent Infrastructure Systems (IIS), which ties a lot of these complex issues and challenges together and that makes it particularly interesting from my point of view.

The IIS initiative was originally sponsored by the DfT, but in practice it was an inter-departmental programme aimed at co-ordinating government planning while thinking about how we might live 50 years from now.

The idea is really to push the boundaries of our long-term, strategic thinking across all the policy areas. By focusing on that long-term perspective along with DEFRA, DCLG, DoH and the other departments, we can see more clearly how we can make intelligent decisions on infrastructure planning and the exploitation of technology.

A lot of it is really about joined-up government. For example, if we want to get people from their houses to hospitals or schools, then co-ordinating our plans with DCLG on planning developments, the DoH on hospitals and DfES on schools, obviously makes complete sense.

The Foresight Project built on existing collaboration and my job now is about trying to identify how science and technology can help meet society's demands in the future – no matter how the world develops between now and the 2050s.

Of course, when you're looking that far ahead, absolutely no-one can say for sure how the world will look in 50 years. But we do have a lot of information available and we can set out scenarios for a number of different futures.

For instance, using the data we have on trends and technology, we can overlay other models such as traffic growth, freight volumes, air passenger numbers and get some really good insights into some of the challenges that lie ahead. That way, we can start thinking now about what we need to do to be prepared.

The findings of the original Foresight Project on IIS were unveiled in January 2006 by Dr Stephen Ladyman, Minister of State for Transport.

The Intelligent Infrastructure Futures (IIF) report provided a vision of the transport challenges that the UK could face over the next 50 years to help stakeholders develop long-term policies and strategies.

The aim was to ensure that decisions made in the near term would maximise the benefits of future opportunities, while offering those involved the chance to manage future risks more effectively.

The one-year review of the IIS will be released shortly via the DTI and the preliminary results show that there have been some very positive outcomes from the project, reaching across Government, academia and the private sector.

Of course, the project has already met one key objective by bringing some of the most important issues about the long-term development of transport into the public arena. So the benefits will continue to accrue as this level of strategic thinking is built into new policy planning.

The Foresight project produced four contexts that helped define areas of uncertainty surrounding the future of intelligent infrastructure systems:

- future scientific capabilities
- technological developments
- the role of business and Government
- social attitudes.

These contexts and the scenarios derived from them were not an attempt to predict what would happen or suggest a preferred future. Rather, they were "stories" with their own internal logic suggesting various possible – even extreme – outcomes.

As such, the scenarios could be used to judge the risks and opportunities of policy relating to the future management of intelligent infrastructure, as well as providing a context to support the decision-making process.

As a follow-up to this work, the DfT commissioned the development of a scenarios "toolkit"[1] to support future thinking. The concept is aimed at providing policymakers and other stakeholders with the resources needed to explore the various scenarios and use them to support their own decision making processes.

What all the scenarios point to, though, is that transport policies do not exist in isolation. They have to work within the context of the policy goals of other government departments and they have to be coherent in the context of the DfT's own strategic objectives.

That is why, for example, I am co-ordinating the convergence of existing DfT workstreams and research on intelligent transport systems (ITS) into one consolidated programme with intelligent infrastructure systems.

This will allow the DfT to take a cross-modal and cross-disciplinary approach in supporting the development of innovative technologies, paving the way towards capturing many of the benefits highlighted in the IIF report.

I think, in the past, we've been very good at modelling individual networks. For example, we have extremely sophisticated models for analysing the potential growth of road congestion and we've used that in the design of arterial routes.

Now, though, I believe that we can develop better ways to model, for instance, how the inter-modal hubs will impact the wider transport network as they grow. For example, how the growth of freight traffic at a port will interact with the traffic on the rail and road elements of the hub.

The project has also influenced the DfT's input on the Future Intelligent Transport Systems (FITS) initiative. The scheme was formally launched at the ITS World Congress in London in October 2006 by the Minister of State for Transport, Dr Stephen Ladyman.

The project is basically targeted at nurturing projects on "next generation" transport technology. That means projects aimed at improving road safety by reducing collisions, casualties and deaths; creating more reliable, accessible and safer public transport services; boosting the efficiency of the road freight industry; improving the road network; and providing better travel information to allow travellers to make informed choices about how and when to travel.

The project is being funded jointly by DTI, DfT, the Engineering and Physical Sciences Research Council (EPSRC) and business. The idea is to bring UK industry and universities together to address key research issues for the longer-term development of the UK transport system and to work in collaboration to tackle some of the major transport challenges we face over the next decades.

On the basis of this and other initiatives, I think it's fairly clear that thinking on intelligent infrastructure systems is likely to play a key part in policy developments across Government for some time to come.

I believe that the concepts and approaches embodied in the intelligent infrastructure approach will help benefit all stakeholders as they prepare to meet the challenges of social, economic and technological change over the decades to come.

For me personally, that means that this is probably one of the most complex briefs of any Chief Scientific Adviser in a government department. But that makes it one of the most interesting as well.

We're planning ahead, but making the transport experience better is a long-term undertaking, so we really need to get on with it. That's the challenge and it's one that I will enjoy helping to drive forward.

[1] The toolkit is available from the DfT website:http://www.dft.gov.uk

Science in Zoos and Aquariums

Professor Gordon McGregor Reid
Director General of the North of England Zoological Society (Chester Zoo), Co-Chair of the Research Committee of the European Association of Zoos & Aquariums and President-elect of the World Association of Zoos & Aquariums

A great deal of important science takes place in leading zoos in the United Kingdom and world wide. A zoo is officially defined as any permanent establishment where living, wild animals are kept for exhibition to the public for seven or more days a year, with or without an admission charge. As well as conventional zoological gardens, this encompasses safari parks, aquariums, bird gardens, birds of prey centres, reptile and amphibian centres, butterfly or bug houses and some animal sanctuaries (private sector and charities). The precise nature of the science varies with the policy, size and resources of the organisation but the emphasis is on conservation, environmental sustainability and animal welfare both at home and abroad; and on work conducted in close collaboration with others. There is also an impetus through educational programmes to communicate advances in conservation and science to the many guests who visit zoos and aquariums each year: 125 million in Europe and 600 million globally – an audience bigger than that for football! Also, through outreach programmes, it is now possible to deliver education in conservation to schoolchildren in developing countries.

Conservation is considered to be actions that substantially enhance the survival of species and habitats, whether in nature *(in situ)* or outside the natural habitat *(ex situ)*. Zoos conduct important *ex situ* work including scientifically managed "assurance" breeding programmes, affording the potential for reintroduction of species that have become extinct in the wild. Zoo research involves benign, non-intrusive, non-invasive methods and is increasingly targeted on natural habitats. Basic and applied programmes in zoos or aquariums can embrace a remarkably large number of topics including: animal care, ageing, behaviour, biomaterials or "gene" banking, biotechnology, contraception, database management, diet, disease, DNA analysis, domestication, environmental enrichment, husbandry, identification, life histories, low temperature biology, population analysis, reproduction, studbooks, human behaviour and visitor studies. Research efforts on these topics will, in turn, typically draw on combinations of major scientific disciplines such as anatomy, biochemistry, biogeography, biotechnology, ecology, education, endocrinology, ethology, evolution, genetics, information technology, nutrition, physiology, population biology, psychology, sociology, taxonomy, and veterinary medicine.

Being zoological *gardens*, there is recent engagement with botanical and horticultural research and the breeding and management of rare and endangered species of plants. There is also increasing emphasis on indigenous as well as exotic fauna and flora. Chester Zoo has, for example, successfully reintroduced to the North West of England zoo-bred Barn Owls, Sand Lizards, Water Voles and Harvest Mice in scientifically monitored schemes; and works in partnership in the field on conserving rare native species as diverse as Freshwater Pearl Mussel, Dormouse, Tadpole Shrimp, Limestone Woundwort, and Black Poplar.

Zoo Science in the UK

The Zoo Licensing Act 1981 (Regulations for England and Wales, amended in 2002) covers conservation measures to be implemented by zoos including "research from which conservation benefits accrue to species of wild animals". The ZLA is administered by the Zoo Branch (WSC2) of the Wildlife Species Conservation Division of Defra, the Department for Environment Food and Rural Affairs. The ZLA and Secretary of State's Standards of Modern Zoo Practice provide the statutory framework for public safety, animal welfare, the delivery of conservation, education, research and an ethical review process. All establishments are regularly and rigorously inspected. Among many other aspects, this covers animal welfare in relation to research, quarantine and bio-security, provision of data or samples for approved outside research, field conservation projects, publications, research grants and links with Higher Education institutions. The Health and Safety Executive publication Health and Safety in Zoos (2005) concerns compliance with the Health & Safety at Work etc Act, 1974 and with

ensuring the safety of the public and employees, including those who work closely with animals and conduct veterinary or scientific investigations.

There is, in addition, a Zoos Forum which acts as the Government's independent adviser on zoo licensing, safety and ethical issues and which publishes a Handbook, also available on the web (www.defra.gov.uk). Chapter 2 of the Zoos Forum Handbook is "Conservation, Education and Research" where guidance and benchmarking is provided on ZLA requirements for zoos to participate in research. There is a recommendation that larger zoos and aquariums (>400,000 visitors pa) should undertake several research projects, collaborate with local universities and colleges on research, facilitate research, offer training opportunities for students and publish papers and notes each year on the results of research and field conservation work.

BIAZA (www.biaza.org.uk) the British & Irish Association of Zoos & Aquariums, with 102 members, is well represented on the Zoos Forum and strongly advocates scientific engagement. Nonetheless, while many of the larger zoos have Scientific Officers, Conservation Biologists, Veterinarians, Nutritionists and Educational staff, science does not always achieve its full potential and the high profile that it merits. This is partly to do with limited facilities, budgets and staffing; and the current national research funding structure, which perhaps over-emphasises abstract innovation (versus practical problem solving) and which, surprisingly, does not heavily support applied research in critical areas of conservation, sustainability and animal welfare. The Government squeeze on Gift Aid to charitable zoos does not help.

The Darwin Initiative

The recent announcement of the £7 million Darwin Awards funding round for 2007 (www.darwin.gov.uk) highlights the fact that zoos can and do contribute at the highest level to research and development work in biodiversity conservation and sustainability. A major award to the North of England Zoological Society was for "Building capacities for mitigating human-elephant conflicts in Assam". Chester Zoo leader Alexandra Zimmerman and her team are working with EcoSystems India to tackle this serious issue, where people are deprived of food, injured or killed as a result of elephant raids on crops, exacerbated by the fact that the natural habitat for elephants is shrinking and many now carry bullet wounds. This large and effective programme now employs 30 local people in Assam and involves sophisticated GIS satellite tracking and analysis of elephant migrations and attacks, alongside community level work on researching simple deterrents (such as planting peppers to keep elephants away from crops) and training for supplementary livelihoods to reduce crop dependence.

International Zoo Science

A European Zoo Directive is in force which places a strong emphasis on conservation, education and science; and this is modelled to a large extent on the UK Zoo Licensing Act. EAZA (www.eaza.net) the European Association of Zoos and Aquariums (with 46 UK members) conducted a membership survey in 2005. Among 301 EAZA institutions, as few as 25 (8.3%) indicated that they had a research department. Only about 33% have a research policy and many do not disseminate findings in a publicly accessible format, or indeed have a specific research budget. To help remedy these shortcomings EAZA will later this year launch a research strategy and action plan entitled "Developing the Research Potential of Zoos and Aquariums".

The World Association of Zoos & Aquariums (WAZA) has its headquarters in Switzerland and its motto is "United in Conservation" (www.waza.org). The mission is to "guide, encourage and support the zoos, aquariums and like-minded organisations of the world in animal care and welfare, environmental education and global conservation" – all of which involves a scientific approach. The WAZA membership includes individual zoos and aquariums, with 12 in the UK; national federations such as BIAZA; and wider geographical associations such as EAZA. There are also WAZA affiliate members, some of whom have a specific remit in science, including the European Association of Zoo and Wildlife Veterinarians (EAZWV), the Leibniz Institute for Zoo and Wildlife Research (IZW) in Berlin, and the International Species Information System (ISIS).

World Zoo and Aquarium Conservation Strategy

WAZA published the "World Zoo and Aquarium Conservation Strategy" (WZACS) in 2005 to act as a central reference point and authoritative source of guidance to the profession and to external stakeholders. The WZACS was prepared under the aegis of an international steering committee led by Dr Jo Gipps of the Bristol & Clifton Zoological Society, UK. Chapter three of the WZACS concerns "Science and Research" – expressing the vision that "Zoos and aquariums are fully and actively integrated into the research community and into public consciousness and understanding of science, as serious, respected scientific institutions that make significant contributions and sound scientific decisions for wildlife worldwide."

The conservation and research challenges are everywhere large and daunting, from threatened Black Rhinos and Orang-utans to African cichlid fishes, Caribbean corals and Pacific Island Land Snails. There is a particularly urgent need to prevent the dramatic decline and extinction of the 9000 (described and undescribed) species of frogs, toads, newts and other amphibians of the world. They are globally threatened from the rapid spread of a lethal fungus which may be associated with climate change (and which has now arrived in Britain!). WAZA, in partnership with the World Conservation Union (IUCN) have developed a global Amphibian ARK partnership to research and address this extinction crisis and much political and financial support will be needed to galvanise effective action.

The British Geological Survey (BGS): Geoscience for decision making

Professor John Ludden
Executive Director, British Geological Survey

It is the increasing public awareness of the environment that brings the science undertaken by the British Geological Survey (BGS) into the public eye. The Survey is the nation's principal supplier of objective, impartial and up-to-date geological expertise and information for decision making for governmental, commercial and individual users. We maintain and develop the nation's understanding of the rocks, soils and groundwater that make up the subsurface, to improve policy making, enhance national wealth and reduce risk. An important part of what we do involves communicating our geological knowledge to a variety of stakeholders and the general public.

BGS does this as part of the Natural Environment Research Council (NERC) family through maintenance of national capability in the geological sciences and developing research with academic, government and industrial partners in strategic areas; these include energy and natural resources, our vulnerability to environmental change and geo-environmental hazards.

We also undertake contractual research which involves "putting the survey science to work" in association with national and international government agencies and with industry. This represents about half of our total £55 million budget and about 30% of our manpower.

My key challenge in the coming years will be to make the most of the different arms of BGS. This will build on the "public good" role of the BGS within NERC, sharpening our research focus as part of the new NERC science plan, and further developing a new knowledge transfer and commercial model of the BGS.

Developing the BGS

The BGS was created in 1835 as the Geological Ordnance Survey and it was in July 1845 that the Geological Survey Act provided the Survey with a legal framework designed "to facilitate the completion of a Geological Survey of Great Britain and Ireland."

Much of Britain's geology is hidden from us by vegetation and the built environment, so that what we produce can often be difficult to obtain, and is an interpretation of a limited amount of observational data. Nonetheless, one might ask why, in more than 150 years, this has not been completed. In fact, the entire digital coverage of Britain will be complete by about 2012. In the future, our interpretations will need to be regularly updated as new data become available. Mapping will be focused on strategic issues (for example for potential geological disposal of nuclear waste) and in key regions at a finer scale and involving multi-dimensional models.

The geological coverage of the UK underpins a plethora of geological information that is essential for our day-to-day living. It is the translation of the geological map and data into knowledge for society that is the most important role of the Survey. In addition, the needs of the country have shifted from being dominantly resource based in the 19th and most of the 20th century to being dominated by environmental issues in the 21st century. It is only recently that geologists have embraced the study of surface processes and their relationships to landscapes, to climate and to biology and habitats in marine and continental environments.

Modern technology is revolutionising the way we display, model and deliver information to end-users. Multi-dimensional models of the subsurface, fundamental in dealing with issues of urban and regional development and resource modelling will be the norm of the future. The BGS is a world leader in dealing with geospatial information, which is widely accessed by users ranging from the British homeowner, who requires information for purchasing a house, to insurers, local authorities, surveyors, civil engineers and many other professions. Recently, a world-wide initiative called "OneGeology" was launched by the BGS to create a dynamic digital geological map data for the globe at a target scale of 1:1 million. We also hope to be working with the European Space Agency in developing geological maps of the planets.

BGS as part of a research council

BGS has been in the NERC family since 1965. Most geological surveys of the world report directly to a minister in the domain of technology, industry, and/or science. The fact that the BGS establishes its science strategy within

that of NERC, several tiers below a minister, has advantages and presents challenges.

Much of our scientific activity is for the public good and a survey by Roger Tym and Partners in 2003 estimated that the "value" generated by BGS science impacts on as much as 5-8% of UK output. Clearly, this sort of delivery for NERC within its DTI remit is essential for the nation. NERC wants to better identify, evaluate and support these activities within its research centres, but it will also recognise that some of its centres, specifically the BGS, undertake important nation-building tasks that may not always be a direct underpinning of the NERC science strategy.

Our relationship with NERC allows us to develop research projects and to build national capability, for example in new mapping and monitoring technology, and also to exploit our data in partnering on exciting new strategic research programmes funded by NERC and other research councils. I include below a "case-study" to demonstrate our relationship with NERC and other stakeholders:

Case-study: Energy resources and their management

Through its mapping BGS provides Government with an assessment of its energy reserves both onshore and offshore. It is generally accepted that fossil fuels will remain a significant source of energy for the UK for some time to come. However, the continued use of fossil fuels will require us to store the CO_2 produced in power generation and large industrial processes. The most appropriate solution for the long-term storage of the CO_2 in the UK will be geological storage. This will involve injecting pressurised CO_2 into deep saline fluids and pore spaces that are contained in rocks, normally sandstones, in underground reservoirs which particularly occur offshore. In a broad sense, we foresee three stages: **(1)** assess and define the extent of the reservoirs; inform Government of the available capacity; work with industry and Government in defining protocols for sequestration; **(2)** a research element which will require specific geophysical measurements, probably involving new technology, and also an understanding of the thermodynamics of CO_2 in a specific type of reservoir; **(3)** long term monitoring of the reservoir both during, and after, injection of CO_2.

Stages 1 and 3 are part of the public good role of BGS; **stage 2** would involve an intensive research programme with universities and industry that could be part of a NERC thematic programme in their new strategy on **"The next generation science for planet Earth".**

I used the carbon capture and geological storage example above to demonstrate the links between the public good role of BGS and the academic and industrial research environment. I could have chosen other examples, such as groundwater resources, deep underground storage of nuclear waste, ground stability, and coastal and estuarine response to climate change. All of these science research areas are timely and critical to the future of the UK, all requiring BGS to develop close links with universities and other research centres.

BGS as an international leader

The BGS "brand" is very strong internationally and our overseas work, until 1965, was carried out by a separate Overseas Geological Survey. We are currently operating in about 15 countries on projects commissioned by the UK Department for International Development, the World Bank and the European Development Bank. Our main role is to provide the basis for generating wealth and rebuilding the natural resource infrastructure through the provision of state-of-the-art geological information, training and institution building. This capacity building is important for the British presence overseas and creates long-term financial benefits for both Britain and the countries in which the BGS works; for example, we are in the final stages of a three year project to rebuild the Afghanistan Geological Survey.

The BGS needs to use its overseas presence to act on behalf of the university community in building academic links in the developing world. It can also provide infrastructure for exciting co-funded projects involving geology, landscapes and ecosystems and including urban and rural development.

Models for BGS commercial activities

BGS has a broad remit and the tension between the contractual research and core programme funded by NERC can mean that sometimes our scientists do not have the time to fully exploit their science. BGS needs to create innovative BGS–university–industry contractual research partnerships and we need to review the way we undertake this research.

Contractual research is currently managed under NERC directives, either as contracts, direct sales or as licensing agreements. BGS has developed technology which can be "spun-out". We continually investigate all possibilities for commercialisation and knowledge transfer of our applied research. A road map of future commercial options, including time-scales, costs, benefits and dis-benefits to BGS and NERC, is being developed. This will most probably include the possibilities of both the migration of suitable activities to a commercial arm of BGS and also the growth of new activities and sectors.

BGS as a national resource

The BGS is a valuable national resource. It is unique among the geological surveys of the world in having both a broad applied geo-environmental research programme, and working under a mixed funding profile involving NERC core funding, contracts from national and international agencies and from industry, and income from data licensing. It plays a central role in providing scientific information not only for decision-making for Government, but for also for horizon–scanning. By means of strategic partnerships with universities and other leading geo-environmental research bodies, the Survey will develop as the focus of applied geological research in the UK, and as leaders of this science on the European and international scene.

For more information please consult our web site http://www.bgs.ac.uk/

National Space Centre

Chas Bishop, Chief Executive, National Space Centre

Seafood Splatter

Lunching in Boosters Restaurant at the base of the open plan Rocket Tower, the Blue Streak and Thor Able rockets watching on as I chatted to guests from Barclays Bank, something fizzed past my right ear and splotted onto the floor next to my right shoe. Looking down I saw a squid. Looking up I saw two small faces disappearing from view, 150 feet up on the top deck.

There is the vaguest chance that the Rocket Tower Two were measuring the acceleration of an object in freefall. There is a greater chance that one of them had found what Mum had bought from the Tesco fish counter sitting in the fridge and had put it in his pocket for an opportune moment of mischief. Three idiots in suits 150 feet below? Don't tell me you wouldn't be tempted.

The National Space Centre has welcomed 50,000 children in school groups each year since its launch to the public in June 2001; 1.4m visitors in total during this time. Its purpose is to inspire all visitors to learn more about space, but particularly young people to get excited about science and engineering using the subject of space. The Nicholas Grimshaw building is stunning. The Haley Sharpe exhibition provides a wonderful mix of interactive displays, artefacts and shows that raise a smile, or sometimes a frown, and keep the imagination firing. Even the hand basins in the toilets are impressively hi-tech with soap, water and hot air from overhead all triggered in sequence by the sensing of movement. I once watched in horror as a twelve year old boy threw up into one. He knew he was going to be sick. He didn't expect the accompanying shampoo and set.

Trading sewage for space

The disused Abbey Meadows sewage works was an imaginative site for the visionaries from the University of Leicester who in 1994 had the idea for a world class visitor attraction,

education and research facility. Recognised around the globe as experts in space science, earth observation and planetary exploration, their concerns then were the same as our concerns today: that too few children were continuing with scientific studies and choosing the course and career options that would set them on the path to becoming the scientists and engineers of the future.

The coincidence of a good idea, a subject of great public interest, the quest for urban regeneration and funding from the Millennium Commission delivered the ingredients necessary to get the project under way. Leicester Regeneration Company has since exploited the National Space Centre's presence as a catalyst for the development of the Leicester Science Park on the derelict land surrounding it. Clearance works are complete and works above ground are due to start in spring 2007.

From Asteroids to Beagle 2

Six years after launch in 2001, the National Space Centre is a mature business that provides an exciting day out, supports formal education and helps celebrate the achievements of the UK and European space communities within the context of global space activity.

Government was an early client, recognising the opportunity to use the National Space Centre as a medium for giving public information about the threat posed by asteroids. The Near Earth Object Information Centre was established in 2003. The Centre makes Government (and the public) aware of asteroids that are identified as a potential threat and briefs it on progress as calculations are made. Kevin Yates, the Space Centre's own expert, speaks for his kind when stating that "a major meteorite strike will happen; it is simply a matter of when".

Also in 2003 came Beagle 2 and the opportunity for Lander Operations to be placed at the heart of the visitor attraction: the first time that the public has been able to watch a mission in progress in this way anywhere in the world. Of course we know the story and the reaction from a public delighted by an eccentric pioneering spirit but so often resigned to heroic failure. The sense of theatre in the final weeks of the journey from Earth to Mars was terrific. Future opportunities to put high profile space missions in the public domain in this way must be exploited.

Since Beagle 2, the Space Research Facility has been hooked up "live" to the SWIFT satellite, intercepting

gamma ray bursts from the biggest explosions that take place in the Universe and telling visitors instantly where and how long ago they happened (up to 13 billion years ago in some cases), and is now preparing for another assault on Mars. A team from Astrium is developing its prototype rover for a mission to the Red Planet in 2013 and needs somewhere to put it through its paces. Where better to absorb a school child in the thought that one day they could be working on a space mission? Should they instead become a research engineer, a mechanic or scientist in any walk of life, then fine. Lose a budding scientist to media studies? That would be a shame.

Education by stealth

A new hi-tech Media Centre will open in October 2007, coinciding with the 50th anniversary of the Sputnik mission in 1957. Development of this facility coincides with new education programme development for a 14-19 year old audience for the first time, complementing the established programmes delivered to 8-14 year olds.

The beauty of a science centre is that the teaching is done not in a classroom but in a themed environment in which the child is invited to become immersed in a workshop or in role play that doesn't feel like school at all. The question, "what have you learned today?" does not receive an immediate answer, but is met with a deluge once the penny drops that saving a space mission from certain disaster involved maths, chemistry and physics as well as teamwork and communication skills that might not have come previously to the surface. Charles Clarke visited whilst Secretary of State for Education and asked a tiny young girl in Mission Control if he could borrow her headset to congratulate her astronaut class mates, orbiting Earth in their space station, on surviving a radiation leak. "No", she said firmly, "that's my job".

New developments will strengthen the National Space Centre's role as a support service for formal education. A day's visit is proven beneficial (two studies by the University of Leicester's School of Education give the facts) but an extended relationship, in the format of longer term study support or a Space School for children showing a spark of interest, will be more so. A 2007 study by Leicester City Council demonstrates quantitatively that children doing space-related study support for a term show a greater improvement in attainment than a control group that don't.

Should the National Space Centre prove capable of influencing children's choice of course and career options, and helping increase uptake of science and engineering in formal education and on apprenticeship schemes, then its worth as a centre of excellence for the use of space in science education can be proved. Funding from the Particle Physics & Astronomy Research Council and East Midlands Development Agency covers early development costs. About £225,000 per annum is needed from 2008 onward to continue programme development and delivery thereafter.

