Spring 2008