The Future of UK Space

We await the Science & Technology Committee's report on UK Space Policy with great interest. The review comes at a time when NASA is talking of a Moonbase and a manned mission to Mars; when the Chinese, Indian and Russian space agencies continue to break new ground and when Europe is leading the world in the development of Galileo: a Global Navigation Satellite System that will out-perform GPS by a significant margin. The UK has fingers in many of these pies and continues to contribute its enormous intellect across many disciplines. It is driven by an industry that contributes over £4.8bn to the UK economy and employs over 16,000 highly skilled people (2004/5 figures).

The East Midlands is capable of leading the way in exploiting these exciting developments for the benefit of education and the promotion of science in society. The University of Nottingham is the leading research centre in the UK for advanced applications of GPS technology and a major player in Galileo. The University of Leicester has internationally recognised programmes in space science, earth observation and planetary science. Together with local industry partners such as Infoterra and the regional Science Learning Centre, the National Space Centre is at the heart of a cluster of science education capabilities and a powerful resource for providing space in science education for the scientists, engineers, technologists and science-trained managers of the future.

Too hot NOT to handle: Time for a reappraisal of geothermal energy in the UK?

Paul L Younger
HSBC Professor of Energy & Environment, Newcastle University
Science Theme Leader: Energy & Environment, Newcastle Science City

Not quite Hawaii but …

There's an old Gaelic proverb which runs:
Is suarach uisge teth a' suireach fo chloich fhuar
ie "It's daft to look for hot water beneath a cold stone"

This might strike most people as common sense. But ask any ex-miner, they'll tell you that the deeper you go, the warmer it gets: there is indeed hot water to be found beneath cold stones! The natural increase in temperature with depth is called the "geothermal gradient". While it's spectacularly high in volcanic districts and in certain active earthquake zones (frictional heat takes a long time to dissipate) it's still significant in geologically calm areas such as the UK. Even in the coolest parts of the Earth's crust in the UK, we'd still expect a 1ºC rise for every 50m depth. Much steeper geothermal gradients are found in places underlain by certain types of granite, which spontaneously produce heat by natural (and largely harmless) radioactive decay: in such areas, a 1°C rise might occur every 25m, or occasionally in only 15m. With such a steep geothermal gradient, boreholes drilled to depths which the oil industry would find trivial (eg ~ 2 km) have the potential to encounter very hot water: so hot it could not only be used for space heating, but also to drive electrical power generators.

Heard it all before?

It has long been realised that these so-called "radiothermal granites" in the UK might well host significant geothermal resources. Experiments were undertaken in the 1970s, with only limited success, at a time when the key concerns of the Government were electricity prices and security of supply: carbon emissions were not yet on the radar screen. Now that we know that as much as 30% of CO_2 emissions are derived from gas boilers in domestic, public and commercial premises, it behoves us to re-evaluate our geothermal resources with possible space heating applications in mind. The very positive experience of the Southampton Geothermal Heating Company over the last two decades, which has successfully exploited some 1.7MW of thermal waters from a sedimentary basin, underlines this point. Furthermore, the earlier studies assumed granite to be essentially impermeable, and test boreholes were accordingly drilled far from known faults and mineral veins. A recent re-evaluation of the chemistry of mine waters encountered in the late 1980s in fluorspar workings in the North Pennines suggested that regional-scale fractures might in fact be transmitting brines from deep within the granite: something they could only do if they were permeable. The case for a scientific re-appraisal was also becoming unassailable.

Warm water from almost 1,000m underground gushes up the borehole at a rate of 400 litres per minute into a tank, during geothermal exploration.

Unlocking potential: the Eastgate experience

Thus it was that the UK's first deep geothermal exploration borehole in 20 years came to be drilled in late 2004, and further tested in 2006. As part of a major redevelopment project on the site of a former cement works in rural County Durham, the Wear Valley Task Force obtained funding from the Regional Development Agency (One NorthEast) to sink a borehole to almost 1000m, cutting more than 720m of the Weardale Granite – one of the promising "radiothermal granites" of the UK, which is nowhere exposed at surface and which had hitherto been entered by only one previous borehole. A technical team was formed comprising scientists and engineers from Newcastle University and leading consultants PB Power. In designing this borehole, we

deliberately targeted a major fracture system associated with an ancient hydrothermal structure, the "Slitt Vein". The outcome was striking: not only did we find a very high geothermal gradient (almost twice as high as the national average) but we also proved the highest values of permeability ever found in granite anywhere in the world. The evidence suggests that a sufficient abundance of water hot enough to drive electrical power generation could be tapped by drilling further. In the mean time, plans are already well advanced to exploit the abundant warm water at this site forthwith for space heating and use in an indoor spa development. The "hot rocks project", as locals have dubbed it, has become the flagship for the entire redevelopment, which promises a wealth of new, sustainable economic activity where once the CO_2-emitting stacks of the cement works stood.

Science City: transforming tomorrow

The Eastgate project exemplifies how unexpected economic benefits can arise from cross-fertilisation between scientists, local government, RDAs and the private sector. This is precisely the type of outcome envisaged in the "Science Cities" initiative announced by the Chancellor of the Exchequer in 2004. Building swiftly on the Eastgate experience, a diverse portfolio of activities related to energy and the environment is now being actively developed within the Newcastle Science City initiative. "Clean Energy from the Geosphere" is one major strand; energy biosciences, fuel cells, photovoltaics of tomorrow and carbon neutral culture are others. This rich portfolio has drawn together the expertise and resources of the Universities of Newcastle, Durham and Northumbria, together with those of the New and Renewable Energy Centre (NaREC) in Northumberland, and the Centre for Process Innovation (CPI) in the Tees Valley. A robust and lively North East low-carbon energy cluster is the result, collaborating enthusiastically and bidding confidently to play a major role in emerging national initiatives such as the Energy Technologies Institute.

Clean energy from the geosphere: more than just granite

The radiothermal granites of the UK are widespread: Cornwall, Devon, the North Pennines, the Lake District, the Cairngorms, Aberdeenshire and the Mountains of Mourne. But what if you live outside these areas? Despair not: geothermal heat pump technology (GHP) offers the benefits of low-carbon heating and cooling in almost any location, simply by harvesting solar heat which is stored in the shallow subsurface. The demand for GHP is rocketing, but so fast that existing companies cannot keep up with demand. The skills a GHP fitter needs lie in mechanical, electrical and geological engineering: these are the very skills now lying dormant in the former mining areas of the UK, such as Easington District in Co Durham, which is one of the UK's worst "worklessness" blackspots. Easington District Council and Newcastle University are jointly championing an initiative within Newcastle Science City to establish the "GREAT Institute" (Geothermal Research Education and Training) to redeploy dormant skills in the service of this sunrise industry nationally, to the benefit of the local employment market. Looking still further ahead, Science City is also exploring the possibility of coupling carbon capture and storage to underground coal gasification, and deploying new biotechnologies for extracting clean energy from heavy oils and otherwise unusable high-sulphur coals.

Drilling the borehole into the Weardale granite in County Durham

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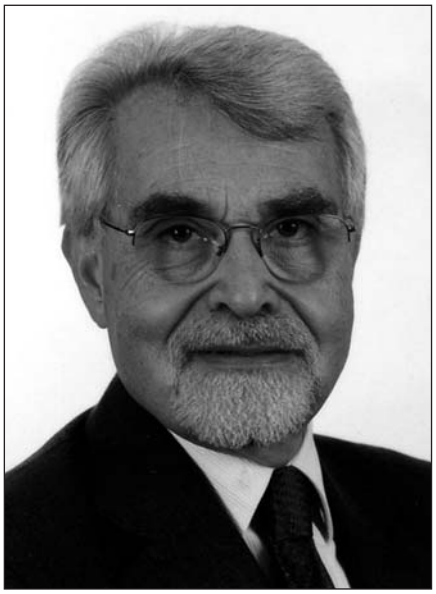
Institute for Research on Environment and Sustainability (IRES) at Newcastle University: http://www.ncl.ac.uk/environment/

Newcastle University

Newcastle Science City TRANSFORMING TOMORROW

Business sense from universities

Professor Mike Spyer
Vice-Provost (Enterprise), UCL



Introduction

UCL is London's research powerhouse, with more than 3,500 academic and research staff in its science, technology, engineering and biomedical departments. In the most recent Research Assessment Exercise, 40 of our departments in these fields were rated '5', '5*' and 'best 5*'.

Our academics focus on the translation of research into solutions to the world's major problems. To help them do so, in 2006 UCL reconfigured UCL Business PLC (UCLB), its wholly owned subsidiary, which now consolidates and integrates our previous technology- and knowledge-transfer activities.

UCLB exemplifies how universities can harness exceptional research for positive social and economic benefit, bringing groundbreaking science and technologies to the people who need them.

UCL Business PLC

UCLB seamlessly covers the complete commercialisation process, from invention disclosure and patent registration through to the drafting of licences, support for the creation of new businesses, and negotiation on sales of technologies and licences to industry partners.

Subject-specialist staff at UCLB focus on specific client and sector needs, while being able to offer the whole spectrum of our university's business services. They have access to substantial investment funds and a large infrastructure of management, staff and advisors, further supported by an established pool of experts in intellectual property and corporate law, as well as commercial advisors and consultants.

A few examples will reflect the effectiveness and varied nature of the UCLB model.

• Incubation

UCLB supports and encourages the incubation of new businesses through the provision of support personnel and modern office facilities in close proximity to our university, ensuring the strong academic or clinical linkage that was the original source of the invention.

UCLB both owns and manages these facilities, in order that the embryonic company can focus its energies on exploiting the technological discovery and commence commercial operations without delay.

• Taking ideas to market

UCLB and its predecessors have launched in excess of 50 spin-out companies, transferring innovative research initiated at UCL into the commercial sector.

Ark Therapeutics, for example, has a broad range of treatments for vascular disease and cancer in late stage clinical development. Ark successfully floated on the London Stock Exchange in 2004.

Arrow Therapeutics focuses on the research and development of novel antiviral drugs. The company has developed a broad pipeline of projects at various stages between early research and clinical development. This led to it being acquired by AstraZeneca for circa $150 million.

SensorNet Works, a spin-out from UCL Electronic & Electrical Engineering, is set to commercialise an innovative approach to the problem of monitoring distributed industrial environments such as railway infrastructures and underground mines. By utilising a number of small, intelligent devices that communicate through meshed radio networks, the company is able to offer an autonomous monitoring solution that is easy for non-experts to install, maintain and use, with Network Rail among its early customers.

Medic to Medic, with its Map of Medicine, is now available for rollout across 85% of the NHS in England and is working closely with NHS Connecting for Health. Separately, NHS Wales and the Nuffield Hospitals and a number of users across the world are already benefiting from the use of the Map, which provides best practice for the complete patient journey from diagnosis to discharge.

• Consultancy

Through UCL Consultants Ltd, UCL Business PLC provides clients – including governments, global corporations, public bodies, and small- and medium-sized enterprises – with direct links to academic staff across our university.

UCL's breadth of expertise allows for consultancy in areas as diverse as: analytical and testing services; expert witnesses for litigation and patent infringement; instrumentation design, prototype design and testing; computer modelling; clinical and drug evaluations; risk assessment; and novel applications for communication and language.

The application of new technologies to the arts and humanities sector includes, for example, authentication technology for the identification of pigments in paintings, drawings and maps. Raman spectroscopy expertise in UCL Chemistry and UCL History of Art was used to authenticate the pigments in 'Young Woman Seated at the Virginals', by Johannes Vermeer. The painting was subsequently sold at Sotheby's for more than £16 million.

• Licensing

Licensing through UCLB puts novel techniques in the hands of practitioners.

Advanced Design Technology, established in 1998 as a joint venture with Ebara Corporation of Japan, commercialises turbo design software developed by Professor Mehrdad Zangeneh at UCL. The company's products, which are based on intellectual property licences from UCL, help not only to shorten development time for turbo-machinery but will also improve the performance of turbo-machinery components.

Building on breakthrough technology licensed from UCL, Space Syntax has developed revolutionary practical user-testing of buildings and public spaces while they are still on the drawing board, allowing architects and planners to solve problems before they arise. UCLB recently negotiated an exclusive licence to allow proposed designs to be interrogated by millions of 'virtual agents', who can be set specific tasks to complete. By monitoring agents performing individual tasks, virtually any usage scenario can be tested

• Clinical trials facilities

UCLB arranges specialist academic clinical research and commercial clinical trials in a variety of facilities.

The new Stanmore Clinical Research Facility is a partnership between UCLB and the Royal National Orthopaedic Hospital (RNOH). Its specialist imaging system can detect when implants such as hip and knee replacements are loosening, long before the patient starts to notice a deterioration in function. The facility is also equipped to measure bone mineral density and 3D structural parameters non-invasively.

UCL Advanced Diagnostics Ltd has one of the largest collections of antibodies for use on tissue sections, allowing pathologists and pathology laboratories to augment their own immunocytochemical analyses.

The UCL Analgesia Centre Ltd focuses on the organisation and management of clinical trials in different acute and chronic pain indications such as neuropathic pain, osteoarthritis, fibromyalgia and lower back pain.

• Entrepreneurial culture

UCLB, in association with UCL Centre for Enterprise & the Management of Innovation (UCL CEMI), helps to infuse the research culture of UCL with entrepreneurial perspectives.

The UCL Business Award was established to reward entrepreneurial achievement. Three UCL scientists recently won the inaugural award for their work in developing Simulect®, which acts to prevent the rejection of organs following transplantation, drawing on the researchers' work on therapeutic monoclonal antibodies. Simulect® has been used to treat over 150,000 patients worldwide.

Along with the Centre for Scientific Enterprise (CSEL) and UCL CEMI, UCLB also contributes to the annual London Entrepreneurs' Challenge, which aims to encourage the next generation of entrepreneurs at UCL and the London Business School by helping students and staff to think about how their ideas can be applied commercially and demonstrating the basic concepts needed to communicate a new business idea.

• Partnering

UCLB initiated and led the negotiations with Arius3D to bring to UCL the latest generation Arius3D colour laser scanner, worth £500,000 and the first of its kind in Europe. The new scanner's applications will serve a range of sectors, including – but not limited to – heritage, engineering, medicine, dentistry, anthropology, archaeology, art and architecture. It is creating opportunities for the university's researchers and conservators, as well as other institutions, such as the British Museum, the Victoria & Albert Museum, the Museum of London and the National Trust, to scan collections in 3D and to make them accessible for all to see over the internet.

UCLB and the RNOH have recently agreed heads of terms to initiate a collaboration with Sewon Cellontech of South Korea to develop new laboratories to undertake therapeutic treatments for cartilage repair and bone fracture healing. The treatments are expected to use stem cells derived from the patient's own bone marrow and cartilage tissue, with the potential to alleviate the need for radical surgery.

Space Syntax worked with architects Foster and Partners to transform Trafalgar Square

If you would like to know more about how UCL translates its excellent research into applicable solutions, please see the UCLB website (www.uclb.com) or the UCL website (www.ucl.ac.uk).

CONFLICTS OF INTEREST – DOES MONEY INFLUENCE SCIENTIFIC PUBLICATION?

MEETING OF THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE ON MONDAY 15TH JANUARY

Richard Smith
Chief Executive, United Health Europe

Conflict of interest in medical research: an introduction

Members of Parliament have long been concerned about conflicts of interest and must register their interests each year. If they fail to declare a relevant conflict of interest then opprobrium will follow. This has not until recently been the case with science. Scientists have perhaps thought that they were immune to conflicts of interest because science is objective. But science is full of judgements that are subjective, and science is undertaken not by machines but by human beings – and those beings are heir to the same weaknesses as all other humans. Increasingly we understand how conflict of interest does matter in science, and science is in the process of improving its processes for managing conflict of interest.

The perspective that follows is that of the editor of a medical journal. I worked for the BMJ (formerly the British Medical Journal) for 25 years and was the editor from 1991 to 2004. During that time there were many intense debates over conflict of interest, and I was involved in researching the subject. I have written on the subject in the BMJ,[1 2] a book on medical journals[3], and the forthcoming Principles of Health Care Ethics.

An illustration of how conflict of interest matters

Although most of those in business and politics do not need convincing that conflicts of interest matter, those in science do – and so I want to begin with an example. In the past 10 years there has been an intense debate about whether newer (third generation) contraceptive pills increase a woman's chance of developing thromboembolic disease (clots in the legs or lungs). This clearly matters to women and their doctors because clots in the lungs can kill. It also matters a great deal to the drug companies who manufactured the pills because they have invested tens, even hundreds, of millions of pounds in developing the drugs: if regulatory authorities were to ban the drugs or doctors advise patients against taking them then the business consequences would be severe – even forcing some companies out of business.

By the end of 1998 there were six studies of the question[4]. All of the three studies funded with public money found that the new contraceptive pills did increase the risk of thromboembolic disease, whereas the three funded by industry did not. In other words, there was a complete dichotomy. By 2000 there were nine publicly funded studies of which eight found an increased risk[4]. In contrast, three sponsored studies found no increased risk, and the one study that did find an increased risk was repeatedly reanalysed giving ever lower risks.

Conflict of interest has completely clouded this problem that is of great importance to women, doctors, drug companies, and health authorities.

What is conflict of interest?

Conflict of interest has been defined as "a set of conditions in which professional judgement concerning a primary interest (such as patients' welfare or the validity of research) tends to be unduly influenced by a secondary interest (such as financial gain)[5]." It is important to understand that it is a condition not a behaviour. It often operates unconsciously, and there is substantial and growing evidence of its influence on how doctors prescribe and treat patients, what research is undertaken, and how research is interpreted[3]. Conflicts may arise from many causes – academic, political, or religious, for example – but the best studied conflicts are financial. Science journals tend to concentrate on financial conflicts of interest, and in medicine the commonest source of financial is interaction with the pharmaceutical industry.

How common are conflicts of interest?

A quarter of medical researchers in the United States have received funding from pharmaceutical companies and half have received "research related gifts[6]." An analysis of 789 articles from major medical journals found that a third of lead authors had financial interests in their research – patents, shares, or payments for working on advisory boards or as a director. An important early study of conflicts of interest published in the New England Journal of Medicine in 1998 tracked

down 69 of 89 authors of 75 pieces in medical journals on new drugs for high blood pressure and found that 45 (63%) had financial conflicts of interest[7]. In other words, we have good evidence that most authors in medical journals have conflicts of interest.

Yet only two of the articles studied in the New England Journal of Medicine paper disclosed the conflicts of interest of the authors[7]. A study that I undertook with a medical student looked at 3642 articles in the five leading general medical jourtnals (Annals of Internal Medicine, BMJ, Lancet, JAMA, and the New England Journal of Medicine) and found that only 52 (1.4%) declared authors' conflicts of interest[8]. The proportion in those journals is now much higher – because the journals require authors to declare conflicts of interest and will report whatever the authors declare, making the authors vulnerable if they do in fact have conflicts of interest but have not declared them.

At the BMJ we began to ask authors to declare conflicts of interest in the late 90s, but they mostly didn't – until we asked very specific questions about reimbursement for attending a meeting, a fee for speaking, a fee for organising education, funds for research, funds for a member of staff, or fees for consulting. At the same time we changed our terminology from "conflict of interest" to "competing interest". For whatever reason the numbers declaring competing interests increased.

Further evidence that conflicts of interest matter

An important study published in the Archives of Internal Medicine in 1994 found that among 69 randomised trials of non-steroidal anti-inflammatory drugs (which are used commonly to treat arthritis) sponsored by the manufacturers of the drugs in not a single trial was the drug being investigated (the sponsor's drug) worse than the comparative treatment[9]. In three quarters of the studies the sponsor's drug was better and in the other quarter of cases the same.

There have now been many studies comparing the outcomes of studies sponsored by industry and those not sponsored, and a review of 11 such studies found that sponsored studies were always more likely to have results favourable to the sponsor[10]. Overall the quality of the sponsored trials was higher. So sponsors are not getting favourable results by fiddling the results. Rather they are clever about the questions they ask and the design of the studies. They may compare their drug with placebo, conduct a comparison trial that will be too small to show an advantage to one treatment, or test their drug against a low dose of the comparison drug. It may also be that the companies are more likely to publish the positive results.

All of this matters greatly because two thirds of the randomised trials published in the major general medical journals are sponsored by the pharmaceutical industry[11]. I've argued elsewhere that in some ways medical journals have become the extension of the marketing arm of pharmaceutical companies[12].

Randomised trials are seen as one of the most important scientific designs for working out whether treatments work, but systematic reviews are as important – and maybe more important. A study of 71 systematic reviews of drugs for treating blood pressure did not find any difference between sponsored and unsponsored reviews in the results of the reviews, but 91% of the conclusions of sponsored reviews were positive and none negative compared with 72% that were positive and 8% negative in unsponsored reviews[13].

Another study compared 24 meta-analyses conducted by the Cochrane Collaboration (a worldwide not for profit collaboration) with 24 meta-analyses of the same two drugs in the same disease, eight of which were supported by industry[14]. The Cochrane reviews were of higher quality, and seven of the reviews sponsored by industry had conclusions recommending the experimental drug (the sponsor's drug) without reservation compared with none of the matched Cochrane reviews – even though the effect of the treatment was the same.

Evidence of the effects of conflicts of interest comes as well from studies other than drug studies. A study published in JAMA in 1998 investigated why of 106 reviews of passive smoking 37% concluded that it was harmful and the rest that it wasn't[15]. The authors thought that the most likely explanation was the quality of the article. They investigated article quality, the year of publication, whether the articles were peer reviewed or not, and the article topic and found that the only factor associated with the review's conclusion was whether the author was affiliated with the tobacco industry. The authors of the study had used a database to find out which authors were affiliated with the industry, but only 23% of the reviews disclosed the sources of funding for the research.

A very recent study looked at 206 studies of milk and soft drinks in which 111 declared financial sponsorship (22% all industry funding, 47% no industry funding, and 32% mixed funding)[16]. Studies funded by industry were seven times more likely to come up with results favourable to the sponsor than studies with no industry funding.

Most of the studies I've quoted on how conflict of interest affects the results of scientific studies have been completed in the past 10 years, but we now have overwhelming evidence of the influence of conflict of interest.

Conflict of interest and journals

Editors of journals have been prominent in exposing and responding to conflicts of interest, but the journals have their own conflicts. Many publish supplements sponsored by the pharmaceutical industry. These supplements are often highly profitable for the publishers, but studies have shown that the quality of such supplements are lower quality than the journals themselves[17 18]. Many journals also depend heavily on income from pharmaceutical advertising, and some sell advertising space off the back of the research they are publishing and will place advertisements beside articles.

But the biggest conflicts of interest for journals arise from "reprints," copies of articles that they publish that are sometimes purchased in huge numbers by pharmaceutical companies. The companies then give the articles to their sales representatives to use in selling their drugs. The reprints are rarely read, but the company can in effect use the brand of the journal to sell their drugs. Companies may buy more than a million dollars' worth of reprints, and the profit margin is high – meaning that publishers may make $700,000 profit on one sale. Increasingly editors have to meet financial targets, and – in stark terms – the choice could be publish the one study or make five editors redundant. Editors will deny that they are influenced by the financial incentive, but they know which articles will attract such sales (not least because they are usually funded by the company that will buy the reprints) – and, as I've said, conflict of interest operates subconsciously.

Responding to conflict of interest

John Bailar, professor of statistics in Chicago, has famously said that "Disclosure is almost a panacea," and disclosure is the main way that most journals try to manage conflict of interest. Increasingly journals disclose the conflicts of interest of authors, but it's a minority that disclose the conflicts of interest of peer reviewers (not least because they are usually anonymous), editors, editorial boards, management committees, and owners[19]. Even when conflicts of interest are disclosed it's rare to give the amounts of money involved – even though most of us would think that the scale of the conflict is likely to influence the impact of the conflict.

Clearly disclosure alone will sometimes not be enough – for example, no journal would have an editorial on a new drug written by an employee of the manufacturer. But where is the point when the degree of conflict is unsupportable? Most journals have made no attempt to define that point.

The effect of conflict of interest on studies of drugs is particularly worrying, and various proposals have been made to try and respond. The Lancet, for example, reviews protocols of trials and then if the protocol of the trials is approved commits to publishing the results of the trial – in an attempt to avoid bias against trials that have negative results. Ian Roberts and I have argued that trial results should not be published in journals but rather with a full dataset on the web[20].

But there are increasing arguments on both sides of the Atlantic that drug trials should be funded with public money rather than by the companies themselves when they have a very clear conflict of interest.

Conclusions

Conflict of interest is common in medical research and has strong influences on the outcomes and conclusions of that research. Yet our response so far is inadequate. More needs to be done to counter the conflicts of interest, particularly the conflicts of the pharmaceutical industry.

REFERENCES

1 Smith R. Conflict of interest and the BMJ. BMJ 1994; 308: 4.

2 Smith R. Beyond conflict of interest. BMJ 1998; 317: 291 – 2.

3 Smith R. Conflicts of interest: how money clouds objectivity. In: Smith R. The trouble with medical journals. London: RSM Press, 2006.

4 Vandenbroucke JP. Competing interests and controversy about third generation oral contraceptives. BMJ 2000; 320: 381.

5 Thompson DF. Understanding financial conflicts of interest. N Engl J Med 1993; 329: 573-6.

6 Bekelman JE, Li Y, Gross CP. Scope and impact of financial conflicts of interest in biomedical research. A systematic review. JAMA 2003; 289: 454-65.

7 Stelfox HT, Chua G, O'Rourke K, Detsky AS. Conflict of interest in the debate over calcium channel antagonists. N Engl J Med 1998; 338: 101-5.

8 Hussain A, Smith R. Declaring financial competing interests: survey of five general medical journals. BMJ 2001;323:263-4.

9 Rochon PA, Gurwitz JH, Simms RW, Fortin PR, Felson DT, Minaker KL, et al. A study of manufacturer supported trials of non-steroidal anti-inflammatory drugs in the treatment of arthritis. Arch Intern Med 1994; 154: 157-63.

10 Lexchin J, Bero LA, Djulbegovic B, Clark O. Pharmaceutical industry sponsorship and research outcome and quality: systematic review. BMJ 2003; 326: 1167-70.

11 Egger M, Bartlett C, Juni P. Are randomised controlled trials in the BMJ different? BMJ 2001; 323: 1253.

12 Smith R. Medical Journals Are an Extension of the Marketing Arm of Pharmaceutical Companies. PLoS Med 2005; 2(5): e138

13 Yank V, Rennie D, Bero LA. Are Authors' Financial Ties With Pharmaceutical Companies Associated With Positive Results or Conclusions in Meta-analyses on Antihypertensive Medications? Abstract presented at fifth international congress on peer review and biomedical publication, Chicago, 2005. http://www.ama-assn.org/public/peer/abstracts.html#meta

14 Jørgensen AW, Hilden J, Gøtzsche PC. Cochrane reviews compared with industry supported meta-analyses and other meta-analyses of the same drugs: systematic review. BMJ 2006;333:782, doi:10.1136/bmj.38973.444699.0B

15 Barnes DE, Bero LA. Why review articles on the health effects of passive smoking reach different conclusions. JAMA 1998; 279: 1566-70.

16 Lesser LI, Ebbeling CB, Goozner M, Wypij D, Ludwig DS. Relationship between Funding Source and Conclusion among Nutrition-Related Scientific Articles PLoS Medicine 2006; 4. e5 doi:10.1371/journal.pmed.0040005

17 Rochon PA, Gurwitz JH, Cheung M, Hayes JA, Chalmers TC. Evaluating the quality of articles published in journal supplements compared with the quality of those published in the parent journal. JAMA 1994;272: 108-13.

18 Cho MK, Bero LA. The quality of drug studies published in symposium proceedings. Ann Intern Med 1996;124: 485-9.

19 Haivas I, Schroter S, Waechter F, Smith R. Editors' declaration of their own conflicts of interest. CMAJ 2004; 171 (5). doi:10.1503/cmaj.1031982.

20 Smith R. Roberts I. Patient safety requires a new way to publish clinical trials. PloS Clinical Trials 2006; 1: 1.

When does clinical science cease to exist?

Sir Iain Chalmers
Editor, James Lind Library

Why are conflicts of interest in clinical science worth bothering about?

In 2004, a former editor of the highly regarded *New England Journal of Medicine*, Jerome Kassirer, published a book for the public entitled *On the take: how medicine's complicity with big business can endanger your health.* From his vantage point at the heart of the medical establishment, Kassirer felt that the time had come to speak publicly about conflicts of interests within clinical science.

These conflicts are worth bothering about because they are associated with biased design and reporting of research. A comparison of information in confidential pre-licensing records of new drugs in Sweden and Finland with information reported publicly in medical journals showed that studies in which researchers had looked for adverse effects were less likely to be published. A similar study of recently introduced drugs concluded that any attempt to develop treatment recommendations using analyses based only on publicly available data was likely to be biased. These two studies are not exceptional: there is now substantial evidence showing associations between industry-sponsorship and research results favouring products made by the companies funding the research.[1] These observed associations sometimes also reflect comparisons of new treatments with existing treatments which are given either in doses too low to be effective, or in doses higher than necessary, with consequent higher incidence of adverse effects than with the new drugs.

Marcia Angell, another former editor of the *New England Journal of Medicine,* discusses these disturbing features of modern clinical research in her 2004 book entitled *The truth about the drug companies: how they deceive us and what to do about it.*

Why is biased design and reporting of clinical science important?

Biased design and reporting of biomedical science is important because it can result in avoidable suffering and death. In 1993, for example, Cowley and his colleagues published a study that had been completed thirteen years previously:

"… When we carried out our study in 1980 we thought that the increased death rate that occurred in the (anti-arrhythmic drug) group was an effect of chance…The development of (the drug) was abandoned for commercial reasons, and this study was therefore never published; it is now a good example of 'publication bias'. The results described here … might have provided an early warning of trouble ahead." [2]

The 'trouble ahead' was a major medical disaster: at the peak of their use in the late 1980s, anti-arrhythmic drugs were causing – every year – comparable numbers of deaths to the total number of Americans who died in the Vietnam war. [3]

When does clinical science cease to exist?

Most research evaluating the effects of medical treatments is sponsored by companies that have an interest in selling treatments. Jan Vandenbroucke has spelled out the consequences of this kind of research having received so little independent support, from public and charitable sources for example. [4]

"In all scientific debates all sides always have their own biases: we have no other way to look at data but to interpret them. However, in usual clinical or epidemiologic research, studies are repeated by others, in different settings and by different means, looking for biases, flaws, and ways of remedying them, endlessly arguing whether the biases are remedied or not. That is the essence of open scientific debate and criticism. That is no longer possible with pharmaceutical products because of the monopoly of the pharmaceutical industry of studies of its own products. This leads to persistently one-sided studies that can no longer be questioned by studies from other sides. Moreover, the one-sidedness cannot be seen from the public record, that is the published papers. Without the possibility of open debate, science simply ceases to exist."

An Italian initiative is addressing this unsatisfactory state of affairs. The Agenzia Italiana per il Farmaco is the first European drug regulatory agency to fund independent clinical research on proprietary and unregistered drugs. Italian legislation now requires pharmaceutical companies to contribute 5% of promotion costs to fund this research. In March 2006, €35m were used to commission 54 clinical research projects evaluating orphan drugs, head to head comparisons of drugs, and for pharmacoviligance (http://tinyurl.com/yfph5l).

What can be done to reduce the adverse effects of conflicts of interest in clinical science?

In an article published last year I reviewed relevant developments over the previous decade. [5] During the

mid-1990s, some individuals working within the pharmaceutical industry recognised that the situation outlined above is indefensible, ethically as well as scientifically. The ethics committee of the Faculty of Pharmaceutical Medicine, for example, stated that:

"Pharmaceutical physicians…have a particular ethical responsibility to ensure that the evidence on which doctors should make their prescribing decisions is freely available….the outcome of all clinical trials on a medicine should be reported."

Schering Health Care and GlaxoWellcome endorsed this view, introduced disclosure policies, and published information about their clinical trials programmes. However, the subsequent efforts of the Association of the British Pharmaceutical Industry to persuade other companies to follow GlaxoWellcome's lead met with very limited success. The situation changed when the attorney general of New York State charged GlaxoSmithKline with suppressing information suggesting that one of the company's products might have serious adverse effects. As other examples of suppressed evidence began to emerge, the public became increasingly conscious of the impact of conflicts of interest in clinical science.

What has Parliament done to reduce conflicts of interest in clinical science?

The growing public awareness that all was not well was reflected in the decision of the Health Committee of the House of Commons in 2004 to examine the influence of the pharmaceutical industry. The Committee's investigation and report were wide ranging. Among other problems, they drew attention to the problem of publication bias.

"If pharmaceutical companies only publish clinical research that is positive and hold back on publishing clinical research which is negative, then patients may well be given treatments which, unknown to either the patient or the doctor, are likely to do more harm than good."

The Committee introduced its recommendations by quoting Sir Richard Sykes, formerly chief executive of GlaxoWellcome, who had told the Committee that "Today the industry has got a very bad name", and that there had to be "some big changes." The Committee noted that "the situation would be much improved by more transparency". Specifically, it called for a register of all clinical trials to be established, maintained by an independent body; and that "the results of all clinical trials data, containing full trials information, be put on the register at launch as a condition of the marketing licence."

Although declaring its shared commitment to "transparency and accountability relating to registration of clinical trials and publication of their results", the Government rejected the Committee's call for an independently maintained register. Instead, it referred to a number of other initiatives which, it claimed, "will soon make comprehensive information about the safety and effectiveness of medicines much more easily accessible."

Comprehensive information about the safety and effectiveness of medicines remains far from easily accessible, and information about ongoing clinical research remains extremely limited. Several years ago I proposed a 'patient-led good controlled trials guide', suggesting that "Researchers and research sponsors will need to realise that one of the preconditions for consumer endorsement of and partnership in their trials is likely to be that protocols and other trial documents should be made public". [6] More recently, in a book for the public, which I co-authored with a medical journalist and a breast cancer patient, [7] our advice to our readers was very explicit:

"Agree to participate in a clinical trial only on condition (i) that the study protocol has been registered publicly on www.controlled-trials.com; (ii) that the protocol refers to the systematic reviews of existing evidence showing that the trial is justified; and (iii) that you receive a written assurance that the full study results will be published, and sent to all participants who indicate that they wish to receive them."

What should parliamentarians do to reduce conflicts of interest in clinical science?

Conflicts of interest are associated with biased reporting of research, and biased reporting of clinical research can result in avoidable suffering and death. These facts have already been acknowledged by British parliamentarians, who have proposed ways of dealing with them. However, further action is required to protect the interests of patients and the public by building on the Health Committee's recommendations. Here are three suggestions:

(i) support the Health Committee's call for "greater transparency" and continue to press for a "register of all clinical trials…maintained by an independent body."

(ii) hold the Government to its 2005 assurance that its initiatives "will soon make comprehensive information about the safety and effectiveness of medicines much more easily accessible."

(iii) promote increased public and charity support for designing, conducting and reporting clinical research of relevance to patients and the NHS, and free from conflicts of interest.

REFERENCES

1 Hemminki E (1980). Study of information submitted by drug companies to licensing authorities. BMJ 280:833-6; Djulbegovic B, Lacevic M, Cantor A, Fields KK, Bennett CL, Adams JR, Kuderer NM, Lyman GH (2000). The uncertainty principle and industry-sponsored research. Lancet 356:635-638; Melander H, Ahlqvist-Rastad J, Meijer G, Beermann B (2003). Evidence b(i)ased medicine - selective reporting from studies sponsored by pharmaceutical industry: review of studies in new drug applications. BMJ 326:1171-3; Lexchin J, Bero LA, Djulbegovic B, Clark O (2003). Pharmaceutical industry sponsorship and research outcome and quality: systematic review. BMJ 326:1167-70; Bhandari M, Busse JW, Jackowski D, Montori VM, Schünemann H, Sprague S, Mears D, Schemitsch EH, Heels-Ansdell D, Devereaux PJ (2004). Association between industry funding and statistically significant pro-industry findings in medical and surgical randomized trials. CMAJ 170:477-480; Lesser LI, Ebbeling CB, Goozner M, Wypij D, Ludwig DS (2007). Relationship between funding source and conclusion among nutrition-related scientific articles. PLoS Medicine 4: e5 doi:10.1371/journal.pmed.0040005.

2 Cowley AJ, Skene A, Stainer K, Hampton JR (1993). The effect of lorcainide on arrhythmias and survival in patients with acute myocardial infarction: an example of publication bias. International Journal of Cardiology 40:161-166.

3 Moore T (1995). Deadly Medicine. New York: Simon and Schuster.

4 Vandenbroucke JP (2005). Without new rules for industry-sponsored research, science will cease to exist. Rapid response on bmj.com, posted 14 December, available at http://bmj.bmjjournals.com/cgi/eletters/331/7529/1350.

5 Chalmers I (2006). From optimism to disillusion about commitment to transparency in the medico-industrial complex. Journal of the Royal Society of Medicine 99:337-341.

6 Chalmers I (2000). A patient-led good controlled trials guide. Lancet 356:774.

7 Evans I, Thornton H, Chalmers I (2006). Testing treatments: better research for better healthcare. London: British Library.

Publish and be damned…

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When the big pharmaceutical companies overstep themselves in published claims of safety and efficacy of the medicines that they sell, the media and the public shout loudly. Attracting criticism and judicial disapproval through a string of disputes, especially involving state court actions in the USA, hangs the dirty laundry of the marketing departments out to dry and tarnishes reputations. The tightrope of worthiness is apparently, very easy to fall from. A healthcare company proudly boasts the ethic of serving the patient first, whilst the unstated duty as a properly structured organisation must be to employees and shareholders. More than most, the companies are seen to engage in activities which bring them little public sympathy: the use of animals in research, making a profit from illness and finally over-promoting the benefits of very expensive medicines against cheaper alternatives.

Conflicts of interest

The need to recognise conflicts of interest and manage them in a transparent way has exercised all disciplines of medicine. Few experts are without potential conflicts of interest since the circumstances rather than deliberate action lays the field expert open to a consideration of motive when recommending a particular therapy. It is extremely difficult to avoid and in my view, entirely undesirable to ignore those events and interactions which are sponsored by the pharmaceutical industry. Most have valid educational content and provided that the marketing component is clearly recognised and not excessive, help shape the view of an intelligent practitioner. The key is perhaps to avoid a monopolistic situation and the following unacceptable situations are well trodden:

- Failure to disclose a financial interest in a publication seeking to promote a drug or product.
- Failure to disclose ownership or being a direct beneficiary of an invention promoted in peer-reviewed literature.
- Having a high personal dependency on a single sponsor of a major research programme through institutional employment.

There is a general agreement that more transparency is necessary since the situation of potential conflicts of interest are extremely pervasive, and in the case of international experts, probably invisible beyond the state level.[1]

Research and data ownership

The forum for structured consideration of the benefits of treatments and new pharmacological agents is medical publishing. This too is big business, with organisations making significant profits from authors who often receive little financial recompense for their effort. In practice, medical researchers do not publish for the purpose of penning the next best-seller, more for recognition of their contribution and for continuing grant support of their institution. As mentioned earlier, the precarious finances of some university departments provide potential pressure points which can distort the relationship between independent researcher and employer. An independent research worker may regard the stewardship of data gathered during a contract between university and a sponsor as their own, but since the ownership is frequently transferred in the agreement to the sponsor, the worker becomes dis-enfranchised; moreover, raw data used in a meta-analysis may not be openly available. From internal and fairly soon afterwards external viewpoints, the bias and veracity of data becomes challenged and the independence of the field expert questioned.

Why don't companies publish more about their failures?

Researchers in the pharmaceutical industry rarely write papers as the work pressure demotes this activity to a tertiary objective. There is little enthusiasm to reveal thought processes as the intellectual property must be carefully considered for patent filing and the financial clampdowns restrict the attendance at scientific meetings to a fortunate few. We hear little of failures in public-access literature but obviously there must be many projects that have to be curtailed at an early stage. Those that do make it through the sieve have proved themselves in a vast battery of tests but identification as a star performer in a pivotal animal model of disease does not necessarily translate into the next blockbuster drug. In any case, disclosure of these less fruitful paths in drug discovery to a competitor makes poor business sense.

The commercial and scientific premise for initiation of a clinical trial is that the compound will be found superior because the cost of a study in the US or UK swallows up huge chunks of the project budget. It is debatable whether clinical research starts from a true null hypothesis and external critics have proposed that conditions may be selected to show the drug works well in a particular scenario to establish proof of concept. In an ideal world, the whole gamut would be tested as

early as possible, in a diverse population of patients. If that is the objective the process would have to be less bureaucratic, more effective and above all, much cheaper.

The partnership between publisher and academic

The partnership between publishing and the researcher is extremely important as the primary vehicle of peer group appraisal. In this system, publishing in medical journals is highly regarded as it will then be extensively cited, a process measured by "impact factor". It is therefore an essential component of the researcher's progression through a career, with universities holding off promotion until the required weight of published work or height of impact factor has been gained. An objective element of assessment for a lecturer or medical researcher, it is the key to international fame and recognition whereas performing as a good teacher has a more parochial radius. The ideal portfolio is mixed, with research council funding accompanied by charity and industry support indicating relevance of research to society's needs.

As the trinity of drug company, impartial and independent researcher and editor might be seen as the engine for the generation of misleading data, all three now engage in codes of practice to allow public scrutiny of motive and financial interest. In the Western World, bigger pharmaceutical companies publish the summaries of all current trials on the web and so move towards more openness. The professional organisations, specifically the ABPI for the industry and the RPSGB for the pharmacists attempt, with some degree of success, to police the industry. Up to now, it has been a steadily improving process but recently the medical treatment spectrum lurched backwards to an earlier, less certain time.

Could we judge alternative therapy by the standards imposed for allopathic medication?

The growth of public interest in alternative medical therapy has blossomed, fostered by the considerable profits in nutraceuticals and "feel good" therapy. This is not just placebo therapy as many herbal products contain oils and actives in sufficient quantities to act pharmacologically. There have been reports of adulteration of herbal products with steroids and one report quoted by Ernst suggested 24% of Taiwanese medicines are adulterated with at least one conventional pharmacological agent.[2] This leaves a confusing mix of the innocuous and the active marketed as modern panaceas as alternatives to "harmful" allopathic remedies. If we accept that evidence-led medicine is a rational progression, is there any generation of peer-reviewed literature that could be useful in the management of this new public-led enthusiasm for ancient pharmaceutical practice?

There are scholarly journals on the web which attempt to address the proof of new medical therapies. One, published by Elsevier in the Science Direct library, is entitled "Phytomedicine" and attracts "innovative and expert" findings in therapy, toxicology and formulation associated with plant-based medicine. The publishers comment that "The papers published in this journal are also useful to drug regulatory authorities in deciding whether to approve certain phytomedicines or not." This sets a public role for the journal as such decisions affect policy and individual well being. Unfortunately potential conflicts of interest, judged by the ethical considerations which we currently apply to allopathic medicines, are equally evident in a sample of papers from this journal particularly in the supplements section. Supplements are often used by publishing houses and are welcomed by young researchers as they concentrate information on a new drug or product in a single issue. They are, almost without exception, moneymakers for publishers.

A sample supplement in 2006 reviews a medicine composed of ethanolic extracts of plant materials, a preparation with a long heritage and used by patients for the treatment of gut motility disorders (Allescher, 2006).[3] The papers are an interesting mix of clinical trial, meta-analysis and some fairly highly technical analysis which attempts to look at mechanism of action. In these refereed papers, the authors are tempted to extemporise beyond the data and suggest that laboratory findings will be directly translated to a clinical effect (Schempp et al, 2006).[4] Moreover, other contributors propose that functional bowel disease may represent a suitable target for a mixture of substances with multiple targets although the claim of clinical superiority is not explicit. This is arguably a different tack to that in conventional gastroenterological research, and in my view must remain highly speculative. On at least one of these papers, authorship included representation from the sponsoring company. There were no statements of financial links disclosed in the individual publications and even if none exist, we should apply the same rules to reassure the public that there are no conflicts of interest.

Small pharmaceutical companies producing "alternative" medicine are therefore in the spotlight. The possibility of inappropriate claims in medical scientific literature and the risk that editorial advisors are less aware of issues of conflicts of interest poses a problem if healthcare policy in the United Kingdom places the two systems side-by-side. Moreover, if it is the stated editorial policy that a journal's output could be used to influence decision making in Government, then the publishers as well as the editor bear a serious responsibility to maintain appropriate standards of scientific evidence and extrapolation.

Clive G Wilson is a consultant for Allergan Inc (USA), Aspire (USA), Egalet a/s (Denmark), GSK (UK), Intec (Israel) and is working on programmes financed by Pfizer and other major pharmaceutical companies. He has no financial interest in the material discussed in this article and acknowledges the assistance of the Royal Pharmaceutical Society Great Britain and ABPI in providing background information relating to the preparation of this material. There were, unfortunately, no "ghost writers" available.

REFERENCES

1 Papanikolaou G. et al. (2001) Reporting of conflicts of interest in guidelines of preventive and therapeutic interventions. BMC Medical Research Methodology 2001, 1:1-3.

2 Ernst E. (2002) Adulteration of Chinese herbal medicines with synthetic drugs: a systematic review. J. Int. Med. 252:107-113.

3 Allescher H D. (2006). Functional dyspepsia-a multicausal disease and its therapy. Phytomedicine 13: SV 2-11.

4 Schempp H., Weiser D., Kelber O., Elstner E F (2006). Radical scavenging and anti-inflammatory properties of STW 5 (Iberogast) and its components . Phytomedicine 13: SV 36-44.

In discussion the following points were made:

Although there was a representative speaking on behalf of the Royal Pharmaceutical Society of Great Britain, the need was expressed for a speaker to represent the pharmaceutical industry. There are major problems in the interpretation of data resulting in a collapse of trust. This requires industry to be more open. The Medicines and Healthcare products Regulatory Agency (MHRA) is unbiased although funded by industry. However, there is still a need for some public funding for the evaluation of drugs. But why spend scarce public money on drugs when the companies have so much? It is very important to acknowledge the failures of the current drug appraisal system. It is considered bizarre by the public that manufacturers control product availability. Research blind alleys are often not disclosed for reasons of commercial competition and confidentiality, and lack of transparency results in much wasted effort by researchers.

Homeopathic testing by the MHRA has slipped from previous high standards in that only homeopathic proof is now required and not scientific testing. Transparency through publication is not possible since if you publish your results you cannot patent them. Non-financial conflicts also exist and may bias outcomes. Nevertheless, despite the difficulties, 25% of all useful drugs were developed in this country. According to Sir Richard Sykes the pharmaceutical industry has a bad name – that is the reality – and industry has a job to do to put it right.

Journals are controlled by the Editors in Societies, who are not under commercial pressure, and not by commercial publishing houses who also have their own standards of ethics. However, reprints of key articles may have a very high commercial value to the publishers and are protected as the source of valuable profits to journal publishers. There are pressures for these to be more freely available on the worldwide web. Peer review also received criticism for the amateurish way it is sometimes conducted, as it may give rise to conflicts between the reviewer and author. Indeed, ideas may be stolen, or suppressed; the drug company may have power of veto over the final published paper, which may not contain all relevant data. This situation might be improved by publishing the reviewers' names.

THE LARGE HADRON COLLIDER SWITCH ON

PARLIAMENTARY AND SCIENTIFIC COMMITTEE BREAKFAST BRIEFING ON TUESDAY 20TH FEBRUARY

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British scientists have played leading roles in CERN operations and management from its inception in the 1950s. John Adams, who joined CERN in 1953 from the Atomic Energy Research Establishment at Harwell, was CERN's leading accelerator designer and engineer, eventually becoming Director General in 1976. With fellow Brit, Mervyn Hine, he built the accelerators that were to establish CERN as the leading particle physics laboratory in the world.

At one stage, three of the four LEP experiments were led by UK physicists: Wilbur Venus (DELPHI), David Plane (OPAL) and Peter Dornan (ALEPH), while Chris Llewellyn-Smith, as Director General between 1994 and 1998, saw the LHC through its final stages of approval. Roger Cashmore was Director for Collider Programmes from 1999 to 2003, overseeing the running of LEP and co-ordinating the LHC programme.

Today, you'll also find UK people working in CERN's extensive outreach programme, in IT, technology transfer and all aspects of management. And, of course, CERN runs on the fuel provided by the efforts of PhD students who come to CERN to work for short periods. Many of them are attracted by the international atmosphere, Geneva's central European location, the mountain scenery – and of course the ski-ing!

THE LARGE HADRON COLLIDER SWITCH ON

Dr Lyn Evans

Lyn Evans has been at CERN for 34 years, working first on the SPS. He is now responsible for ensuring that the LHC will be up and running by 2007.

Everyone knows what a nightmare installing a new kitchen can be. The builders have knocked down the walls, the units have been delivered but the plumbing isn't ready. So you'll have some sympathy for Lyn Evans who found himself "in a considerable state of frustration" waiting for the arrival of the cryogenic system for the LHC. Until it's installed the rest of the systems can't be put in place. The thousands of magnets have been arriving and have been piled up around the CERN site. A delay at this critical stage of construction means that the rest of the collider complex must be commissioned more quickly. The collider is divided into eight octants, and rate of delivery of the many components was meant to ensure that the eight sections were tackled in series. "We have had to revise our planning and put in more teams, but we will meet the deadline for the physicists," assures Lyn.

Lyn has been project leader for the LHC since it was first proposed in 1983 and is considered CERN's most experienced accelerator expert. He first came to CERN in 1970 as a Fellow, joining John Adam's team in 1971 to build the SPS. "The really big challenge came in the late 1970s to turn the thing into a proton-antiproton collider," recalls Lyn. "The challenge was to make it into a storage ring that could keep antiprotons circulating for hours. It was amazing it worked so well."

In the 1980s, Lyn also worked on the Tevatron, the US's proton-antiproton collider, heading off to Fermilab during the CERN winter shutdown (Fermilab projects shut down in the summer when electricity is expensive due to air conditioning). Towards the end of the decade he also became responsible for both the running of the SPS and LEP. So what Lyn doesn't know about accelerators probably isn't worth knowing.

However, Lyn nearly didn't become a physicist: "Actually I went to university in Wales to do chemistry but found it too difficult; there was too much to remember whereas I could work out physics from first principles." He did his PhD on producing plasmas with high-power lasers, and after his fellowship at CERN finished he nearly went to work on nuclear fusion at the JET laboratory in Culham. But the challenge of the proton-antiproton collider project was too much of a lure and Lyn has remained at CERN ever since, settling with his family on the French side of the border. "I've been living in France for 34 years now and I'm beginning to get used to the French lifestyle," he jokes.

THE LARGE HADRON COLLIDER SWITCH ON

Particle physics and the LHC

Dr Tara Shears
Royal Society University Research Fellow

To really understand the universe you need to understand its origins, and that means understanding the behaviour of the most fundamental constituents of matter that were produced in the Big Bang some fourteen billion years ago. This is the quest that drives particle physicists to create huge particle accelerators that probe what happened at the earliest times in the Universe. The Large Hadron Collider (LHC) is the newest particle accelerator of all and should provide answers to some of the most fundamental questions in science today.

Particle physicists are great reductionists, and believe that everything, all matter in the universe, consists of the same fundamental constituents – twelve types of matter particles, which are thought to interact via four fundamental forces. The behaviour of most of these fundamental forces and particles are encapsulated mathematically in a theory known as the "Standard Model" – for the very good reason that all experimental observations made so far

agree with Standard Model predictions. It is a remarkably successful theory.

However, good as the theory is, it is also incomplete as it offers no explanation for many of the fundamental properties of matter and features of the universe. It doesn't predict the number of fundamental particles that have been observed, include gravity, or even explain why particles possess a characteristic mass. The theory doesn't explain where all the antimatter originally produced in the Big Bang has gone and why the universe is now dominated by matter. Even more worryingly, the theory only categorizes the observable universe, which is a paltry 4% of the total. Of what remains, a quarter is assigned to mysterious "dark matter", whose presence is inferred from the extra gravitational attraction observed between galaxies. The rest is ascribed to the even more elusive "dark energy", thought to be responsible for the acceleration of the universe but whose nature is unknown.

To learn more we need to return to the very early universe to study the fundamental particles whose behaviour holds the key to these mysteries. It is impossible to study the early universe directly. Instead the very energetic, hot conditions near to the Big Bang can be momentarily recreated using particle accelerators. This is why

the LHC, a new particle accelerator based at CERN, the European centre for particle physics, which will start operating later this year, is so important. What makes the LHC notable is that it is the most powerful particle accelerator ever built – so powerful in fact that it will be capable of recreating conditions last seen a billionth of a second after the Big Bang when its powerful proton beams collide together. These collisions won't be rare either. They will occur forty million times a second at four points around the 27km long LHC circular accelerator. At each of these four points an experiment has been built whose purpose is to record information about any particles produced in a collision – much like taking a three dimensional digital snapshot that can be later analysed with a computer and compared to Standard Model hypotheses to determine if anything unusual has happened. Of these four experiments, two (ATLAS and CMS) are general purpose in nature and designed to detect almost anything. The others have been designed with a more specific task in mind: ALICE to investigate a state of matter called quark-gluon plasma which existed in the universe a fraction of a second after the Big Bang; LHCb to investigate why the universe now consists of matter and not antimatter.

Finding the answer to any of the questions posed before demands an intensive search through all the data that the LHC experiments produce – and this too is not without challenge. The experiments will produce a million times more information than the world annual book production each year, an amount that requires approximately one hundred thousand computers to analyse. Processing this much data is such a problem that a new distributed computing paradigm, called the Grid, has been developed to solve it. Armed with the Grid, the LHC and the four experiments, particle physicists are ready to observe and interpret the very early universe. This year should see our first steps towards understanding some of the deepest mysteries in science.

In discussion the following points were made:

Could the Grid become a hackers' paradise? Presumably there are systems in place to protect it? In order to use the grid one has to obtain a digital certificate to authorise access. The security system is now trusted by all of the 10,000 collaborators and is paramount. When data is returned it is accompanied by a proxy of the original certificate which acts like a passport. Grid security has never been breached yet.

The technology and costs of the cooling were queried in the light of future potential demands for energy for the LHC. 130MW is the current consumption which is a considerable reduction on the 200MW previously required.

What is the public response, if any, to the presence of radiation arising from the LHC, especially in relation to the well known outcry of protest against the occasional telephone mast? CERN, which crosses the Swiss-French border, has always had a very open policy with regard to public relations and there has never been any problem with the public that has not been amicably resolved.

Computerisation is a vital part of this project, have CERN therefore ever approached Whitehall with a view to providing them with some advice on this matter? Is there any prospect of using CERN computer technology to aid the NHS for example? The facilities available at CERN are made known to a wider audience and a technology transfer policy is already in place and each member state has a technology transfer officer. The UK has been very pro-active in this regard and possibly more so than other Member States. There are never enough funds but a high priority will be given to funding the LHC from the available resources. The budget has been constant over time in spite of the increases in power generation and CERN strives to live within its budget allocation for scientific research.

INNOVATIVE SCIENTIFIC AND ENGINEERING SOLUTIONS FOR THE MANAGEMENT OF CLIMATE CHANGE

NATIONAL SCIENCE AND ENGINEERING WEEK SEMINAR ON THURSDAY 15TH MARCH

Every year during National Science and Engineering Week the Parliamentary and Scientific Committee joins with the Department of Trade and Industry to host an event to bring together leading scientists, engineers and politicians to discuss the contribution of science and technology to the development of public policy. This year the subject chosen for discussion was Climate Change and the contribution of science and engineering to mitigate and manage the potential effects on our national infrastructure.
The joint chairmen were Malcolm Wicks MP, Minister for Science and Innovation, and Dr Douglas Naysmith MP, Chairman of the Parliamentary and Scientific Committee. The meeting, which attracted a capacity audience, was held in the Grand Committee Room, Westminster Hall.

Report by Robert Freer, The Royal Institution of Great Britain

Introduction

Malcolm Wicks MP
Minister for Science and Innovation

Mr Wicks welcomed the audience and thanked the Parliamentary and Scientific Committee for hosting this meeting. He identified climate change as arguably the biggest challenge which has yet faced our civilisation; its effects will worsen some of the world's other great problems such as the insecurity of food and water, poverty, conflict and disease.

Science has helped us understand the problem, we look to engineering to help provide the solutions. Energy generation and its use is an important part of the problem and Mr Wicks said these issues bring together his former role as Energy Minister and present role as Science Minister.

The UK has become a pre-eminent centre of knowledge for climate science and our expertise can contribute to the work of organisations such as the Intergovernmental Panel on Climate Change (IPCC) which has identified human activity as the cause of global warming. We now have to decide what we need to do and how quickly we should do it.

One thing we need to do is to reduce our emissions of greenhouse gases, a transformation which will require research, innovation and ingenuity. Burning fossil fuels, land changes and deforestation are all part of the problem, an increasing problem as world energy demand is expected to increase by over 50% by 2020. We need to achieve substantial cuts in our domestic emissions and show leadership to the EU and to international efforts to do the same. Developing countries such as China and India, where new coal-fired power stations are being completed by the week, are unlikely to use modern technologies to reduce emissions unless they see the developed countries doing so themselves.

The Climate Change Bill is intended to set a long term legal framework for reducing emissions over the next 45 years and provides the means to achieve this objective. This Bill is the first of its kind in the world. It demonstrates the UK commitment to the national transition to a low carbon economy and demonstrates decisive international leadership.

Technological innovation is central to achieving these objectives. We have a number of low carbon technologies ready for deployment, but the barriers to deployment in such instances lie elsewhere than in the technologies themselves. Fossil fuels will continue to play a significant role in energy production and the rapid development of carbon capture and storage is vital. The ambition of the European Commission is that from 2020 all new fossil fuel power stations built in the EU should capture and store CO_2 subject to developing the necessary technical, economic and regulatory framework.

There is also a range of potential renewable sources such as bio-fuels, hydrogen and fuel cells but further research, development and

demonstration work is needed to accelerate learning and cost reductions. The Stern report concluded that global research spend needs to double and deployment incentives for the new technologies increase by up to five fold.

In January 2006 the Government established the Energy Research Partnership, a public-private initiative to galvanise the efforts and investments of Government, business and the research community to add cohesion to energy research and improve the impact of funding. Following this in September 2006 the Government launched the prospectus for the Energy Technologies Institute, another public-private initiative with a budget of up to £1bn over ten years. And last year the Chancellor announced a new Environmental Transformation Fund to support low carbon technologies. These initiatives will provide the UK with world class means for delivering energy technology research to underpin practical deployment.

National Science and Engineering Week is an opportunity to celebrate the role of science, engineering and innovation in securing our energy future, and through that, our economic and social well being.

How can we safely dispose of CO_2 released by the combustion of fossil fuels for power generation?

Professor Martin Blunt
Head, Department of Earth Science and Engineering, Imperial College

Professor Blunt considered the two main challenges facing the world this century to be global warming and the acidification of the oceans caused by the emission of CO_2 into the atmosphere.

The CO_2 emissions from fossil fuel power stations can be reduced either by reducing demand by improved energy efficiency or by replacing fossil fuel power stations with nuclear power and renewable energy sources. But there is another option: carbon capture and storage (CCS) that involves the separation of CO_2 from sources such as fossil fuel power stations and injecting it into deep underground geological formations. Since 85% of the world's energy is supplied by oil, gas and coal this technique has considerable potential, especially in developing countries such as China and India which rely on coal-burning power stations to fuel their economic growth.

Of the potential sites for storage the deep saline aquifers have the greatest storage potential. The International Energy Agency has estimated that up to 10,000 Gt of CO_2 (1Gt=10(12) kg) could be stored world wide in aquifers, which is equivalent to many centuries of CO_2 emissions at the current rate of around 25 Gt per year, equivalent to 7Gt carbon per year.

For comparison, each person in the UK is responsible for 10 tonnes of CO_2 per year. And if 1Gt carbon per year (ie 15% of current emissions) was stored underground at a density of 600 kg per m^3 the volume of CO_2 injected would be similar to current world oil production.

Injection into depleted oil and gas fields has benefits associated with enhanced oil and gas recovery but the storage potential is less, and injection into abandoned coal seams has a storage potential which is smaller still.

The North Sea is an attractive possible site for CO_2 storage. The sea bed has relatively well characterised geological formations and the Department of Trade and Industry and the British Geological Society have estimated that aquifers under the North Sea have a storage potential of 700 Gt CO_2 compared with 13 Gt in the gas fields and 6 Gt in the oil fields. But the first application of CCS in the UK is likely to be in the mature oil fields with an existing pipeline infrastructure where it will offer the benefit of enhanced oil recovery (EOR).

CO_2 injected deep underground has liquid-like properties with a density slightly less than water. At typical reservoir temperatures and pressures CO_2 is miscible with the light oils found in the North Sea and the injection of CO_2 sweeps out the remaining oil.

CCS is a new technology but the component operations, separating CO_2 from the other gases and underground injection, are well established in the oil industry. There are some 70 CO_2 injection projects world wide, most of them in Texas where natural underground sources of CO_2 have been used in EOR schemes for 30 years. In the North Sea the Sleipner project has been running for ten years and several other projects are being considered.

One of the major concerns in any storage project is the potential leakage of the CO_2 into the atmosphere. In the oil and gas reservoirs the overlying geological strata are impermeable, but the integrity of the cap rock of saline aquifers is less certain. One way to prevent leakage is to inject water with the CO_2: the water traps the CO_2 in the micro-scale pore spaces of the rock and renders it immobile. Leakage is a possibility mainly during the initial

injection. Over a long period of time the CO_2 will dissolve in the water and may react with the rock precipitating carbonate. Brine containing dissolved CO_2 is denser and will sink slowly.

At Imperial College a cross-departmental team of research workers is studying CCS in collaboration with Shell as part of the Shell-Imperial College Grand Challenge Programme on Clean Fossil Fuels. One component of this work is the design of injection to render the CO_2 immobile, which includes the use of advanced computer simulation to predict where the CO_2 is likely to travel. The UK has a golden opportunity to take a lead in CCS working with the oil industry to demonstrate carbon storage with EOR.

Power Generation from the Barnsley Seam by Clean Coal Technology (IGCC) and Carbon Capture and Sequestration (CCS)

Richard Budge
CEO, Powerfuel plc

Mr Budge said the Hatfield Power Project aims to be the first fully commercial coal-fired power station in the world with carbon capture. It is to be located at the Hatfield colliery in South Yorkshire, which has access to up to 100 million tonnes of British coal, and is located within a cluster of local power stations. Planning permission and a Government Consent (the only Section 36 for a coal fired IGCC station) have already been obtained and the likely cost of the project should be £1.2 billion for 900 MW. Our timetable is to commence generating power from the beginning of 2012.

The IGCC power station, incorporating carbon capture from the outset has the ability to produce both hydrogen for transport use and "syngas" for possible pipeline export to other local natural gas stations for power generation or injection into the national gas grid.

The Hatfield IGCC is one of several being planned in the vicinity of Humberside; the others being EoN and Conoco, making this region an outstanding contender for centralised investment in CO_2 pipeline infrastructure for export into the North Sea.

In recent years we have had Energy White Papers that have been superseded before publication because the process has been to seek widest consultation rather than identify the obvious. It is difficult, if not near impossible, to forecast commodity prices for energy. All that is needed is to state the obvious that the UK needs to maintain a mixed diverse energy portfolio to avoid becoming too dependent on any one source of energy.

This extended consultation must not be allowed to continue and we trust that the Government and Treasury will, sooner rather than later, sign up to a more secure energy policy for the UK which is sufficiently prescriptive to underpin future investment.

We believe that coal gasification is the cheapest form of CO_2 capture because with pre-combustion capture the process captures low volumes at high density whereas with post combustion capture there are large volumes of exhaust gas to deal with.

I strongly support the replacement of nuclear plant with new nuclear because if the Government is serious about reducing greenhouse gases there is no choice. I just wish someone would decide the timetable and get on with it.

I do not support wind farms because they operate for less than 30% of the time and therefore by definition they must be a bad investment and very expensive for electricity consumers.

Our proposal is to capture a large volume of CO_2 from a cluster of potential power stations in the Humber Region and pump it through a pipeline to the North Sea oil fields to increase the recovery of oil from those oil fields which are nearly depleted. This process of Enhanced Oil Recovery (EOR) should recover an extra 7% to 10% and extend the life of the oil fields. At present about 40% of oil is recovered from an oil field. Estimates suggest that EOR is a viable proposition at $35 to $40 per barrel, ie less than the present $60 per barrel but more expensive than alternative investments for the oil companies.

The oil companies need the Treasury to put in place the necessary fiscal policies to encourage them to invest in EOR in the North Sea. The increased petroleum revenue tax will be of significantly greater value to the country than any taxation loss resulting from financial incentives to the oil companies.

Another risk that has a negative impact on investment decisions is the volatility of the primary CO_2 price. When CO_2 was trading at just under €30 investors were considering commercial projects purely on the basis of CO_2 capture, but the present price of €5 isn't sufficiently

attractive for new investment. The European Trading Scheme (ETS) and the Government must underpin the price of CO_2 guaranteeing a realistic price for CO_2 that will make future developments viable.

Coal gasification produces 99.4% pure hydrogen which when mixed with a small amount of nitrogen is known as synthetic gas (syngas). Syngas can be injected into the national gas grid as an alternative to imported gas and when fired through conventional gas turbines emits only water vapour.

The hydrogen could also be used in transport to kick start the hydrogen economy. Powerfuel's Hatfield Colliery could produce sufficient hydrogen to fuel 2,000 buses in the inner cities of Doncaster, Rotherham, Sheffield, Leeds and York. Gaseous hydrogen is not a long term solution for transportation but is a viable medium term alternative until the hydrogen cell technology is better advanced.

At present half of the world's gas is in the hands of Gazprom and the National Iranian Gas Corporation, and a further 20% is in the Middle East and North Africa, all countries which are potentially politically unstable, whereas coal is spread around the globe with no geo-political dominance. We need coal in our energy mix to improve our security of supply and coal gasification offers the lowest commercial cost capture of CO_2 and provides an alternative to imported gas.

But we need to stop talking about EOR and get on with it. The oil companies and the Treasury need to complete their negotiations quickly to allow developments to begin in the North Sea.

At Hatfield we have sought to bring together real joined up policy and we trust it will be supported by energy policy in the future for the benefit of UK plc.

Beyond Petroleum?

Dr Steven E Koonin
Chief Scientist, BP plc

Dr Koonin said he would concentrate on the use of biology and of the biosciences to manufacture transport fuels. The rationale for developing the energy biosciences is simple and compelling. Biology is the most rapidly developing of the sciences and will produce some novel technologies.

All life and about 80% of the world's energy is based on carbon and over the 3.5 billion years of evolution nature has developed multiple solutions to meet our energy challenges. So far most of the funding for the biosciences has been for medical work, there have been far smaller investments in agriculture, materials and chemicals. The field of energy biosciences is largely open territory.

There are many potential large scale applications for energy biotechnology including carbon sequestration and bio-remediation of land but this presentation will concentrate on bio-fuels.

For transport purposes it is very difficult to find a better fuel than liquid hydrocarbons. Based on volumetric energy density and gravimetric energy density gasoline is about fifty times better than the best batteries available at present, and we have the technical processes to convert a range of carbon sources into hydrocarbon fuels suitable for transportation.

The most promising carbon source is biomass. During growth plants absorb CO_2 from the atmosphere and produce carbon as cellulose. This carbon is harvested and processed as biofuel and when it is burnt it returns the CO_2 to the atmosphere. The cycle is carbon neutral except for the energy used in the manufacturing process and in the distribution of the fuel.

The natural circulation of CO_2 from plants to the atmosphere and back to plants is many times greater than the man-made input of CO_2 into the atmosphere.

The key questions concern the costs of biofuel, the supply of the raw materials, the environmental sustainability of the process and the energy balance.

Using these criteria ethanol made from maize is not an optimal fuel. 1 MJ of ethanol requires 0.9 MJ of other energy to make it and the CO_2 emissions are only 18% less than for petrol. Its energy and environmental benefits are limited.

Manufacturing bio-fuels brings together the process and production chains in the petroleum industry and in the agricultural industry. Sugar cane from Brazil is a better raw material for ethanol based on the fuel yield per acre of land and for the same reason the best plant for making bio-diesel is oil palm. Plant breeding and genetic modification over the years has strongly increased crop sizes, resistance to drought and crop yields.

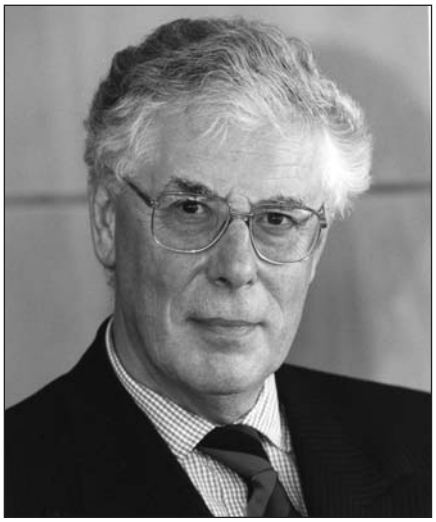
One of the most productive of the energy crops is Miscanthus, a grass which grows to a height of 11 feet in one season and yields 17.5 tons/acre.

Ethanol is only a first generation bio-fuel; butanol, a hydrocarbon with a higher carbon number than ethanol, is a more suitable bio-fuel. It is easily blended into petrol, it can use the existing fuel infrastructure, can be used in higher blend concentrations than ethanol and has an energy content closer to that of petrol than does ethanol.

The BP Energy Biosciences Institute is a new research organisation dedicated to explore the application of biology and biotechnology to energy issues. It is located at the University of California - Berkley and has partners at the University of Illinois Urbana-Champagne and Lawrence Berkley National Laboratory. It will bring together BP, academia, biotechnology firms and Government in a $500 million commitment for 10 years starting in June 2007.

Innovative Nuclear New Build for Sustainable Power

Dr Robert Hawley
Vice Chancellor, World Nuclear University



Dr Hawley said nuclear power is alive and well around the world. Today there are 435 nuclear power reactors in 31 countries (58 in France alone) supplying over 16% of the world's electricity demand. There are a further 28 plants under construction, 64 planned and 158 proposed, several of them in America. Nuclear capacity has significantly and constantly increased with upgrades and plant life extensions. Dr Hawley said he wanted to demonstrate how nuclear power improves the security of our electricity supply and especially how it contributes to the reduction in the build up of greenhouse gases and hence to global warming. This is important in the UK because electricity generation from coal and gas is responsible for 33% of our emissions.

The global demand for energy is increasing as a consequence of population growth, commercial development and urbanisation. And the use of electricity will increase faster than primary energy demand.

How is this demand for electricity to be met? At present the world demand is heavily dependent on fossil fuels (coal 39%, gas 17% and oil 8%). Most of the rest is supplied by hydro and nuclear. At present coal produces twice the quantity of CO_2 that oil or gas does but nuclear produces only 0.4% that of coal. Building more nuclear power stations is one of the few realistic options we have of reducing carbon dioxide emissions. In the OECD countries electricity from nuclear power stations has already saved more than twice the CO_2 emissions set by the Kyoto targets.

The economics of new nuclear build have improved dramatically in recent years. Power stations in Japan and Korea are being built to time and budget, and since the fuel cost is only about 15-20% of the total operating cost, nuclear power is better insulated from increasing fuel costs than is a gas fired station where the fuel is about 60% of the operating cost.

The design of modern nuclear power stations has also improved. Future power stations are a simpler design, have higher plant availability, shorter outages and lower maintenance costs. Also the fuel is used more efficiently resulting in less waste. Modular design concepts with factory built modules mean that the power stations can be built quickly with site activities reduced to 36 months.

There are a number of new reactor designs being developed, but for the UK there are two significant contenders, the AREVA EPR and the Westinghouse AP 1000, both light water reactors. An AREVA EPR with an output of 1600MW is being built in Finland and another is planned in France as a prototype for replacing their existing reactors.

The Westinghouse AP 1000 has the advantage of passive safety features, relying on gravity, natural circulation and compressed gas. And compared with the earlier generation of nuclear power stations it has far fewer components and requires smaller buildings. In December 2006 Westinghouse signed a contract to build 4 reactors for the Chinese, the biggest international reactor contract in history.

Very High Temperature Reactors (with coolant temperatures up to 1,000ºC) offer the exciting possibility of producing hydrogen by hydrolysis as well as generating electricity. A potential source of hydrogen at a reasonable price created without emitting CO_2 makes the use of fuel cells for transportation a realistic proposition. This design has the benefit that during periods of light load the excess power could be diverted to the electrolysis plant. The power station need not then be restricted to supplying only the base load but can be used to supply some of the peak load electricity which commands a higher price. This would further advance the economics for nuclear power generation. An experimental VHTR is operating in Japan and the US intends to build a test reactor by 2015.

There are other successful reactor designs. For instance, 7 Boiling Water Reactors in Japan developed by GE/Toshiba/Hitachi are producing 8.2GW but future significant developments in water cooled reactors are unlikely, whereas gas cooled reactors are serious contenders for the future because of their modern design, inherent safety and ability to produce heat and electricity.

A design of high temperature gas reactor uses helium at high temperature as the coolant and is equipped with a direct cycle gas turbine conversion system. High temperature reactors have ceramic cores and have a high thermal efficiency.

Another design is the pebble bed modular reactor which is being developed in South Africa. This is more efficient than other reactors and has an output of 165MW (compared with 1,000MW for the AP 1000) which makes it more attractive to developing countries.

Fast breeder reactors are potentially interesting because the fuel from fission reactors is used to breed more fuel, but the experimental ones at Dounreay and in France have been shut down due to technical difficulties.

In the more distant future is the possibility of electricity from thermonuclear fusion in which the nuclei of deuterium and tritium are joined at a very high temperature. Both constituents are readily available and this design offers the prospect of electricity for a very long time ahead. The physics has been demonstrated in the Joint European Torus (JET) at Culham and a prototype International Thermonuclear Experimental Reactor (ITER) is being built at Cadarache in France. It is due to be commissioned by 2016.

Nuclear power is not only alive and well, it has a significant future. And the UK Government now realises this.

The Role of Wind, Wave and Tidal Energy in Securing Clean Energy Supplies for the UK

Maria McCaffery
Chief Executive, British Wind Energy Association

Energy Resources for energy from wind, waves and tidal streams

A map of mean wind speeds over Europe shows much of Scotland and its offshore waters within the area of highest mean wind speed and most of the rest of the UK within the second highest area.

The potential for wave energy is greatest west of the Hebrides in the north west of Scotland and in the south west of England, whereas the tidal stream energy is mainly concentrated in the Pentland Firth between Orkney and the Scottish mainland. In this one area alone there is estimated to be between 50% and 60% of the UK's total tidal energy resource. Other areas of potentially high tidal stream energy are in pockets around central southern England, the Severn Estuary, Anglesey and the west coast of northern England.

Technical development

Onshore wind is the leading technology at present. The present design of wind turbine has developed from the "Danish concept" of a three-bladed, horizontal axis, tower mounted, up-wind device. The first wind farm in the UK was built at Delabole in Cornwall in 1991 but since then the rated capacity of the machines has increased some ten fold and the present designs are for machines of 2MW rated capacity. Machines in the planning stage are approaching 2.5MW rated capacity.

The cost per kW of these machines had been falling until last year, but prices started to rise again in the second half of 2006 and in early 2007 due to the rising cost of materials and to rising demand on the manufacturers. The price tax credit in the US is a key factor in the market dynamics. The total rated capacity of the onshore machines is now 2GW and wind farms with a further rated capacity of 8GW are in various stages of development. Offshore wind farms are being developed combining the technical developments of the onshore machines with the marine engineering skills developed in the exploration of the oil and gas fields. Offshore a total rated capacity of 9GW is being planned.

Machines to harness wave energy and energy from tidal streams are still at an earlier stage of development but there are some promising devices at the demonstration stage which may progress to commercial development.

Issues and barriers facing the industry

The industry needs a robust economic, regulatory and political framework to enable it to contribute to the Government's objective of generating 10% of the national electricity supply from renewable resources by 2010 and to secure the long term future of the industry.

The economic support provided by the Renewables Obligation in its revised form is vital to the continuation of wind energy and other renewable developments, but there are problems with capacity and access to the National Grid. Many wind farms are located in areas remote from population centres and hence from the existing grid which would have to be extended and increased in capacity to connect to the wind farms. Developers consider it is unreasonable for them to bear the cost of these extensions which would undermine the viability of many renewable energy projects.

Ironically Scotland has a national policy in support of wave and tidal energy development but no grid capacity to accommodate it, while in south-west England there is capacity to spare but no firm policy for development.

The greatest area of concern is with the planning system, the proportion of wind energy projects being consented has fallen and the time taken to secure a determination at all is now over three years in many cases. Changes in the planning system require primary legislation and may not be in place for years. Meanwhile planning delays are threatening the achievement of the 2010 target and also the crucially important investor confidence needed to maintain, let alone improve, our performance in the fiercely competitive global market place.

In conclusion Dr Naysmith thanked the speakers for their presentations and Peter Simpson, Annabel Lloyd and their colleagues in the DTI for putting the programme together.

In discussion the following points were made:

Revision of the OSPAR and London treaties, cost of retrofitting EOR, energy efficiency of sequestration, other potential IGCC sites, MSW as a biomass source, subsidy for wind energy, competition between nuclear and wind energy, public opinion about nuclear, improved battery performance, price volatility of bio-fuels.

BOOK REVIEW

Stem Cell Wars: Inside Stories from the Front Lines

Eve Herold. 2006
Palgrave MacMillan: New York

Taking cells from adults or the umbilical cord of newborn babies for regenerative purposes seems to have been accepted almost universally without obvious concern. Moreover, even using abortuses as a source of cells or tissue for this purpose has prompted surprisingly little protest. Thus, "Stem Cell Wars" is not about stem cells generally, but is concerned specifically with so-called embryonic stem cells obtained from very early stages of human embryonic development grown *in vitro*. While this is a war that is being fought on many fronts throughout the World, the author focuses on one particular theatre, namely the USA, and the reader will soon appreciate that her stance is far from that of a dispassionate observer.

The case for allowing research on early stages of human embryonic development for certain specified purposes was accepted some sixteen years ago in the United Kingdom with the passing of the Human Fertilization and Embryology Act. More recently, regulations governing this research were extended to allow both the derivation of the embryonic stem cells and what has come to be know as "therapeutic cloning". While those in the UK who are totally opposed to the use of early human embryos for research or the production of stem cells still continue to protest, they have at no stage enjoyed any real clout politically. That the situation is starkly different in the US is evident from Eve Herold's documentation of political shenanigans and economies with the truth on a scale that almost beggars belief. What she does not attempt to explain is why the embryonic stem cell debate continues to arouse so much passion on the other side of the Atlantic.

It must, at least in part, be because the US is a country of stark contradictions, where primacy in biomedical research coexists with more widespread belief in Creationism and Intelligent Design as alternatives to evolution than can be found anywhere else. And, undoubtedly, the strength of such fundamentalism in Republican circles has helped to engender an ambivalence towards science within the Federal administration that has coloured its handling of important issues like embryonic stem cells and climate change.

"Stem Cell Wars" is written in an engaging and eminently readable style and, apart from somewhat over-enthusiastic interpretation of a few of the animal studies cited to illustrate the promise of stem cell therapy, the relevant science is presented with commendable accuracy and clarity. My one quarrel with Herold's discussion of the ethics of using early embryos as a source of stem cells is laxity in terminology. The critical issue in the embryo debate is not when human life begins, which ceased to be pertinent with the demise of belief in spontaneous generation, but when the life of a new human individual begins.

A particularly interesting part of the book, and one to which considerable space is devoted, is the extraordinarily precipitate fall from grace of Woo Suk Hwang following his meteoric rise to international scientific stardom. The author's close involvement with aspects of this very sad episode provides novel insight into how initial disquiet about the provenance of human eggs for producing cloned embryonic stem cell lines led eventually to the revelation that Hwang had fabricated his published results. This disclosure was not only deeply embarrassing for the Government of South Korea, but is claimed by Herold to have been exploited ruthlessly by those in the US opposed to embryonic stem cell research as a way of discrediting it.

This book is a must for anyone wishing to understand the complexities of the stem cell debate in the US and, in particular, how casually relevant scientific findings can be variously exaggerated, belittled or ignored in a battle in which emotive impact becomes the principal weapon. Thus, I think it will appeal rather more to people concerned with facilitating the application of stem cells to regenerative medicine than to those actually doing the research.

Sir Richard Gardner FRS

Edward Penley Abraham Research Professor of the Royal Society in the University of Oxford

Korea's success through innovation – an important partner for the UK

Mark Tomlinson
First Secretary (Science & Innovation), British Embassy, Seoul

In the Spring 2007 edition of Science in Parliament my counterpart in the British High Commission, New Delhi, quoted from the recent Demos report: *"Atlas of Ideas: How Asian innovation can help us all"*. This report discusses the current dynamics of technology and science in China, India and South Korea, and suggests how the UK might respond.

South Korea is certainly a country that has derived success – and wealth – through innovation. A largely agrarian economy and a Japanese colony before WWII, the country was then devastated by the Korean War in 1950-53. The South was one of the poorest countries in the world 50 years ago. And much of the industry that had existed previously was in the part of the country that became North Korea.

By the early 1970s there was still little to indicate that Korea would become a developed nation, and the world's 11th largest economy, within three decades. But with support from the US – and following the example of Japan – Korea began to industrialise rapidly. A strong work ethic and rigid social values certainly helped. But innovation was key, and followed the basic formula: take existing technologies and processes from other countries, copy them, improve them and develop them at low cost.

Becoming the 11th largest economy is no mean feat considering South Korea is a nation of less than 50 million people. Of course this is an advantage in that there is not a huge population to support such as in China or India, but the pace of development has been remarkable nonetheless. South Korea is now the world's largest shipbuilder, the second largest steel producer, is involved in the construction of many of the world's tallest buildings, is the largest supplier of DRAM memory chips and is home to two of the world's leading LCD and Plasma television manufacturers. Around 40% of its electricity supply is generated from nuclear power stations

Samsung is the 3rd largest mobile handset maker in the world, LG refrigerators and air-conditioners boast a range of high-tech functions and almost every car on Korean roads seems to be a Hyundai (with a GPS Navigation System of course). Broadband Internet penetration is the highest in the world (at around 70% of the population), around 4.5m people subscribe to mobile television (broadcast by satellite and terrestrially) and the Government plans to have "a robot in every home" by 2020. Korea is now one of the most high-tech countries in the world, with good infrastructure, a per capita income nearing US$20,000 and an increasingly high standard of living.

How did it get there? Korea managed to create thousands of engineers and technologists within a few decades. Many took advantage of studying overseas, primarily in the early days in the US. But Korea also expanded its stock of state and private universities and government research institutions. It has separate national research institutes for Electronics & Telecommunications, Chemical Technology, Bioscience & Biotechnology, Energy, Aerospace and many more. The Government is committed to increase gradually the share of R&D expenditure in the national budget to 7%, a quarter of which will be used to support basic research. South Korea now has almost as many scientist and engineers as the UK, more if measured on a per capita basis.

During the peak growth years, a select few Korean companies were given government support in terms of contracts and licences, as well as the freedom to grow independently. This created a number of large corporations (Chaebols) that grew rapidly and still dominate the corporate landscape. These new companies used innovation to adapt and develop existing technologies and to refine manufacturing and processing methods imported from outside. As the companies grew, their demand for engineers and technologists had a pull-through effect on the talent pool, which helped attract members of the diaspora back to South Korea.

Over two-thirds of R&D expenditure in Korea comes from the private sector. And most of this is by just a few companies (around 40% being from Samsung alone).

It is not hard to see why the British Government believes it is important to maintain and build research links with South Korea. A UK-Korea "Science Technology and Innovation Partnership" was established in 2004. This brought together the existing bilateral programme on basic science with our trade and investment activity in high-tech industry sectors. Each Government commits around £200,000 to supporting bilateral initiatives such as scoping missions, trade missions, seminars and placements. Focus areas have included ICT, alternative energy, Space, nanotechnology and biotechnology.

Outcomes include successful bids for joint research funding, a project under consideration to construct and launch a joint satellite, a UK-Asia forum on influenza vaccine research, UK training courses on science policy and management and initiatives to help promote the participation of women in science and in engineering. The British Council also runs a programme promoting the public understanding of science. The partnership is working. But it needs to be sustained if it is to keep on delivering real outcomes for both parties.

Launch of UK-Japan University-Business linkage agreement

Seminar and Reception at the Embassy of Japan, 28th February

February 28th saw the UK launch of an unprecedented collaborative agreement between the University of Brighton and the Tokyo University of Agriculture and Technology (TUAT) regarding university and business linkages. The agreement was launched at, and with the generous support of, the Embassy of Japan in London.

Both universities are members of the Japan/UK Higher Education Group which allowed the development of a strong and mutually beneficial relationship resulting in the two universities signing a formal agreement for international co-operation in Tokyo in November 2006.

The agreement heralds a unique approach to improving international technology transfer in small new technology companies. Each university will help companies in its own country expand into the markets of the other country.

This is particularly timely as it echoes the intent of the Joint Statement released by the Prime Minister of Japan, HE Shinzo Abe, and Prime Minister Tony Blair at their first summit meeting held in London in January 2007 highlighting science, technology and innovation as a key area for further joint development.

Japan and the UK will work together to share best practice on knowledge transfer, particularly between academic institutions and the private sector.

Present at the launch were UK policy makers, ministry officials, and representatives from the Higher Education Funding Council for England (HEFCE), research councils, foundations and companies. It was also well supported by the Japan Society for the Promotion of Science (JSPS), the Japan External Trade Organisation (JETRO) and the Japanese Chamber of Commerce and Industry (JCCI).

The proceedings began with a seminar on business-university linkages opened by University of Brighton Vice-Chancellor, Professor Julian Crampton.

Dr Takahiko Ono, TUAT's Vice-President for Public Relations and International Affairs, and HEFCE's Alice Frost, Head of Business and Community Team, outlined the national picture in the two countries and the policies in place to support universities as key drivers for socio-economic development through collaboration with industry and the community.

The President of TUAT, Dr Hidefumi Kobatake, and the Pro-Vice-Chancellor of the University of Brighton, Mr Colin Monk, described current experiences in their respective universities, illustrated by examples of industrial linkages and new technologies already being developed in their institutions. Both universities are committed to building on their growing national success in university-industry collaborations by developing international collaborations and see this agreement as an important step forward in this ambition.

The key elements of the agreement are:

- Assisting companies and technologies to transfer to the other country
- Establishing an industry liaison office in each country
- Identifying opportunities through regular annual research meetings
- Attracting companies and ideas into each university
- Facilitating staff and student exchanges
- Providing systematic language and cultural support to the levels required

A reception followed in the magnificent ballroom of the Embassy to celebrate the agreement with some outstanding sparkling wine from Plumpton Agricultural College, a partner college of the University of Brighton.

The Minister of Economic Section in the UK, Mr Takaoka, reiterated the "fit" of the agreement to the science, technology and innovation section of the statement issued by the two Prime Ministers in January. As a result of further discussions held the day after the launch, the two universities have already identified a number of possible research and business development opportunities to take forward.

A programme has been set out for the next year which will include a visit by Brighton to Japan to exhibit at the TUAT annual business exhibition in November 2007 – the only university in Japan to hold such an exhibition for current and potential business clients. The first annual research meeting will be held in Tokyo in April 2008 to coincide with the UK-Japan 2008 which celebrates the 150th anniversary of the treaty that established diplomatic relations between the two countries. These annual meetings will be the foundation to continuing and building the relationship between the two universities, and identifying opportunities for further development.

The two universities are delighted with the success of the launch and are certain that they will be strengthened by this ground-breaking partnership that may act as an exemplar of best practice in university-industry collaboration.

A Postcard from Brazil

David Dent
International Agriculture and Technology Centre

Brazil only tends to make UK news on issues of climate change or loss of biodiversity in Amazonia, irrespective of its growing importance to the world as an emerging economy. UN figures indicate that by 2015, Brazil is likely to be the world's largest producer of agricultural products and currently is the world's biggest producer of cotton and biofuels based on sugar cane. The success story that is Brazilian agriculture (agribusiness represents 29% of Brazil's GDP, 37% of total exports and of all jobs, and sustains the Brazilian trade balance) and the country's overall growing economic prosperity has been made possible by the strong commitment and investment by its Government to their scientific infrastructure, human resources, technology development and targeted research.

For a scientist visiting Brazil it is apparent that the UK have both common and complementary interests in science and innovation that could be developed for mutual benefit. In agriculture, Brazil has a track record of success with biofuels, their research is applied, very market focused and linked well to their farming community. The UK specialises in high quality fundamental agri-science, has technology based agri-businesses and is committed to growing its bio-economy. We also share concerns over climate change, environmental degradation and sustainable use of biodiversity. Brazil's diverse natural ecosystems and abundance of unique biodiversity are on a scale unimaginable for most in the UK, and yet the task of identifying, recording and generating benefit for Brazil from this vast biological resource is overwhelming. The UK has a distinguished history of biological collection, recording and of ecological study on an international scale, with world renowned institutions and expertise.

It was for these reasons that Brazil is considered a key partner country for the UK and why a group including Patricia Nuttall (NERC Centre of Ecology Hydrology), John Lucas (BBSRC Rothamsted Research), John Sime (Bioscience for Business KTN), John Wood (Council for the Central Laboratory of the Research Councils), Philip Esler (Arts and Humanities Research Council) and I, accompanied

Sir David King to Brazil, at the end of March to launch the UK-Brazil Year of Science (YoS), part of the UK-Brazil 2006 Joint Action Plan on Science and Innovation. The YoS is providing a framework around which to formulate a comprehensive approach to our UK-Brazil research engagements.

Our delegation was able to visit a number of key scientific institutions in a programme of formal presentations and informal discussions, meetings with senior figures from national and regional Government, an occasional press conference and impromptu photo calls. Sir David King, accompanied by Peter Collett (British Ambassador, Brazil), moved energetically from one appointment to the next, avidly promoting UK abilities in science and innovation. Each meeting or event was succeeded by detailed scientific discussions to identify common interests and tangible opportunities.

At INPA (Insituto Nacional de Pesquisas de Amazonia) in Manaus we were introduced to a wealth of research on Amazonian biodiversity from micro-organisms to the Amazonian Manatee. Ensuing discussions involving the Government of Amazonas, Department of Environment and Sustainable Development generated the idea for an Amazonas Biological Records Centre based on the UK Biological Record Centre (a web-based facility collating 20 million records).

Also at Manaus we visited the Amazon Biotechnology Centre (CBA) which was created to promote the economic and sustained use of Amazonia biodiversity. Although government sponsored, the CBA want industry to identify market opportunities and sponsor the collection of relevant source organisms, screening and identification of active molecules. Areas for collaboration with the UK emerged in discussions concerning technology transfer and genetic resource collections, the latter based around the UK's contributions to the OECD on standards for Biological Resource Centres. CBA also informed us that they are interested in attracting high calibre scientists to their Institute through their fellowship programme, which is open to UK researchers.

Our delegation travelled next to the political capital of Brazil, Brasilia. A meeting with the Minister of Agriculture and the President of EMBRAPA (Brazilian national agricultural research centre) included the formal signing of an MOU between EMBRAPA and Rothamsted and consideration of a Brazil supported collaboration with Norwich Research Park. The Brazilian Minister of Science and Technology then hosted the formal ceremony for the launch of the YoS from where we decamped to Sao Paulo for one last, very well attended presentation by Sir David, our delegation and Brazilian counterparts.

All too quickly, the week's work completed, it was time to say farewell to everyone and particularly to the FCO staff, who with their tireless professionalism and good humour, had made everything possible in a hectic schedule. We made one last sojourn through the traffic and the skyscrapers of cosmopolitan Sao Paulo to the airport and then home.

Blood diamonds v Ethical sourcing - who's winning?

Rt Hon Kevin Barron MP
Chair, All-Party Parliamentary Group for Earth Sciences

The All-Party Parliamentary Group for Earth Sciences met in March to listen to presentations given by representatives from De Beers, The Government Diamond Office (GDO, Foreign & Commonwealth Office) and R Holt Co Ltd (Hatton Garden Jewellers) and to discuss the effectiveness of the Kimberley Process Certification Scheme.

"Conflict diamonds" is the term used to describe diamonds that are illegally traded to fund conflicts. Conflicts in some of the poorest parts of Africa have focused on rebels controlling their country's natural resources and assets; about 75,000 people were killed in the West African conflict, which ended in 2002. The release of the Hollywood film "Blood Diamond" has served to bring the issue of conflict diamonds (blood diamonds) to the forefront and highlighted the difficulties of the diamond industry to stop unlawful or unethical behaviour.

The diamond industry, aware of the negative impact that the film might have on diamond sales, took the opportunity to further increase awareness and compliance in the diamond industry and effectively articulate the benefits to developing countries of legally traded diamonds, which contribute about US$8.4 billion annually to African economies. 65% of the world's diamonds are from Africa, mainly Botswana, South Africa, Namibia and Tanzania. Botswana produces diamonds worth US$3.2 billion annually, accounting for 76% of export revenue, 45% of government revenue and 33% of gross domestic product.

> The UN Security Council (2001) defines conflict diamonds as "diamonds that originate from areas controlled by forces or factions opposed to legitimate and internationally recognised Governments, and are used to fund military action in opposition to those Governments, in contravention of the decisions of the Security Council".

The Kimberley Process, diamonds and ethical sourcing

In December 2000 the United Nations General Assembly (UNGA) voted unanimously to support an initiative instigated by the South African Government to include the diamond industry and non-governmental organisations (NGOs) to create a global system to prevent conflict diamonds from entering the legitimate diamond supply chain – the Kimberley Process Certification Scheme (Kimberley Process). The scheme was set up following three years of negotiation between Governments of the major diamond trading and producing countries and representatives of the diamond industry and NGOs, endorsed by the UNGA and the United Nations Security Council (UNSC) and launched in January 2003.

The scheme requires Governments to certify that shipments of rough diamonds are free from conflict (blood) diamonds. Countries that agree to participate must pass legislation to enforce the Kimberley Process and set up control systems for the import and export of rough diamonds. Participants are only allowed to trade rough diamonds with other participants and any rough diamonds transported across international borders are required to be sent in tamper-proof containers with unique serial numbers.

Working groups monitor participants' implementation of the scheme, assess applications to join, gather and analyse statistics, and discuss technical issues. Global Witness, Partnership Africa Canada (PAC), and other NGOs have been involved in developing and building support for the scheme, helping to write the Kimberley Process Technical Document, and playing an active role in negotiations and implementation. Participants undertook a three year review (2003-2006) to assess the effectiveness of the Kimberley Process.

Andrew Bone, Head of Government Relations for the De Beers Group, spoke about the media attention and the work that the diamond industry has done to help eradicate conflict diamonds and to tell the story of how, as the President of Botswana, Festus Mogae put it: "For our people, every diamond purchase represents food on the table, better living conditions, better healthcare, potable and safe drinking water, more roads to connect our remote communities and much more." He also introduced the Diamond Development Initiative, which aims to accelerate sustainable socio-economic development in the communities around local artisanal diamond mining areas.

In the UK, implementation of the Kimberley Process is centred on the Government Diamond Office (GDO) operating out of the Foreign and Commonwealth Office (FCO). Ben Stride, Manager of the GDO, is responsible for authorising exports of diamonds by issuing the Kimberley Process certificate. Ben described how the GDO monitors imports and issues confirmation of safe receipt to exporting authorities, liaises with industry, collates necessary statistical data, prepares Kimberley Process reports and represents the UK at

Kimberley Process plenary meetings. The Kimberley Process participants (Governments) and observers (the diamond industry, NGOs) meet once a year to discuss the implementation of the scheme.

Jason Holt of R Holt Co Ltd (gemstone and jewellery experts since 1948) gave the industry view, congratulating De Beers, the GDO and others in helping to maintain confidence in an industry that has relied predominantly on reputation and trust.

Who's winning?

The diamond industry is winning in its aim to prevent conflict diamonds from entering the Kimberley Process system and to maintain confidence in the diamond marketing process. However, its ultimate success depends on all participants having strong control systems and procedures for collecting and sharing trade data on rough diamonds, for inspecting imports and exports of these diamonds, and for tracking confirmations of import and export receipts.

The scheme is voluntary and there are no sanctions or fines for those who are found to be contravening the guidelines. Stronger controls (including government controls) and better systems for identifying suspicious shipments of diamonds through international trading centres are just two of the proposals put forward to increase the efficiency of the system.

De Beers has called on every diamond trader worldwide to:

- Establish absolutely the provenance of the diamonds they purchase
- Refuse to buy diamonds without the warranties required by the Kimberley Process
- Question and double-check the validity of vendors guarantees; and
- Report any suspected breaches of the Kimberley provisions.

Today, 71 countries, including Sierra Leone, are members of the Kimberley Process, ensuring that more than 99% of the world's diamonds are certified to be from conflict free sources. The statistics show that legitimate trade in rough diamonds is winning, but there is still work to be done - one conflict diamond is still one too many.

Acknowledgements

I would like to thank the speakers for their presentations and Cally Oldershaw, Administrative Secretary for the Group, for organising the meeting.

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Scientists impress MPs with work to minimise the use of animals

Researchers who were most successful in communicating to Parliamentarians their work to Replace, Refine or Reduce the use of animals in research and testing were awarded prizes of £2,000 each at a poster exhibition, held in Portcullis House on 28th February. The event, hosted by Phil Willis MP, chair of the House of Commons Science and Technology Committee, and organised by the National Centre for the Replacement, Refinement and Reduction of Animals in Research (NC3Rs), featured 50 projects that applied the 3Rs to research using animals in academia and industry.

Prizes were awarded to the best posters in the areas of Replacement, Refinement and Reduction, as selected by a panel of 15 judges on the day, and the event was sponsored by the Association of the British Pharmaceutical Industry (ABPI) and the Wellcome Trust.

The Replacement Prize was won by Kelly BéruBé and Tracy Hughes from Cardiff University's School of Biosciences, for their work to find a possible alternative to animal testing in the field of Inhalation Toxicology. By developing 3-D cell cultures of lung tissue from human cells or "human tissue equivalents of respiratory epithelia", they were able to give them an appearance and behavioural characteristics that closely resembled those found in the human airway, and accurately mimicked the human responses to tissue damage. This innovation could eventually replace the use of animals in toxicity testing of airborne materials.

The Refinement Prize was won by Claire Rourke, GlaxoSmithKline, for her work investigating a novel way to give laboratory rodents doses of drugs for testing. Currently, a tube is inserted down the throat of the animal, but it was found that the animals could be trained to drink voluntarily from a syringe that contained the drug, with some sugar added for taste.

The Reduction Prize was won by Richard Walmsley, University of Manchester, and Paul Hastwell, GlaxoSmithKline, and Nick Billinton of Gentronix Ltd for their work in improving the identification of cancer causing chemicals using cell cultures. They developed a cell line that glows green when exposed to chemicals that damage genetic material. Because this test is much more accurate than the existing cell culture tests, far fewer chemicals have to be tested in animals, which are currently still necessary to see whether chemicals actually have the potential to cause cancer.

Phil Willis said: “My colleagues and I were tremendously impressed with the outstanding range and quality of research on display. The research demonstrated that not only could alternatives to animal models be developed but the quality of scientific outcomes could be improved.”

Vicky Robinson, chief executive of the NC3Rs, said: “We were overwhelmed by the interest that our event ‘Showcasing the 3Rs’ generated. Not only did we get a huge number of researchers keen to communicate their work to a wider audience, but we also had an impressive turnout from MPs, who obviously felt that finding out more about this type of work was central to being informed about the issue of using animals in research when talking to their constituents.”

Kelly BéruBé said: “I was impressed by the level of interest from the MPs. It is important for them to realise that the majority of their constituents will be concerned over the use of animals in medical research, and that researchers like me will only use animal models, such as the rat lung, as an absolute last resort if no replacement model is available.”

Richard Walmsley said "Developing a new test for use in the highly regulated and conservative field of pharmaceutical safety presents unique challenges for companies like Gentronix. However, the enthusiasm within GSK for this innovative and reliable screening method, coupled with the recognition of our work through this award, should ensure wider adoption and corresponding reduction in animal use throughout the industry.”

Philip Wright, Director of Science & Technology, ABPI, said: "Pharmaceutical companies are constantly looking at ways to research medicines that reduce the need for animals and minimise suffering. The ABPI was delighted to be able to support this showcase of the imaginative techniques being developed by academic and industrial scientists. It is critical that wherever developments occur to reduce, refine and replace the use of animals in research, these are communicated as rapidly as possible."

The National Centre for the Replacement, Refinement and Reduction of Animals in Research (NC3Rs) provides a UK focus for the promotion, development and implementation of the 3Rs in animal research and testing. It brings together stakeholders from academia, industry, Government and animal welfare organisations to facilitate the exchange of information and ideas, and the translation of research findings into practice that will benefit both animals and science. Further information available at www.nc3rs.org.uk

Can the European Electricity Grids cope with more Windfarms?

Robert Freer

The EU Directive 2001/77/EC on the promotion of Renewable Energy expects wind power in Europe to increase from 41MW in 2005 to nearly 67MW in 2008, and increase still more by 2015. But a recent study1 by the European Transmission System Operators (ETSO), the operators of the five main European grid systems serving 28 countries, draws attention to the technical and financial problems which may arise from such expansion and from the attempts to integrate the output from windfarms into the various national Grids. The study makes recommendations to try to solve these problems. Many of the new windfarms will be in Germany but some will be in Spain, Portugal and Great Britain.

The idea of generating electricity from the wind is superficially attractive. The fuel is free, windmills use established technology, they are not difficult to make and they can be built quickly so that a Government minister can see something happen during the time he is in office. But the practical reality is very different. ETSO's *European Wind Integration Study* identifies a number of major problems in developing wind electricity if it is intended to make a useful contribution to both our National Grid and to the European electricity system. There are technical solutions to these problems but they increase the costs of what is already an expensive form of generation.

A general problem with large windmills is that they generate electricity only when there is a strong wind blowing and these occasions are unpredictable and intermittent. Also they do not necessarily occur when there is a demand for the electricity. The average electrical output is small. In the UK the annual output from all

the windmills contributes less than 1% to the national electricity demand of 375Twh per year and they provide no sufficiently predictable power on which the operators of the National Grid can rely. They are also expensive and not economically competitive; without the government subsidy provided by the Renewables Obligation it is unlikely that anyone would build them: "The subsidy for wind power until 2020 will be some £30 billion due to the freedom of multiple departmental committees to reach consensus conclusions in a policy vacuum with no effective ministerial leadership." [2]

The technical problems which ETSO consider arise from trying to integrate wind energy into the electricity grid and affect all the European grid systems. For instance, many wind farms built on sites with high average wind speeds are remote from the main load centres so that new overhead lines are necessary to transport the surplus electricity to the regions where it is consumed. And it is necessary to provide back-up generation, with its own requirements for grid reinforcement, to balance the variable contributions from wind power.

Lengthening the transmission lines increases the line losses (in Germany the active grid losses are doubled by large amounts of wind power) and leads to a higher load factor which consumes more reactive power. An increase in reactive power generation at high voltage will need to be installed before 2008 to meet the EU's development plan.

ETSO consider that the cost of these new investments and extra work should be met by the developers of the wind farms. If these costs have to be met by the system operator the costs become part of the tariff paid by the customer and there is no incentive for the windfarm developer to reduce the cost of integration with the grid.

Another problem ETSO looked at was the effect of an unpredictable gale which could generate a large surplus of wind power and cause a temporary power surge through neighbouring grids. Such surges, together with the sudden increase and decrease in output as the wind speed rises and falls, could reduce the stability and security of the grid and affect trading capacities.

A recent paper [3] by Hugh Sharman illustrated this problem in western Denmark.

The situation is likely to get worse as more wind farms are built. By 2008 it has been estimated that proposals for large amounts of wind power will cause bottlenecks in the internal and cross border transmission lines in Northern Europe. Single circuit outages due to a disturbance on the grid could cause internal overloads on the remaining lines of up to 180% in Germany, the Czech Republic, Poland, Belgium and the Netherlands.

The security of the grid can be put at risk by the way the windfarms are connected to it. Conventional power stations do not disconnect from the grid even after a grid failure but many of the windfarms so far built disconnect themselves even in the event of a minor brief voltage dip. This can lead to serious power failures on the system. ETSO recommend manufacturers should ensure that their machines are designed to support system stability even in the event of a fault.

ETSO also considered the economic impact of wind energy. System operators are required to give priority to renewable electricity such as local sources of wind energy, but by doing so they will cut out some cost-effective generation from conventional plant.

To solve these problems ETSO make a series of recommendations. They recommend that a Europe-wide rational allocation of renewable energy sources should be established with a more even spread of windfarms to avoid concentrations of output and to make use of the most efficient sites, and they recommend the priority rules for the transmission of electricity from renewable sources should be re-examined. Licensing approvals for both renewable sites and grid infrastructure should go hand in hand to avoid delaying the expansion of the grid. Also, wind farm developers should be responsible for correcting the imbalances their output creates on the system and for ensuring they do not adversely affect the stability of the grid in the event of voltage or frequency drops.

The EU Directive demonstrates that the EU is rightly seeking to find new sources of energy to reduce Europe's dependence on imported oil and gas, but it is surprising that it has focused so much attention on wind energy when better alternatives are available. The better alternatives would include the promotion of heat pumps for local space heating and energy from waste plants for the generation of electricity and heat from municipal waste. Energy from waste plants can be built near towns and cities, which are both the source of waste and the demand centres for the energy produced. This would solve both an energy problem and an environmental problem by recycling into energy wastes which would otherwise have to go to landfill. And on the large scale the EU should be promoting a Europe-wide plan for a new generation of nuclear power stations which would solve the problem of providing reliable carbon-free electricity to meet the base load.

REFERENCES

1 "European Wind Integration Study. Towards a Successful Integration of Wind Power into European Electricity Grids" European Transmission System Operators, Final Report, 15 January 2007

2 Lord Tombs, House of Lords debate 23 June 2005, Hansard 1787

3 Hugh Sharman, "Why wind power works for Denmark" Civil Engineering, Vol 158 May 2005

House of Commons Select Committee on Science and Technology

Under the Standing Orders, the Committee's terms of reference are to examine "the expenditure, policy and administration of the Office of Science and Innovation and its associated public bodies".

The new Committee was nominated on 19 July 2005. Members of the Committee are Adam Afriyie (Con, Windsor), Mr Robert Flello (Lab, Stoke on Trent South), Linda Gilroy (Lab Co-op, Plymouth Sutton), Dr Evan Harris (Lib Dem, Oxford West and Abingdon), Dr Brian Iddon (Lab, Bolton South East), Chris Mole (Lab, Ipswich), Mr Brooks Newmark (Con, Braintree), Dr Bob Spink (Con, Castle Point), Graham Stringer (Lab, Manchester, Blackley), Dr Desmond Turner (Lab, Brighton Kemptown), and Mr Phil Willis (Lib Dem, Harrogate and Knaresborough). Mr Phil Willis was elected Chairman of the Committee at its first meeting on 20 July 2005.

Oral Evidence

The corrected transcripts of these evidence sessions are available on the Committee's website.

Science Question Time
The Committee hosted a "Science Question Time" with Malcolm Wicks MP on Wednesday 21 March 2007. The topics covered included ring-fencing of the science budget, the 21st century science GCSE, the Cooksey Review, and public engagement.

Introductory Hearing with Professor Philip Esler, Chief Executive of the Arts and Humanities Research Council
On Wednesday 28 February 2007, the Committee held an introductory hearing with Professor Philip Esler, Chief Executive of the Arts and Humanities Research Council.

Current Inquiries

Space Policy
On 19 July 2006, the Committee announced an inquiry into space policy in the UK. The inquiry is focusing upon the current levels of investment in the sector, the UK's relationship with the European Space Agency, the delivery of public benefits from the space-related activities of different Government departments, and the support for space-related research.

The Committee has held seven oral evidence sessions and has heard from the Minister for Science and Innovation, the BNSC, the European Space Agency, industrialists, and academics. A Report is expected to be published in the summer.

Investigating the Oceans
The Committee is undertaking an inquiry into marine science. It will consider the organisation and funding of marine science, the role of the UK internationally in this field, support for marine science, the use of marine sites of special scientific interest, and the state of the UK research and skills base underpinning marine science.

The inquiry was launched on 27 November 2006. Oral evidence sessions will commence in late spring.

International Policies and Activities of the Research Councils
On 6 March 2007, the Committee launched a new inquiry as part of its thematic scrutiny of the Research Councils. The terms of reference include international collaboration through the EU Framework Programme, interaction between the Research Councils and Government Departments on international collaborations, and the international mobility of scientists and engineers.

The deadline for written evidence was 16 April 2007 and oral evidence sessions are expected to begin in early summer.

Reports

Office of Science and Innovation: Scrutiny Report 2005 and 2006
The Committee published its Sixth Report of Session 2006-07, *Office of Science and Innovation: Scrutiny Report 2005 and 2006* (HC 203) on 5 April 2007. The Report concluded that the merger of the former Office of Science and Technology and the Innovation Group of the DTI to form the Office of Science and Innovation had been a success. The Report also noted the Committee's concern regarding the DTI 'raid' on the Science Budget to meet other obligations and called for an absolute commitment to observing the ring-fencing of the Science Budget in the future.

Government Proposals for the Regulation of Hybrid and Chimera Embryos
The Committee published its Fifth Report of Session 2006-07, *Government Proposals for the Regulation of Hybrid and Chimera Embryos* (HC 272) on 5 April 2007. The Committee's inquiry was prompted by the coincidence of proposals by the Government for inclusion in its forthcoming draft Bill on the creation of human-animal chimera or hybrid embryos for research purposes with recent applications by scientists to the Human Fertilisation and Embryology Authority for licences to create specific types of such embryos for use in the derivation of stem cells. The Report found that the Government's proposals to prohibit the creation of human-animal chimera or hybrid embryos for research to be unacceptable and potentially harmful to UK science.

Research Council Institutes
The Committee published its Fourth Report of Session 2006-07, *Research Council Institutes* (HC 68) on 22 March 2007. The Committee concluded that Research Council Institutes make a unique contribution in terms of providing national capacity and access to facilities and in developing multidisciplinary science driven by a clearly-defined mission. The Report recommended more co-ordination between those who have a direct interest in the work and health of the RCIs. The Committee also proposed that the OSI should be given formal responsibility for improving dialogue between Government departments, RCIs and the Research Councils.

The Cooksey Review
The Committee published its Third Report of Session 2006-07, *The Cooksey Review* (HC 204) on 15 March 2007. The Report broadly endorsed the Review's conclusions but

noted some reservations regarding the ways in which the proposals affect basic research, research outside the priority areas and the processes followed by the Medical Research Council.

Human Enhancement Technologies in Sport
The Committee published its Second Report of Session 2006-07, *Human Enhancement Technologies in Sport* (HC 67) on 22 February 2007. The Committee suggested several new measures to tackle doping in sport in the run up to the London Olympic games. These measures included more research into the use of human enhancement technologies, better information regarding banned substances, the development of more sophisticated detection techniques and the creation of a separate body to undertake drug testing of athletes.

Work of the Committee in 2005-06
The Committee published its First Report of Session 2006-07, *Work of the Committee in 2005-06* (HC 202) on 24 January 2007. The Report outlined the work of the Committee since its establishment in July 2005.

Government Responses

Scientific Advice, Risk and Evidence Based Policy Making
On 27 February 2007, the Committee published *Scientific Advice, Risk and Evidence Based Policy Making: Government Response to the Committee's Seventh Report of Session 2005-06* (HC 307).

Further Information

Further information about the work of the Committee or its current inquires can be obtained from the Clerk of the Committee, Dr Lynn Gardner, the Second Clerk, Dr Celia Blacklock, or from the Committee Assistant, Ana Ferreira on 020 7219 2792/0859/2794; or by writing to: The Clerk of the Committee, Science and Technology Committee, House of Commons, 7 Millbank, London SW1P 3JA. Inquiries can also be emailed to scitechcom@parliament.uk. Anyone wishing to be included on the Committee's mailing list should contact the staff of the Committee.

Anyone wishing to submit evidence to the Committee is strongly recommended to obtain a copy of the guidance note first. Guidance on the submission of evidence can be found at http://www.parliament.uk/commons/selcom/witguide.htm.

The Committee has a new website address: www.parliament.uk/s&tcom. All recent publications (from May 1997 onwards), terms of reference for all inquiries and press notices are available at this address.

House of Commons Library Science and Environment Section
Research Papers

The following are summaries of papers produced for Members of Parliament.
Information and copies of papers can be obtained from Michael Crawford at the House of Commons Library on 0207 219 6788 or through www.parliament.uk/parliamentary_publications_and_archives/research_papers.cfm

The Planning-gain Supplement (Preparations) Bill

Research Papers 07/04 and 07/13

The Planning-gain Supplement (Preparations) Bill provides authorisation for expenditure to prepare for Planning-gain Supplement (PGS), which would be a tax on the increase in land values resulting from the grant of planning permission. The Bill received Royal Assent on 20 March 2007. Paper 07/04 dealt with the Bill as originally presented to the Commons and Paper 07/13 was a report on the Commons Committee Stage.

PGS would apply across the UK, but because it is essentially a local measure, all PGS revenues generated in the Devolved Administrations would be returned to the country in which they were generated. At the time of writing the Government had not announced whether it would go ahead with PGS.

The Energy Saving (Daylight) Bill

Research Paper 07/09

This Bill is sponsored by Tim Yeo who came second in the ballot for Private Members' Bills. The Bill would advance time in England throughout the year by one extra hour for an experimental period of three years from October 2008 to October 2011. Winter would be one hour ahead of Greenwich Mean Time and summer two hours ahead. This would increase daylight by one hour in the evenings and decrease it by the same amount in the morning. It would also bring time in England in line with that of the Central European Time Zone.

The Bill would provide the Scottish Parliament, the Welsh Assembly and the Northern Ireland Assembly with powers similarly to change time. The Bill did not complete its Second Reading on 26 January.

The Land Use (Gardens Protection etc) Bill

Research Paper 07/10

This Bill is sponsored by Mrs Caroline Spelman who came third in the ballot for Private Members' Bills. The Bill would make provision for the protection of gardens and urban green space and would confer on local authorities the power to set housing density targets. It would encourage the transfer of some land formerly used for economic purposes to residential use.

The Bill did not complete its Second Reading on 2 February.

Parliamentary Office of Science and Technology

Recent POST publications

Ethnicity and health
January 2007 *POSTnote 276*

Black and minority ethnic (BME) groups generally have worse health than the overall population, although some BME groups fare much worse than others, and patterns vary from one health condition to the next. Evidence suggests that the poorer socio-economic position of BME groups is the main factor driving ethnic health inequalities. Several policies have aimed to tackle health inequalities in recent years, although to date ethnicity has not been a consistent focus. This POSTnote reviews the evidence on ethnic health inequalities, the causes and policy options.

Strategic science
January 2007 *Postnote 277*

Science, technology, engineering and mathematics (STEM) were among the higher education (HE) subjects identified in 2005 as being strategically important and vulnerable. Set against this background are downward trends in the numbers of students studying certain STEM subjects and closures of STEM departments in UK universities. This POSTnote outlines trends in STEM education and the possible reasons for them, and looks at their significance in terms of supply and demand of STEM qualifications. It also examines issues concerned with closures of university STEM departments.

Alzheimer's and dementia
February 2007 *Postnote 278*

In the UK an estimated 750,000 people suffer from Alzheimer's and other dementia disorders. Dementia makes independent living either difficult or impossible in the later stages. As the UK population ages the number of cases is predicted to rise over the next two decades, placing a significant demand on health and social services. This POSTnote reviews current understanding of the causes of dementia, the hopes for interventions, and the UK's current position in terms of handling future demand for services.

Internet governance
February 2007 *Postnote 279*

There is increasing international debate on 'Internet governance', which encompasses a variety of public policy issues related to internet infrastructure, management and use. This POSTnote describes the structure of the Internet and summarises the debate over its management. It also discusses the prospects for its international governance, following the first meeting of the UN-sponsored Internet Governance Forum.

Electricity in the UK
February 2007 *Postnote 280*

Electricity generation accounts for around 30% of UK carbon dioxide (CO_2) emissions. In the next decade many coal and nuclear plants will close, leaving the UK increasingly dependent on imported gas. The Government sets out two priorities in its Energy Review: security of energy supply and emissions reductions. This POSTnote discusses challenges facing electricity networks in the light of these priorities, such as connecting renewable generators in remote areas, and incorporating small-scale generation. It discusses barriers to progress, and policy options such as planning reform and incentives.

Ecosystem services
March 2007 *Postnote 281*

The natural environment provides people with goods and services that are fundamental to human wellbeing. Damage to the environment is seriously degrading these services and this will have economic implications. This POSTnote outlines what ecosystem services are, and how provisions for maintaining them in the UK could be incorporated into policy frameworks.

Current work

Biological Sciences and Health – Assisted reproduction technologies, Alternatives to custodial sentencing for young adult offenders, Tackling malaria in developing countries, Health behaviour, Cognition enhancers, Eating disorders.

Environment and Energy – Carbon balance of biofuels, Smart metering, Public perception of electricity supply sources, Carbon offsetting, Urban flooding, Energy and sewage, Marine exploitation and conservation.

Physical Sciences, IT and Communications – International migration of scientists and engineers, E-Science and the grid, Electronic waste, Future nuclear technologies, Spectrum management.

Seminars

In February POST held the first of an intended series of meetings in constituencies of House of Commons POST Board members in the Swindon South constituency of Anne Snelgrove MP. The subject was Households and Carbon Management.

In March POST collaborated with the Parliamentary Education Unit to host a debate for 50+ sixth form students on stem cell research policy, which took place in Parliament.

Fellows and interns at POST

In January Frances Slater from the Centre for Ecology and Hydrology joined POST as a NERC fellow to work on Energy and sewage.

In January Rachel Crockett from the Institute of Psychiatry joined POST as a Wellcome Trust fellow to work on Health behaviour.

In January Cathy Taylor from the London School of Hygiene and Tropical Medicine joined POST as an MRC fellow to work on Tackling malaria in developing countries.

In February Gangani Niyadurupola from the University of Bath joined POST as a Royal Society of Chemistry Fellow to work on Cognition enhancers.

In April Lyndsey Dodds from the Scottish Association for Marine Science joined POST as a NERC fellow to work on Marine exploitation and conservation.

International Activities

POST has hosted parliamentary delegations from the Norwegian, Swedish and Mexican Parliaments.

POST has been working, within the European Technology Assessment Group framework, for the European Parliament's STOA office, on the subject of Tunnel Safety. The project is being managed through Heriot Watt University, Edinburgh. The first stage will be reported to the European Parliament at a workshop in Brussels on May 16.

House of Lords Science and Technology Select Committee

The members of the Committee (appointed 21 November 2006) are Lord Broers (Chairman), Lord Colwyn, Lord Haskel, Lord Howie of Troon, Lord May of Oxford, Lord O'Neill of Clackmannan, Lord Patel, Lord Paul, Baroness Perry of Southwark, Baroness Platt of Writtle, the Earl of Selborne, Baroness Sharp of Guildford, Lord Sutherland of Houndwood and Lord Taverne. Baroness Finlay of Llandaff was co-opted to the Committee on 12 December 2006

Water Management

The Committee's report was published in June, and the Government response was received in August, followed by a debate in the House on Friday 13 October. A short follow-up report was published on 11 January 2007.

Science and Heritage

The Committee's report was published in November. It sets out a comprehensive vision for the future of what the Committee has termed "heritage science" – the diverse range of scientific research that underpins the conservation of our cultural heritage. The Government's response was published in January 2007. While the Committee's recommendations were embraced warmly by the Research Councils, the response from DCMS was less positive, and written comments on the response have now been sought from witnesses. These will be published, along with the Committee's commentary, in May. A debate will follow in the early summer. In the meantime key players in the sector, notably the Institute for Conservation, are exploring options for implementing the Committee's recommendations independently.

Science Teaching in Schools

The Committee's report was published last November. Among other things, it called for dramatic action to recruit and retain more specialist physics and chemistry teachers; a wider baccalaureate-style examination system to replace A-levels; increased funding for school science laboratories; improved careers advice for students; and a proper career structure for school science technicians. The Government response was published in January 2007. The Committee's report was debated in the House on 3 May. The Committee will next publish a short follow-up report, including the Government's response along with written comments received from witnesses to the inquiry.

Personal Internet Security

Sub-Committee II's inquiry into personal Internet security was launched in November. The inquiry, chaired by Lord Broers, has looked at a broad range of security issues affecting private individuals when using the Internet. In March the Committee visited the United States, talking to federal government and the FBI, as well as to key industry players (including Apple, Microsoft and eBay), think-tanks, and researchers. The final public meeting took place on 25 April, and the report is likely to be published in July.

Allergy

Sub-Committee I, chaired by Baroness Finlay of Llandaff, is carrying out an inquiry into allergy. The inquiry was launched in October and has sought to take an holistic approach to allergy, rather than focusing solely on allergy service provision. The Committee has visited allergy centres in both Germany and Denmark, where different approaches to the diagnosis and treatment of allergic diseases are being adopted. Following its final public meeting, with Health Minister Ivan Lewis MP on 18 April, the Sub-Committee will consider its draft report, with a view to publication in July.

Radioactive Waste Management

In December 2006, the Select Committee announced a short follow-up inquiry, chaired by Lord Broers, into radioactive waste management. The inquiry focused on the final report of the Committee on Radioactive Waste Management (CoRWM), which was published last July, and Government's response to the report published in October 2006. The Committee took evidence from CoRWM, the Nuclear Decommissioning Authority, the Government and others. The Committee's report on this inquiry is expected to be published around the Whitsun recess.

Further information

The written and oral evidence to the Committee's inquiries mentioned above, as well as the Calls for Evidence on the Committee's new inquiries, can be found on the Committee's website www.parliament.uk/hlscience. Further information about the work of the Committee can be obtained from Cathleen Schulte, Committee Specialist (schultec@parliament.uk or 020 7219 2491). The Committee's email address is hlscience@parliament.uk.

Parliamentary and Scientific Committee News

Annual General Meeting

Election of Office-holders
At the Committee's Annual General Meeting on Monday 23rd April the Rt Hon Lord Jenkin of Roding, Dr Richard Worswick, Ms Sandra Gidley MP, Mr Stephen Cox CVO and Mr Peter Raymond MBE retired as Vice-Presidents and Professor Peter Saunders retired as a member of the Advisory Panel. The following office-holders were elected:

Vice-Presidents:	Professor Peter Saunders
	Mr Andrew Miller MP
	Mr Robert Goodwill MP
	Mr Philip Greenish CBE
	Mr Robert Freer
Advisory Panel:	Mr Paul Ridout

All remaining office-holders were re-elected for the year.

New Members

We are delighted to welcome the following new members:

Scientific and Technical Organisations

Materials UK
represented by Dr David Bott
Plymouth Marine Laboratory
represented by Professor Nicholas J P Owens

Industrial Members

Blackwell Publishing Ltd
represented by Robert Campbell

C-Tech Innovation Ltd
represented by Ged Barlow

North West Development Agency
represented by Steven Broomhead

Website Matters

www.scienceinparliament.org.uk

Discussion Forum

It has been agreed by the Editorial/Management Board of Science in Parliament that a Discussion Forum will operate on the website for the benefit of members. In order to minimise administration and costs the Forum will be unmoderated. Messages will not be checked in advance and will be posted immediately. Users will have the option of editing or deleting their own messages and administrators will have the ability to edit or delete any messages. In the first instance there will be three administrators: the scientific secretary, administrative secretary, and webmaster.

The Forum will consist of a number of "boards" organised hierarchically. It will commence with a board on Discussion Meetings where members will have an opportunity to post further discussion on a meeting topic. There will also be a board on General Discussion that will be open for postings on any other matter likely to be of interest to the Committee.

Any member wishing to use the Discussion Forum will need to be logged on as a member and will additionally need to register to use the Forum as an individual (ie should not hide behind the anonymity of a corporate member of the P&SC). However, if someone still wishes to remain anonymous, there are no built-in checks on their name and address details. The assurance that they are genuine is based on the fact that they are already logged into the main P&SC website.

Back Numbers of Science in Parliament at reduced cost to members and non-members alike

(a) Hard copies of back numbers of Science in Parliament that are more than one year old will be listed at a greatly reduced cost of £3 each, including postage within the UK by second class mail. The availability of individual back numbers will be presented as a new page under the "Publications" header. Orders will be completed following a request sent to the office.

(b) Digital copies of back numbers of Science in Parliament that are more than one year old will be available at no cost to members and non-members alike by download from the website.

Links to members' websites and to the Committee website

Members are invited to post the Committee's site www.scienceinparliament.org.uk on their own website and in exchange the Committee will be pleased to place their website on the Committee's site at no charge to members.

A Guide to Science in Parliament and Government

This authoritative and informative guide explains for the first time how both Parliament and Government manage science. It is now freely available and is maintained and updated regularly by the author, Dr David Dent, Vice-President of the Parliamentary and Scientific Committee.

P R Simpson (Scientific Secretary) and
S Henley (Webmaster)

Debates and Selected Parliamentary Questions & Answers

Following is a selection of Debates and Parliamentary Questions and Answers from the House of Commons and House of Lords.

Full digests of all Debates, Questions and Answers on topics of scientific interest from 8th January to 8th February and from 19th February to 29th March 2007 from both Houses of Parliament can be found on the website:

www.scienceinparliament.org.uk

Please log in using the members' and subscribers' password (available from the Committee Secretariat) and go to Publications: Digests

Climate Change

United States (Climate Change Policy)
Debate in Westminster Hall on Tuesday 13 March

Mr Peter Kilfoyle (Liverpool, Walton) I travelled through several of the United States recently with other members of the British-American parliamentary group. We discovered that many States and companies already have in place plans and projects designed to minimise the impacts of CO_2 emissions in the US. We were left in no doubt of how seriously the bodies that were represented all took the problems that face the planet, and of their determination to overcome those problems in a considered and consensual way. All were appreciative of the lead that has been offered to the United States by the British commitment in the field. That was a constant refrain that was repeated time and time again both at governmental and at an academic level. When I say "governmental", I am talking about state and municipal government; unfortunately, the jury is out on what the present national US Administration might or might not do in its remaining term in office. None of our party had any doubt about the sincerity of the people who were involved – either in their focus on the real issues behind global warming or in their determination to steer a new path for the United States, whether Washington is on board or not.

The Minister for Climate Change and the Environment (Ian Pearson): In response a comprehensive list was presented of issues and topics demonstrating the extent of UK co-operation on a wide range of political levels and with major energy producing industries.

Education

World Class Skills 2020
Debate in Westminster Hall on Wednesday 8 February

The Minister for Higher Education and Lifelong Learning (Bill Rammell): This debate was proposed at the prompting of the Under-Secretary of State for Education and Skills, the Member for Corby, Phil Hope, and provides an opportunity to discuss the case for making Britain the home of world-class skills that will affect prosperity for generations to come. Lord Leitch published his independent report on the skill needs for the UK in 2020. The report set out the current state of skills in this country, the challenges to be faced, and what is required to meet them. It was effective, detailed, accurate and robust. I strongly believe that giving people the skills to enable them to succeed, to sustain themselves and to compete in the workplace is the best and most effective way of obtaining social justice and tackling poverty.

Mr Barry Sheerman (Huddersfield) Two years ago a group of us formed the all-party skills group, the National Skills Forum and the Skills Commission, which I jointly chair. We did so because of the irritation we all felt – particularly in the Select Committee – that every time we discussed early years or mainstream education, higher education or much else the press were there, as were the radio and the TV, but as soon as we turned to skills no one came. In those two years, we have seen some amazing changes in terms of the level of interest and how we have managed together – with a lot of help from Government and from Opposition parties – to raise skills up the political agenda. That is where we are today, and in a sense this debate in Westminster Hall is a symptom of that success.

Energy

Energy: Electricity Supply
Debate in the House of Lords on Thursday 8 February

Lord Tombs: This is the fifth annual debate on the subject, although the problems which initiated the series remain unaddressed and are of growing seriousness. The privatisation of the industry effectively removed its capacity for strategic planning as a result of the fragmentation of the industry. For some years Governments held to the view that strategic planning would be provided by the open market competition resulting from privatisation. This has proved to be a delusion. Instead strategy has emerged from the Government's manipulation of the electricity market – not always successfully. Electricity is especially important because it is derived from primary fuels such as coal, oil,

gas, nuclear and hydro. It cannot be stored and operates by almost instantaneous response to demand. It is relied on nationally to an extent unmatched by any other energy industry. It is the only practical large-scale outlet for the products of renewable energy and is likely to contribute to reducing the CO_2 emissions of our largest polluting sector – ground transport.

The absence of any clear strategy has resulted in the UK becoming reliant on gas supplies for some decades to come, especially from unstable areas of the world and at increasing cost. That is the price of relying on national and international energy markets to provide a strategy which has traditionally been the responsibility of the industry. When combined with Government initiatives designed to minimise climatic impacts such as the Renewables Obligation Certificates, the only technology to benefit significantly from this highly subsidised spending by consumers, will be wind power, to the level of £30 billion by 2020, without reference to the Treasury, Parliament or the Public Accounts Committee. But whatever the environmental attractions, this technology does not deliver the baseload electric power required to sustain a national grid. It follows therefore that there is an urgent need especially to consider new nuclear build. None of the existing management or financial infrastructure will suffice to achieve this goal, hence there is now, and has been for some considerable time, an urgent need for a complete rethink requiring strength and vision by the Government to recover from the present impasse.

Lord Jenkin of Roding: Gazprom is not a normal company and should not be treated as one. It is entirely controlled by the President's office in Moscow. Furthermore, if the private sector is to be encouraged to invest in new infrastructure for electricity generation the future price of carbon is an integral component of the economic analysis which will be used to decide whether any new scheme is viable or not. Present policy is to base it on the European Emissions Trading Scheme, but this scheme has suffered wild fluctuations and no one has the slightest idea what it will be in Phase Three which is due to start in 2012.

The Parliamentary Under-Secretary of State, Department of Trade and Industry (Lord Truscott): The Government remains committed to the UK's competitive energy market and a strategic decision-making mechanism is neither desirable nor necessary. There is no reason to think that decisions by a strategic decision-making authority would be any more successful in correctly identifying and providing what will be needed to meet the nation's energy demands than are decisions by industry professionals in a market where companies compete in a market to do just that.

Security of supply is a major issue. The Government reminds the Russian Federation of the St Petersburg energy supply principles that it signed up to at the G8 in St Petersburg in which it committed itself to open, competitive and transparent markets. There has been no Gazprom bid for Centrica or any other UK company.

The Government's aim is to set the right regulatory framework to encourage and enable the market to move in the right direction to meet the long-term challenges. Despite the many real challenges facing the UK's energy industry, it continues to deliver secure sources of energy supply. This was followed by a detailed rehearsal of the Government's current list of goals, objectives and aspirations for energy policy. The Government is mindful of the need to give investors more certainty about the carbon market as soon as possible.

Lord Tombs The Government has had every opportunity of taking up the sensible arguments that have been made but has chosen not to do so. I therefore see no point in continuing this series of debates.

Alternative Energy

Question and Written Answer on Tuesday 20 February

Mr Malik (Dewsbury): To ask the Secretary of State for Trade and Industry how much Government money was spent on researching re-usable energy sources in (a) the last year for which figures are available and (b) 1997.

Jim Fitzpatrick: The Government spend on R and D on renewable energy is set out in the following table.

£ million		
	1997-98	*2005-06*
Research councils	[(1)]7	[(1)]15.8
Government Department (DTI, DEFRA, DfT)	6.2	11. 8

[(1)] Exceeds

The Research Councils also spent £16.6 million in 1997-98 and £20.6 million in 2005-06 on nuclear fusion research. They are also providing funding of £13.88 million over the period 2004-09 for the UK Energy Research Centre (which undertakes a range of research relating to sustainable and renewable energy) and £15.8 million over the period 2000-08 to the Tyndall Centre for Climate Change research (which includes some research on renewable energy). In addition the Council for the Central Laboratory of the Research Councils estimate that access for energy research to its facilities accounted for £4.5 million in 2005-06.

The Government also funds the Carbon Trust, which provides support for research into low carbon energy activities amongst other activities.

Carbon Capture and Storage
Debate in Westminster Hall on Tuesday 27 February

Mr Alex Salmond (Banff and Buchan): The BP Peterhead Miller field (DF1) project in my constituency will be able to take methane from St Fergus, separate it into carbon dioxide and hydrogen through the pre-burn process and send the carbon dioxide back down the Miller pipeline into the North Sea, where it will be re-injected into a largely depleted oilfield which is due to be abandoned shortly. This will increase its lifespan by up to 20 years and enable the equivalent of a further 40 million barrels of oil to be recovered. The hydrogen will be burnt in the power station generating 500 MW available to the grid. Towards the end of March 2007 when the pre-engineering design stage is finished – the scheme's sponsors, BP, General Electric and Scottish and Southern Energy, have already invested £50 million – the teams will be stood down awaiting the Government's decision on how to support the technology.

The Minister for Science and Innovation (Malcolm Wicks): At this stage it is not possible to say whether the Government can meet the conditions that BP set out for the project's continuation, which is subject to the Government's investigation into incentives for Carbon Capture and Storage and other works being undertaken in the Department on the appropriate regulatory regime. The pre-Budget report committed the Government to making a decision this year, and I am advised that it is not incompatible with the Miller field decommissioning time scale. I think that the Conservative party's position is that we should ally the technology under discussion to the renewables obligation, but I do not want to risk disrupting renewables development. A decision on demonstration will be taken later in 2007. We will continue to encourage industry to develop innovative solutions to the global carbon capture challenge to ensure that over the next few years we have a portfolio of competing technologies throughout the world to help us all rise to the challenges set out in the Stern report.

Health

Maggot Debridement Therapy
Debate in the House of Commons on Wednesday 28 February

Mrs Madeleine Moon (Bridgend): ZooBiotic Ltd, a laboratory in my constituency, produces clinically sterile maggots for medical use. Maggot therapy is a potent tool in the treatment of wounds and a potential weapon in the battle against methicillin-resistant Staphylococcus aureus, offering a potential saving to the NHS of £30 million a year and is a tool that could limit the spread of super-bugs in hospitals and care homes. Maggots act on a wound by debriding or dissolving necrotic tissue. They disinfect the wound by killing bacteria and stimulating wound healing. In the past sterile maggots have been accepted as a valuable resource and hospitals are again beginning to accept the treatment. They are contained in a sterile dressing that is changed every three or four days. The success of the therapy is undisputed, although no formal review of the treatment has been undertaken. I therefore want to use this debate to call on the Government to ensure that such a review takes place as soon as possible.

The Minister of State, Department of Health (Caroline Flint): It is important to generate robust evidence that the procedures are effective. This is why the Department of Health is currently funding a major study in this area by the University of York that will also establish the cost-effectiveness of the maggot therapy. The report of the research is expected in 2009. In order to get a licence to market maggots as a medicine, a manufacturer would need to submit all relevant data, including those from extensive clinical trials, to the regulator. The Medicines and Healthcare products Regulatory Agency has not yet received an application for such a licence, but such an application would be welcome. Some patients might have clinical needs requiring the use of unlicensed medicines. ZooBiotic Ltd currently holds a manufacturer's "specials" licence enabling it to produce maggots for this purpose.

Science Policy

International Polar Year 2007-08
Debate in the House of Lords on Monday 15 January

Viscount Montgomery of Alamein rose to ask what benefits are expected from the International Polar Year 2007-08 (IPY) following the British hosting of the Antarctic Treaty Consultative Meeting in Edinburgh in June 2006. It is 13 years since the Antarctic Bill UK reached the statute book. That enabled the UK to implement the treaty obligation imposed by the 1991 Environmental Protocol to the original Antarctic Treaty, and to ratify that protocol. The Polar Regions Unit in the Foreign Office is also important and should be expanded not contracted – it is vital. The IPY which started in March will be the most significant commitment to polar science since the International Geophysical Year 1957-58 and will initiate a research campaign designed to measure planetary processes, especially climate change. The British Antarctic Survey should be encouraged during the IPY to extend its coverage to include the Arctic, thus generating a bipolar and coherent policy for the global poles. Tourism has tripled since 1994 thereby increasing the risk of accidents. The support vessel "Endurance" which is important, in the light of competing territorial claims by Argentina and Chile, for work in conjunction with the British Antarctic Survey (BAS), and as a search and rescue vessel, may be threatened with mothballing. Reassurance is sought from the Minister on these points.

The Earl of Selborne indicated that when Scott sailed south on the "Discovery" expedition through the Ross Sea, he named Cape Selborne after the then First Lord of the Admiralty, who had helped to get a combined naval and scientific expedition up and running, and checks at the Royal Geographical Society map room confirm that it is still called Cape Selborne. This Year which extends until 2009, is an opportunity for furthering data collection and interpretation and therefore the proposed reductions in the resource and capital budgets for the British Antarctic Survey budget over the period from 2007 to 2009 are a matter of concern as they affect the science budget preferentially rather than the fixed costs which must be met whatever the budget.

The Parliamentary Under-Secretary of State, Foreign and Commonwealth Office (Lord Triesman), pointed out that the UK invests over £50 million every year in polar science work, primarily in the Antarctic, for reasons of history and politics, as well as of science. The Natural Environment Research Council has also invested an additional £4.9 million in new Arctic international science projects, thus creating a commitment to a leading role in scientific endeavours at both poles. We cannot underestimate the work of British scientists on the physics, chemistry, geology, and biology of the Antarctic, which is vital for the whole planet. That is why BAS has set the goal of becoming the leading international centre for global science in the Antarctic context by 2012. There are no plans to reduce the readiness of HMS "Endurance".

Innovation Policy

Debate in Westminster Hall on Wednesday 24 January

Dr Ian Gibson (Norwich N): The Department of Trade and Industry (DTI) above all others has taken up this issue in the UK and produced copious documents illustrated with pie charts, histograms, and various graphs. This indicates just how seriously the DTI and the Government regard Innovation Policy. This can be defined simplistically as the ability to translate serious ideas into products and ways of doing things that will benefit the people whom we serve, and people across the world. It is a skill that can be learnt and developed and probably arose from the innovate or die concept in the US. However, underlying all this innovation is the post-neoclassical endogenous growth theory, and speaking of the theory, Michael Heseltine, a right hon Member of this House once said "It's not Brown's. It's Balls." The theory saw subsidies for research, development and education increasing the growth rate by increasing the incentive to innovate and this idea is now pervasive in the Treasury. It does not explain however why some countries are much richer than others and the income divergence between the developing and developed worlds.

It is hard work to to study the DTI website and to get through the initiatives that the Department employs to handle some of the problems. However, I agree with the DTI that Britain is much more innovative than it has ever been. The 2003 report shows how many graduates there are in different parts of the country and it makes clear that university education plays into and encourages innovation, with university degrees promoting innovative, active enterprises. This reflects a change in culture from only recognising the importance of academic goals, such as Nobel prizes, to one where people may say to themselves, "Maybe this thing we are doing in the laboratory is marketable." That idea has suddenly taken hold among some people, but it is not pervasive enough. I have always been and always will be in favour of a Ministry of Science. We talk about different Departments talking to each other, but I do not believe it. I would have a Ministry of Science where the staff are all stuck in one place and talk about scientific and creative ideas. They can talk about things together, and say, "This is what we're capable of doing. How do we make it happen?"

The Minister for Science and Innovation (Malcolm Wicks): Policies on innovation aim to maintain and improve the United Kingdom as a knowledge economy by encouraging the successful exploitation of ideas. Work across Government is undertaken to ensure that public sector procurement – which is worth more than £125 billion a year – stimulates innovative solutions. It is believed that the RDAs' innovation policies are working to address challenges in commercialisation, knowledge transfer, the promotion of innovation, the creation of networks and improvements in skills. Science and industry councils have been set up in each region to guide RDA innovation spending. Innovative businesses need intellectual property protection and clarity on standards and measurement. The DTI and its agencies provide that clarity and protection, and the implications of the Gowers review of intellectual property are under consideration. Knowledge transfer has been given a high profile since the Lambert review of business-university collaboration in 2003, the policy set out in the 10-year framework for science and innovation and more recent updates of that framework. The Technology Strategy Board will become a non-departmental public body in July, which will improve its ability to operate with flexibility. Through the Higher Education Innovation Fund the Government provides resources to all universities to increase knowledge transfer activity and business engagement, leading to a wider cultural change in universities' innovation activities. Research and development tax credits are important but new evidence on their efficacy will be considered.

Research: Finance
Questions and Written Answers on Tuesday 13 March

Mr Stewart Jackson (Peterborough): To ask the Secretary of State for Trade and Industry what progress has been made on achieving the European Union target of three per cent of GDP being allocated to research and development investment by 2010; and if he will make a statement.

Malcolm Wicks: The aspiration for investment in R&D across EU countries to reach 3 per cent of GDP by 2010 is a challenge for Europe as a whole. But it is not necessarily appropriate for an individual member state.

In the light of UK circumstances, the 10-year Science and Innovation Framework set out a long-term ambition to see the total R&D to GDP ratio in the UK increase to 2.5 per cent of GDP by 2014. The R&D measure is the Gross Expenditure in Research and Development (GERD), which is the sum of R&D performed in business (BERD) and public expenditure on R&D, by Government Departments and higher education.

The latest available GERD and BERD figures for the UK and the EU are:

GERD as per cent of GDP		
	2003	*2004*
United Kingdom	1.8	1.7
EU25	1.8	1.8
EU15	1.9	1.9

BERD as per cent of GDP			
	2003	*2004*	*2005*
United Kingdom	*1.1*	*1.1*	*1.1*
EU25	*1.1*	*1.1*	*1.1*
EU15	*1.2*	*1.2*	*1.2*

Mr Stewart Jackson: To ask the Secretary of State for Trade and Industry what assessment has been made by his Department of the possible effect on international competitiveness in (a) biosciences, (b) engineering sciences and (c) medical research of the 2007-08 reduction in funding to the UK Research Councils; and if he will make a statement.

Malcolm Wicks: In order to help to manage the significant pressures on the Department's budget in 2007-08, a decision has been made to use some of the accumulated unspent funds within the science budget. This decision will not affect research projects which are already being funded.

The UK has a strong track record in research excellence, and benefits from a consistently good performance across disciplines. On the basis of an independent report, it is currently ranked second in the world in biosciences and health-related sciences, and fourth in engineering. The report is available on the DTI website at:http://www.dti.gov.uk/files/file27330.pdf

Mr Stewart Jackson: To ask the Secretary of State for Trade and Industry whether he plans to assess the impact on scientific research of the planned reduction in funding to UK Research Councils in 2007-08; and if he will make a statement.

Malcolm Wicks: In order to help to manage the significant pressures on the Department's budget in 2007-08, a decision has been made to use some of the accumulated unspent funds within the science budget. This decision will not affect research projects which are already being funded. The sum in question amounts to less that 1 per cent. of the nearly £10 billion awarded to science over the three-year spending period.

Sustainable Development
Question and Written Answer on Wednesday 28 March

Mr Andrew Smith (Oxford E): To ask the Secretary of State for Trade and Industry if he will assess the merits of appointing a chief engineer to advise the Government on sustainable infrastructure.

M**alcolm Wicks:** The role of the Government's Chief Scientific Adviser (GCSA) is a broad one, covering all scientific, engineering and technological disciplines.

The GCSA, currently Sir David King, has provided advice on a wide range of issues relating to sustainable infrastructure, for example in connection with climate change and energy, and including via previous Foresight projects on Intelligent Infrastructure Systems and Flooding and Coastal Defence, and the current Sustainable Energy Management and the Built Environment project.

Progress of Legislation before Parliament

A comprehensive list of Public Bills before Parliament, giving up-to-date information on their progress through Parliament, is published regularly when Parliament is sitting in the Weekly Information Bulletin, which can be found at:

http://www.publications.parliament.uk/pa/cm/cmwib.htm

Euro-News

Commentary on science and technology within the European Parliament and the Commission

European Research Council opens its doors

Sir David King bridges the divide between science and politics, being the chief scientific adviser to the British Government. When the idea of the ERC was first mooted, the British Government was sceptical. "They thought that it could be yet another bureaucratic nightmare produced by Europe," he joked. But when it became clear that the ERC would fund solely on the basis of excellence, the Government changed its position. Those who have received funding from the ERC will be regarded as the crème de la crème. The ERC will sit at the pinnacle and haul research in the rest of Europe upwards, he said. The EU needs to be fit to face the 21st Century and its challenges such as increased economic competition, population growth, the Earth's depleting resources and global warming. The ERC will go part way towards meeting these challenges. Professor Maciej Zylicz, President of the Foundation for Polish Science, said that the ERC's ability to cope with high-risk projects was one of its main attractions since national research councils with their lower budgets are unable to take such risks. He also referred to the need to speed up the career advancement of young scientists and said that individual countries will learn from the ERC how to do this. Professor Josef Syka, President of the Czech Science Foundation, said that since the EU began to fund science, there has been a focus on innovation and applied research. Now EU policy makers realise that there must be something at the beginning. You cannot have applied research if you do not have science to apply.

Open Access Publishing

More experiments are needed to find the best open access models for scientific publishing was one of the main messages coming out of a panel discussion on open access during a conference on scientific publishing in the ERA, held in Brussels on 15 and 16 February 2007. While they were broadly in favour of open access, the publishers on the panel pointed out that running a journal costs money and in the end someone has to pay. "We are a not-for-profit publisher, but we are also not for loss," commented Dr Martin Blume, Editor in Chief of the American Physical Society. Currently two of the APS' nine journals are open access; one is funded by sponsorship from large laboratories such as the CERN, European centre for nuclear research, while the other is funded by the "author pays" principle. However, scientists who have papers published in the other seven journals are welcome to self archive their articles in their institutions' open-access e-print archives. The British Medical Journal (BMJ) went completely open access for a few years. But the experiment was stopped as the policy led to a sharp fall in the level of subscriptions to the print version of the journal. "We like the idea of open access but we realised that to survive we needed to close the open access website," explained Alex Williamson, the BMJ's Publishing Director. The European Commission has recently published a communication outlining the actions it intends to undertake at European level to help increase and improve access to and dissemination of scientific information. The intention of the document is not to mandate open access publishing and digital preservation, but to promote best practices and initiate a policy debate on these matters.

European Defence Industry

Europe retains a widely capable defence technological industrial base, made up of several world-class companies and facilities. "But we are far from having the strong, globally competitive technological and industrial base that we need to fulfil our ambitions and preserve our options for the future." The time has come to create a truly European defence technological and industrial base (DTIB), one which is more than the sum of the separate national industries according to Mr Verheugen, Vice-President of the European Commission in charge of Enterprise and Industry at the European Defence Agency (EDA) conference in Brussels on 31 January 2007. The problem lies in the fact that the defence programmes, procurement and industrial alliances in Europe are shaped by national decisions and policies. This results in duplication of research and technology as well as in the development and production of equipment. For example, in the EU there are four different battle tank programmes and 23 programmes for armoured fighting vehicles. The EU has a total of 89 weapons programmes compared to only 27 in the United States. The fragmented industrial bases in Europe will not be sustainable. This will be the true heritage of duplication on a national level.

European Union – Digest

Monthly digests of European legislation, taken from the Official Journal of the European Communities can be found on the website: www.scienceinparliament.org.uk

Please log in using the members' and subscribers' password (available from the Committee Secretariat) and go to Publications: Digests

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Royal Statistical Society

Surface Science
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Biosciences Federation
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Health Protection Agency
Society for General Microbiology

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LGC
Royal Society of Chemistry
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Wildlife
Biosciences Federation
British Ecological Society
Institute of Biology
Natural England
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Association of the British Pharmaceutical Industry

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The ABPI is the voice of the innovative pharmaceutical industry, working with Government, regulators and other stakeholders to promote a receptive environment for a strong and progressive industry in the UK, one capable of providing the best medicines to patients.
The ABPI's mission is to represent the pharmaceutical industry operating in the UK in a way that:

- assures patient access to the best available medicine;
- creates a favourable political and economic environment;
- encourages innovative research and development;
- affords fair commercial returns

Association of Marine Scientific Industries

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The Association of Marine Scientific Industries (AMSI) is a constituent association of the Society of Maritime Industries (SMI) representing companies in the marine science and technology sector, otherwise known as the oceanology sector.

The marine science sector has an increasingly important role to play both in the UK and globally, particularly in relation to the environment, security and defence, resource exploitation, and leisure. AMSI represents manufacturers, researchers, and system suppliers providing a co-ordinated voice and enabling members to project their views and capabilities to a wide audience.

Academy of Medical Sciences

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The Academy of Medical Sciences promotes advances in medical science and campaigns to ensure these are converted as quickly as possible into healthcare benefits for society. The Academy's Fellows are the United Kingdom's leading medical scientists from hospitals, academia, industry and the public service. The Academy provides independent, authoritative advice on public policy issues in medical science and healthcare.

AIRTO

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AIRTO represents the UK's independent research and technology sector - member organisations employ a combined staff of over 10,000 scientists and engineers with a turnover in the region of £1.5 billion. Work carried out by members includes research, consultancy, training and global information monitoring. AIRTO promotes their work by building closer links between members and industry, academia, UK government agencies and the European Union.

Biochemical Society

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The Biochemical Society exists to promote and support the Molecular and Cellular Biosciences. We have nearly 6000 members in the UK and abroad, mostly research bioscientists in Universities or in Industry. The Society is also a major scientific publisher. In addition, we promote Science Policy debate and provide resources, for teachers and pupils, to support the bioscience curriculum in schools. Our membership supports our mission by organizing scientific meetings, sustaining our publications through authorship and peer review and by supporting our educational and policy initiatives.

BIOSCIENCES FEDERATION

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The Biosciences Federation is a single authority representing the UK's biological expertise. The BSF directly represents 45 bioscience organisations, and contributes to the development of policy and strategy in biology-based research – including funding and the interface with other disciplines – and in school and university teaching by providing independent opinion to government.

Biotechnology and Biological Sciences Research Council

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The BBSRC is the UK's leading funding agency for academic research in the non-medical life sciences and is funded principally through the Science Budget of the Office of Science and Innovation. It supports staff in universities and research institutes throughout the UK, and funds basic and strategic science in: agri-food, animal sciences, biomolecular sciences, biochemistry and cell biology, engineering and biological systems, genes and developmental biology, and plant and microbial sciences.

British Association for the Advancement of Science - the BA

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The BA (British Association for the Advancement of Science) is a charity which exists to advance the public understanding, accessibility and accountability of the sciences and engineering. The BA aims to promote openness about science in society and to engage and inspire people directly with science and technology and their implications.
Established in 1831, the BA organises major initiatives across the UK, including the annual BA Festival of Science, National Science Week, programmes of regional and local events, and an extensive programme for young people in schools and colleges.

British Ecological Society

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The British Ecological Society promotes the science of ecology worldwide. The Society has 4,000 members who are active in advancing the science and application of ecology.
The BES publishes four internationally renowned scientific journals and organises the largest scientific meeting for ecologists in Europe. The BES also supports ecologists in developing countries and fieldwork in schools through its grants.
The BES informs and advises Parliament and Government on ecological issues and welcomes requests for assistance from parliamentarians.

British Nutrition Foundation

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2007 is the 40th Anniversary of the British Nutrition Foundation. This scientific and educational charity promotes the well-being of society through the impartial interpretation and effective dissemination of scientifically based knowledge and advice on the relationship between diet, physical activity and health.

British Pharmacological Society

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The British Pharmacological Society has now been supporting pharmacology and pharmacologists for over 75 years. Our 2,000+ members, from academia, industry and clinical practice, are trained to study drug action from the laboratory bench to the patient's bedside. Our aim is to improve the quality of life by developing new medicines to treat and prevent the diseases and conditions that affect millions of people and animals. Inquiries about drugs and how they work are welcome.

The British Psychological Society

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The British Psychological Society is an organisation of over 45,000 members governed by Royal Charter. It maintains the Register of Chartered Psychologists, publishes books, 10 primary science Journals and organises conferences. Requests for information about psychology and psychologists from parliamentarians are welcome.

British Society for Antimicrobial Chemotherapy

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Founded in 1971, and with 800 members worldwide, the Society exists to facilitate the acquisition and dissemination of knowledge in the field of antimicrobial chemotherapy. The BSAC publishes the *Journal of Antimicrobial Chemotherapy* (JAC), internationally renowned for its scientific excellence, undertakes a range of educational activities, awards grants for research and has active relationships with its peer groups and government.

British Veterinary Association

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BVA's chief interests are:

* Standards of animal health
* Veterinary surgeons' working practices
* Professional standards and quality of service
* Relationships with external bodies, particulary government

BVA carries out three main functions which are:

* Policy development in areas affecting the profession
* Protecting and promoting the profession in matters propounded by government and other external bodies
* Provision of services to members

CABI

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CABI brings together and applies scientific information and expertise to improve people's lives. Founded in 1910, CABI is owned by over 40 member countries. Today CABI publishes books, journals and scientific outputs, carries out scientific research and consultancies to find sustainable solutions to agricultural and environmental issues and develops innovative ways to communicate science to many different audiences. Activities range from assisting national policy makers, informing worldwide research, to supporting farmers in the field.

Campden & Chorleywood Food Research Association

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An independent, membership-based industrial research association providing substantial R&D, processing, analytical, hygiene, best practice, training, auditing and HACCP services for the food chain worldwide.
Members include growers, processors, retailers, caterers, distributors, machinery manufacturers, government departments and enforcement authorities. Employs over 300; serves over 2,000 member sites; and has a subsidiary company in Hungary. Activities focus on safety, quality, efficiency and innovation. Participates in DTI's Faraday Partnerships and collaborates with universities on LINK projects and studentships, transferring practical knowledge between industry and academia.

Cavendish Laboratory

The Administrative Secretary, The Cavendish Laboratory,
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The Cavendish Laboratory houses the Department of Physics of the University of Cambridge.

Its world-class research is focused in a number of experimental and theoretical diverse fields.

Astrophysics: Millimetre astronomy, optical interferometry observations & instrumentation. Astrophysics, geometric algebra, maximum entropy, neutral networks.

High Energy Physics: LEP, SPS & future LHC experiments. Detector development. Particle physics theory.

Condensed Matter Physics: Semiconductor physics, quantum effect devices, nanolithography. Superconductivity, magnetic thin films. Optoelectronics, conducting polymers. Biological Soft Systems. Polymers and Colloids. Surface physics, fracture, wear & erosion. Amorphous solids. Electron microscopy. Electronic structure theory & computation. Structural phase transitions, fractals, quantum Monte Carlo calculations Biological Physics.

Cefas

Centre for Environment, Fisheries & Aquaculture Science

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Website: www.cefas.co.uk

Cefas offers multidisciplinary scientific research and consultancy for fisheries management and aquaculture, plus environmental monitoring and assessments. Government at all levels, international institutions (EU, UN, World Bank) and clients worldwide have used Cefas services for over 100 years. Three laboratories with the latest facilities, plus Cefas' own ocean-going research vessel, underpin the delivery of high-quality science and advice to policy-makers.

Chartered Institute of Patent Attorneys

Contact: Michael Ralph -
Secretary & Registrar
The Chartered Institute of Patent Attorneys
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Website: www.cipa.org.uk

CIPA's members practise in intellectual property, especially patents, trade marks, designs, and copyright, either in private partnerships or industrial companies. CIPA maintains the statutory Register. It advises government and international circles on policy issues and provides information services, promoting the benefits to UK industry of obtaining IP protection, and to overseas industry of using British agents to obtain international protection.

Clifton Scientific Trust

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Website: www.clifton-scientific.org

Science for Citizenship and Employability, Science for Life, Science for Real

We build grass-roots partnerships between school and the wider world of professional science and its applications

- for young people of all ages and abilities
- experiencing science as a creative, questioning, human activity
- bringing school science added meaning and notivation, from primary to post-16
- locally, nationally, internationally (currently between Britain and Japan)

Clifton Scientific Trust Ltd is registered charity 1086933

Council for the Central Laboratory of the Research Councils

Contact: Natalie Bealing
CCLRC Rutherford Appleton Laboratory
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CCLRC Daresbury Laboratory
Daresbury, Cheshire, WA4 4AD
Tel: 01235 445484 Fax: 01235 446665
E-mail: enquiries@cclrc.ac.uk
Website: www.cclrc.ac.uk

The CCLRC is the UK's strategic agency for scientific research facilities. It also supports leading-edge science and technology by providing world-class, large-scale experimental facilities. These advanced technological capabilities, backed by a pool of expertise and skills across a broad range of disciplines, are exploited by more than 600 government, academic, industrial and other research organisations around the world each year. The annual budget of the CCLRC is c. £150 million.

Economic and Social Research Council

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The ESRC is the UK's leading research and training agency addressing economic and social concerns. We pursue excellence in social science research; work to increase the impact of our research policy and practice; and provide trained social scientists who meet the needs of users and beneficiaries, thereby contributing to the economic competitiveness of the United Kingdom, the effectiveness of public services and policy, and quality of life. The ESRC is independent, established by Royal Charter in 1965, and funded mainly by government.

Eli Lilly and Company Limited

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Eli Lilly and Company Limited is the UK affiliate of major American pharmaceutical manufacturer, Eli Lilly and Company of Indianapolis. This affiliate is one of the UK's top pharmaceutical companies with significant investment in science and technology including a neuroscience research and development centre and bulk biotechnology manufacturing operations.

Lilly medicines treat schizophrenia, diabetes, cancer, osteoporosis, attention deficit hyperactivity disorder, erectile dysfunction, severe sepsis, depression, bipolar disorder and many other diseases.

Engineering and Physical Sciences Research Council

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EPSRC invests more than £500 million a year in research and postgraduate training in the physical sciences and engineering, to help the nation handle the next generation of technological change. The areas covered range from mathematics to materials science, and information technology to structural engineering.
We also actively promote public engagement with science and engineering, and we collaborate with a wide range of organisations in this area.

Freshwater Biological Association

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Tel: 01539 442468 Fax: 01539 446914
www.fba.org.uk info@fba.org.uk
Registered Charity Number : 214440

The FBA welcomes collaboration with Government and Agencies. Founded in 1929 the Association promotes freshwater science through; innovative research, serviced facilities, a programme of meetings, scientific publications, and sound independent advice. The FBA houses one of the world's finest freshwater information resources and is the custodian of long term data sets from sites of scientific significance. Membership is offered on an individual or corporate basis.

Health Protection Agency

Contact: Professor Pat Troop, Chief Executive
Health Protection Agency Central Office
7th Floor, Holborn Gate, 330 High Holborn
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Fax: 020 7759 2733
Email: webteam@hpa.org.uk
Web: www.hpa.org.uk

The Health Protection Agency is an independent organisation dedicated to protecting people's health in the United Kingdom. We do this by providing impartial advice and authoritative information on health protection uses to the public, to professionals and to government.

We combine public health and scientific expertise, research and emergency planning within one organisation. We work at international, national and regional and local levels and have many links with many other organisations around the world. This means we can respond quickly and effectively to new and existing national and global threats to health including infections, environmental hazards and emergencies.

Human Fertilisation and Embryology Authority

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Website: www.hfea.gov.uk

The HFEA is a non-departmental Government body that regulates and inspects all UK clinics providing IVF, donor insemination or the storage of eggs, sperm or embryos. The HFEA also licenses and monitors all human embryo research being conducted in the UK.

Institute of Biology

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The biological sciences have truly come of age, and the Institute of Biology is the professional body to represent biology and biologists to all. A source of independent advice to Government, a supporter of education, a measure of excellence and a disseminator of information - the Institute of Biology is the Voice of British Biology.

IOP Institute of Physics

Contact: Public Relations Department
76 Portland Place, London W1B 1NT
Tel: 020 7470 4800
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Website: www.iop.org

The Institute of Physics supports the physics community and promotes physics to government, legislators and policy makers.

It is an international learned society and professional body with over 35,000 members worldwide, working in all branches of physics and a wide variety of jobs and professions – including fundamental resarch, technology-based industries, medicine, finance – and newer jobs such as computer games design. The Institute is active in school and higher education and awards professional qualifications. It provides policy advice and opportunities for public debate on areas of physics such as energy and climate change that affect us all.

Institute of Physics and Engineering in Medicine

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IPEM is a registered, incorporated charity for the advancement, in the public interest, of physics and engineering applied to medicine and biology. It accredits medical physicists, clinical engineers and clinical technologists through its membership register, organises training and CPD for them, and provides opportunities for the dissemination of knowledge through publications and scientific meetings. IPEM is licensed by the Science Council to award CSci and by the Engineering Council (UK) to award CEng, IEng and EngTech.

IChemE

Institution of Chemical Engineers

IChemE is the hub for chemical, biochemical and process engineering professionals worldwide. We are the heart of the process community, promoting competence and a commitment to sustainable development, advancing the discipline for the benefit of society and supporting the professional development of over 27,000 members.

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Institution of Civil Engineers

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ICE aims to be a leader in shaping the engineering profession. With over 75,000 members, ICE acts as a knowledge exchange for all aspects of civil engineering. As a Learned Society, the Institution provides expertise, in the form of reports and comment, on a wide range of subjects from energy generation and supply, to sustainability and the environment.

Institution of Engineering and Technology

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The Institution of Engineering and Technology was formed in 2006 by the Institution of Electrical Engineers and the Institution of Incorporated Engineers. The IET has more than 150,000 members worldwide who work in a range of industries. The Institution aims to lead in the advancement of engineering and technology by facilitating the exchange of knowledge and ideas at a local and global level and promoting best practice.

LGC

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Website: www.lgc.co.uk

Setting standards in analytical science

LGC, a science service company, is Europe's leading independent provider of analytical and diagnostic services and reference standards. LGC's market-led divisions - LGC Forensics, Life and Food Sciences, Pharmaceutical and Chemical Services and LGC Promochem (for Reference Materials) - operate in a diverse range of sectors for both public and private sector customers.

Under arrangements for the office and function of Government Chemist, LGC fulfils specific statutory duties and provides advice for Government and the wider analytical community on the implications of analytical chemistry for matters of policy, standards and regulation.

LGC is based in Teddington, Middlesex, with other UK operations in Runcorn, Edinburgh, Culham, Risley and Tamworth and facilities in France, Germany, Italy, Poland, Spain, Sweden and India.

London Metropolitan Polymer Centre

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The London Metropolitan Polymer Centre provides training, consultancy and applied research to the UK polymer (plastics & rubber) industry. A programme of industrial short courses and customised courses, together with distance learning and other flexible delivery methods, lead to qualifications ranging from technician to Masters level, alongside the full-time courses for Polymer Engineering and Product Design. Recent successes include a WRAP sponsored programme to develop new commercial applications for recycled PET and several technology transfer projects with companies.

Marks & Spencer Plc

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Main Business Activities

Retailer – Clothing, Food, Financial Services and Home

We have around 750 stores in 33 territories worldwide, employing 65,000 people.

We offer our customers quality, value, service and trust in our brand by applying science and technology to develop innovative products and services.

Medical Research Council

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The Medical Research Council (MRC) is funded by the UK taxpayer. We are independent of Government, but work closely with the Health Departments, the National Health Service and industry to ensure that the research we support takes account of the public's needs as well as being of excellent scientific quality. As a result, MRC-funded research has led to some of the most significant discoveries in medical science and benefited millions of people, both in the UK and worldwide.

Merck Sharp & Dohme Research Laboratories

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Merck Sharp & Dohme is a UK subsidiary of Merck & Co Inc a global research-driven pharmaceutical company dedicated to putting patients first. Merck discovers, develops, manufactures and markets vaccines and medicines in over 20 therapeutic categories directly and through its joint ventures. Our mission is to provide society with superior products and services by developing innovations and solutions that improve the quality of life.

The National Endowment for Science, Technology and the Arts

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NESTA's aim is to transform the UK's capacity for innovation. We work across the human, financial and the policy dimensions of innovation. We invest in early stage companies, inform innovation policy and encourage a culture that helps innovation to flourish. The unique nature of our endowed funds means that we can take a longer term view, and develop ambitious models to stimulate and support innovation that others can replicate or adapt. NESTA works across disciplines, bringing together people and ideas from science, technology and the creative industries.

National Physical Laboratory

National Physical Laboratory
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Website: www.npl.co.uk

The National Physical Laboratory (NPL) is the United Kingdom's national standards laboratory, an internationally respected and independent centre of excellence in research, development and knowledge transfer in measurement and materials science. For more than a century, NPL has developed and maintained the nation's primary measurement standards - the heart of an infrastructure designed to ensure accuracy, consistency and innovation in physical measurement.

Natural England

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Natural England is the Government's conservation agency working throughout England; we conserve, enhance and manage the natural environment for the benefit of current and future generations. We commission research and publish papers which underpin the development of our policies and programmes.

Natural Environment Research Council

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The UK's Natural Environment Research Council funds and carries out impartial scientific research in the sciences of the environment. NERC trains the next generation of independent environmental scientists.

NERC funds research in universities and in a network of its own centres, which include:

British Antarctic Survey, British Geological Survey, Centre for Ecology and Hydrology, National Oceanography Centre and Proudman Oceanographic Laboratory

Newcastle University

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Newcastle University is a member of the Russell Group of research intensive universities. Newcastle's focus is Excellence with a Purpose. The University has a well balanced portfolio of research funding and a very significant portfolio of FP6 EU activity (with over 100 projects involving more than 1800 partners) with a strong interdisciplinary approach to research. The University was a winner in the 2006 EPSRC Knowledge Transfer awards. The University is taking its commitment further through the development of Newcastle Science City in partnership with the City Council and RDA.

The Nutrition Society

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Founded in 1941, The Nutrition Society is the premier scientific and professional body dedicated to advance the scientific study of nutrition and its application to the maintenance of human and animal health.
Highly regarded by the scientific community, the Society is the largest learned society for nutrition in Europe. Membership is worldwide and is open to those with a genuine interest in the science of human or animal nutrition.
Principal activities include:
1. Publishing internationally renowned scientific learned journals
2. Promoting the education and training of nutritionists
3. Promoting the highest standards of professional competence and practice in nutrition
4. Disseminating scientific information through its publications and programme of scientific meetings

PHARMAQ Ltd

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Website: www.pharmaq.no

Veterinary pharmaceuticals specialising in aquatic veterinary products. Fish vaccines, anaesthetics, antibiotics and other products.

Prospect

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Prospect is an independent, thriving and forward-looking trade union with 102,000 members. We represent scientists, technologists and other professions in the civil service, research councils and private sector.

Prospect's collective voice champions the interests of the engineering and scientific community to key opinion-formers and policy makers and, with negotiating rights with over 300 employers, we seek to secure a better life at work by putting members' pay, conditions and careers first.

The Royal Academy of Engineering

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Website: www.raeng.org.uk

As Britain's national academy for engineering, we bring together the country's most eminent engineers from all disciplines to promote excellence in the science, art and practice of engineering. Our strategic priorities are to enhance the UK's engineering capabilities; to celebrate excellence and inspire the next generation; and to lead debate by guiding informed thinking and influencing public policy.

KEW GARDENS

The mission of Kew is to enable better management of the Earth's environment by increasing knowledge and understanding of the plant and fungal kingdoms – the basis of life on Earth. Kew is fundamentally a scientific, amenity and educational organisation devoted to increasing knowledge and public understanding of plant and fungal diversity – how it came to be, what its current status is, how it can be conserved for future generations, and how it can be used in sustainable ways for human benefit.

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SAVING THE WORLD'S PLANTS FOR LIFE

The Royal Institution

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The Royal Institution has a reputation established over 200 years for its high calibre events that break down the barriers between science and society. It acts as a unique forum for informing people about how science affects their daily lives, and prides itself on its reputation of engaging the public in scientific debate. During 2007 the Ri is closed for the refurbishment of its Grade 1 listed building. The public and schools' events programme will continue throughout this time. For more details on this and our refurbishment plans, please see our website.

The Royal Society

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The Royal Society is the UK academy of science comprising 1400 outstanding individuals representing the sciences, engineering and medicine.
As we prepare for our 350th anniversary in 2010, our strategic priorities for our work at national and international levels are to:

- ·Invest in scientific excellence to create tomorrow's leaders of science
- ·Influence policymaking with the best scientific advice
- ·Invigorate science and mathematics education
- ·Inspire an interest in the joy, wonder and fulfillment of scientific discovery

The Royal Society of Chemistry

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http://www.chemsoc.org

The Royal Society of Chemistry is a learned, professional and scientific body of over 46,000 members with a duty under its Royal Charter "to serve the public interest". It is active in the areas of education and qualifications, science policy, publishing, Europe, information and internet services, media relations, public understanding of science, advice and assistance to Parliament and Government.

The Royal Statistical Society

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The RSS is much more than just a learned society. We lead the way as an independent source of advice on statistical issues and play a crucial role in raising the profile of statistics, through our links with government, academia and the corporate and voluntary sectors. We have a powerful voice at Royal Commissions, Parliamentary Select Committees and at public consultations, offering our own unique view on just about anything, from freedom of information to sustainable development.

The Science Council

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The Science Council has a membership of over 27 professional institutions and learned societies covering the breadth of science and mathematics. Its purpose is to provide an independent collective voice for science and scientists and to maintain standards across all scientific disciplines. We are active in science policy issues including science in education, health, society and sustainability. In 2003 the Science Council was granted its Royal Charter and in 2004 it launched the Chartered Scientist (CSci) designation as a measure of high standards in the practice, application, advancement and teaching of science. We now have over 10,000 Chartered Scientists.

SEMTA

Technology Skills For Productivity & Performance

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Website: www.semta.org.uk

SEMTA (Science, Engineering and Manufacturing Technologies Alliance) is the Sector Skills Council for the science, engineering and manufacturing technology sectors.

Our **mission** is to ensure that our industry partners have the knowledge and skills required to meet the challenges faced by the workforce of the future.

Our sectors account for a significant proportion of the UK economy. There are about 2 million people employed in about 76,000 establishments in the core Science, Engineering and Technology sectors, currently contributes over £74 billion per annum – about ten per cent – of total UK GDP.

Society for General Microbiology

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SGM is the largest microbiological society in Europe. The Society publishes four journals of international standing, and organises regular scientific meetings.

SGM also promotes education and careers in microbiology, and it is committed to represent microbiology to government, the media and the public.

An information service on microbiological issues concerning aspects of medicine, agriculture, food safety, biotechnology and the environment is available on request.

Society of Chemical Industry

SCI where science meets business

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SCI is an interdisciplinary network for science, commerce and industry. SCI attracts forward-looking people in process and materials technologies and in the biotechnology, energy, water, agriculture, food, pharmaceuticals, construction, and environmental protection sectors worldwide. Members exchange ideas and gain new perspectives on markets, technologies, strategies and people, through electronic and physical specialist conferences and debates, and publish journals, books and the respected magazine *Chemistry & Industry*.

Society of Cosmetic Scientists

FOUNDED 1948 SCS SOCIETY OF COSMETIC SCIENTISTS

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Advancing the science of cosmetics is the primary objective of the SCS. Cosmetic science covers a wide range of disciplines from organic and physical chemistry to biology and photo-biology, dermatology, microbiology, physical sciences and psychology.

Members are scientists and the SCS helps them progress their careers and the science of cosmetics ethically and responsibly. Services include publications, educational courses and scientific meetings.

Universities Federation for Animal Welfare

UFAW Established 1926

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Email: ufaw@ufaw.org.uk
Website: www.ufaw.org.uk
Registered Charity No: 207996

UFAW is an internationally-recognized independent scientific and educational animal welfare charity. It works to improve animal lives by:

- supporting animal welfare research.
- educating and raising awareness of welfare issues in the UK and overseas.
- producing the leading journal Animal Welfare and other high-quality publications on animal care and welfare.
- providing expert advice to government departments and other concerned bodies.

Science Diary

The Parliamentary and Scientific Committee

Contact: Annabel Lloyd
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www.scienceinparliament.org.uk

Wednesday 6 June 17.30
Elephants – will they survive the next 100 years in the wild?
Speakers: Dr Ian Whyte, Kruger National Park
Prof Twink Allen, University of Cambridge

Monday 18 June 17.30
Is Dual Funding of our Universities Fit for Purpose in the 21st Century?
Speakers: Rama Thirunamachandran, HEFCE
Sir Keith O'Nions FRS, Director General of Science and Innovation, DTI
Dr Peter Cotgreave, CaSE

Monday 9 July 17.30
The Design and Regulation of Modern Clinical Trials
Speakers: Prof Sir Gordon Duff, Sheffield University
Prof Janet Darbyshire, MRC Clinical Trials Unit
Dr Julia Dunne, MHRA

The Royal Institution

Due to refurbishment, all Ri events are to be held at external venues throughout 2006 and into 2007. See www.rigb.org or telephone 020 7409 2992 for full details and to book tickets.

Wednesday 6 June 20.15
Bending Minds
Dr Martin Westwell
Town Hall, Cheltenham

Saturday 9 June 20.30
Ageing inside and out
Prof Tom Kirkwood
Town Hall, Cheltenham

Wednesday 13 June 19.30
The future of the knowledge economy through the lens of the brain sciences
Ian Brinkley, Michelle Mahdon and Dr Martin Westwell
Holborn Bars, London

Tuesday 19 June 19.00
Science in virtual worlds
Aleks Krotoski, Joanna Scott and Dr Dave Taylor
The Apple Store, London

Wednesday 20 June 19.00
Engineering the gold: sport and technology in the future
Prof Steve Haake
Showroom and Workstation, Sheffield

Tuesday 26 June 19.00
How the media promotes the public misunderstanding of science
Dr Ben Goldacre
Friends Meeting House, London

Thursday 28 June 19.00-20.30
Silicon animals: how computers simulate biology
Prof David Harel and Prof Stephen Muggleton
The Institution of Engineering and Technology, London

Tuesday 3 July 19.00
The intellectual ragpicker
Prof George Whitesides
University College London

Monday 9 July 19.00
An ocean of air
Gabrielle Walker
Zoological Society of London

The Royal Society

6-9 Carlton House Terrace
London SW1Y 5AG
The Royal Society runs a series of events, both evening lectures and two day discussion meetings, on topics covering the whole breadth of science, engineering and technology. All the events are free to attend and open to all.

Highlights in the next few months include:

Monday 18 and Tuesday 19 June (all day)
The evolution of the animals: a Linnean tercentenary celebration

Summer Science Exhibition 2007, 2-5 July
Opening times:
Monday 2 July 6-9pm
Tuesday 3 July 10am-9pm
Wednesday 4 July 10am-4.30pm
Thursday 5 July 10am-4.30pm
The exhibition is FREE to attend and open to all.

Please see www.royalsoc.ac.uk/events for the full events programme, more details about the above highlights and web casts of past events.

The Royal Academy of Engineering

29 Great Peter Street,
London SW1P 3LW.
For further information about events visit www.raeng.org.uk/events or contact events@raeng.org.uk

Tuesday 29 May 18.00 for 18.30
Carpe diem: the dangers of risk aversion
Lloyd's Register Educational Trust Lecture & Dinner
Speaker: Professor Roderick Smith FREng
7 Carlton House Terrace
For further details contact:
Faye Whitnall
Email: faye.whitnall@raeng.org.uk

The Royal Society of Edinburgh

22-26 George Street,
Edinburgh EH2 2PQ.
Tel: 0131 240 5000
Fax: 0131 240 5024
events@royalsoced.org.uk
www.royalsoced.org.uk
All events require registration and, unless otherwise indicated, take place at the RSE.

Monday 28 May 17.30
Can Information be Private?
Baroness O'Nora O'Neill of Bengarve, President, The British Academy
At the Royal Museum

Monday 18 June 17.30
A Brush with Foxes and other Carnivore Tales
Professor David W Macdonald, Director, Wildlife Conservation Research Unit, Oxford University

Wednesday 20 June 17.30
Architecture in Nano-Space
Professor Sir Harry Kroto FRS HonFRSE, Royal Society Research Professor, School of Chemistry, Physics and Environmental Science, University of Sussex

Monday 2 July (all day)
The 250th Anniversary of the Birth of Thomas Telford
Conference

SCI

14/15 Belgrave Square
London SW1X 8PS
Contact: conferences@soci.org or 020 7598 1562
Unless otherwise stated events are at SCI

Thursday 7 June
What a Chemist needs to Know about Safety Assessment
SCI Fine Chemicals Group

Tuesday 26 June
Retrosynthesis and Heterocyclic Chemistry
SCI Fine Chemicals Group, SCI Young Chemists' Panel Group
At City Lodge Hotel, Nottingham

Wednesday 27 June
Practical Crystallisation: The Black Art Solved
SCI Young Chemists' Panel Group, SCI Fine Chemicals Group
At Strathclyde University

Wednesday 27 June
Mixed Mode Chromatography - a Multimodal Separation Technique for Biopharmaceutical Purification
SCI Separation Science and Technology Group

Science in Parliament
3 Birdcage Walk, London SW1H 9JJ
Tel: 020 7222 7085 Fax: 020 7222 7189
Editor: Professor Peter Simpson
Editorial Assistant: Mrs Annabel Lloyd

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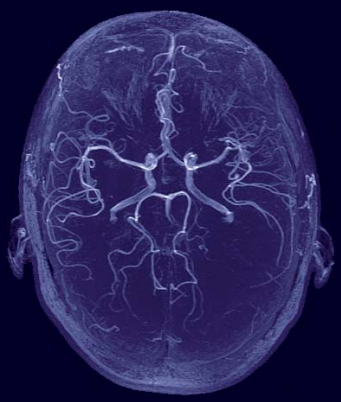

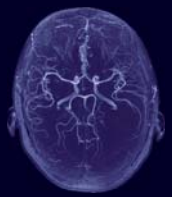

Magnetic resonance angiograph of blood vessels in the brain, obtained by the Centre for Medical Image Computing, in UCL Medical Physics & Bioengineering and UCL Computer Science. By Dr Dean Barratt, who works on imaging applications for minimally invasive intervention

www.ucl.ac.uk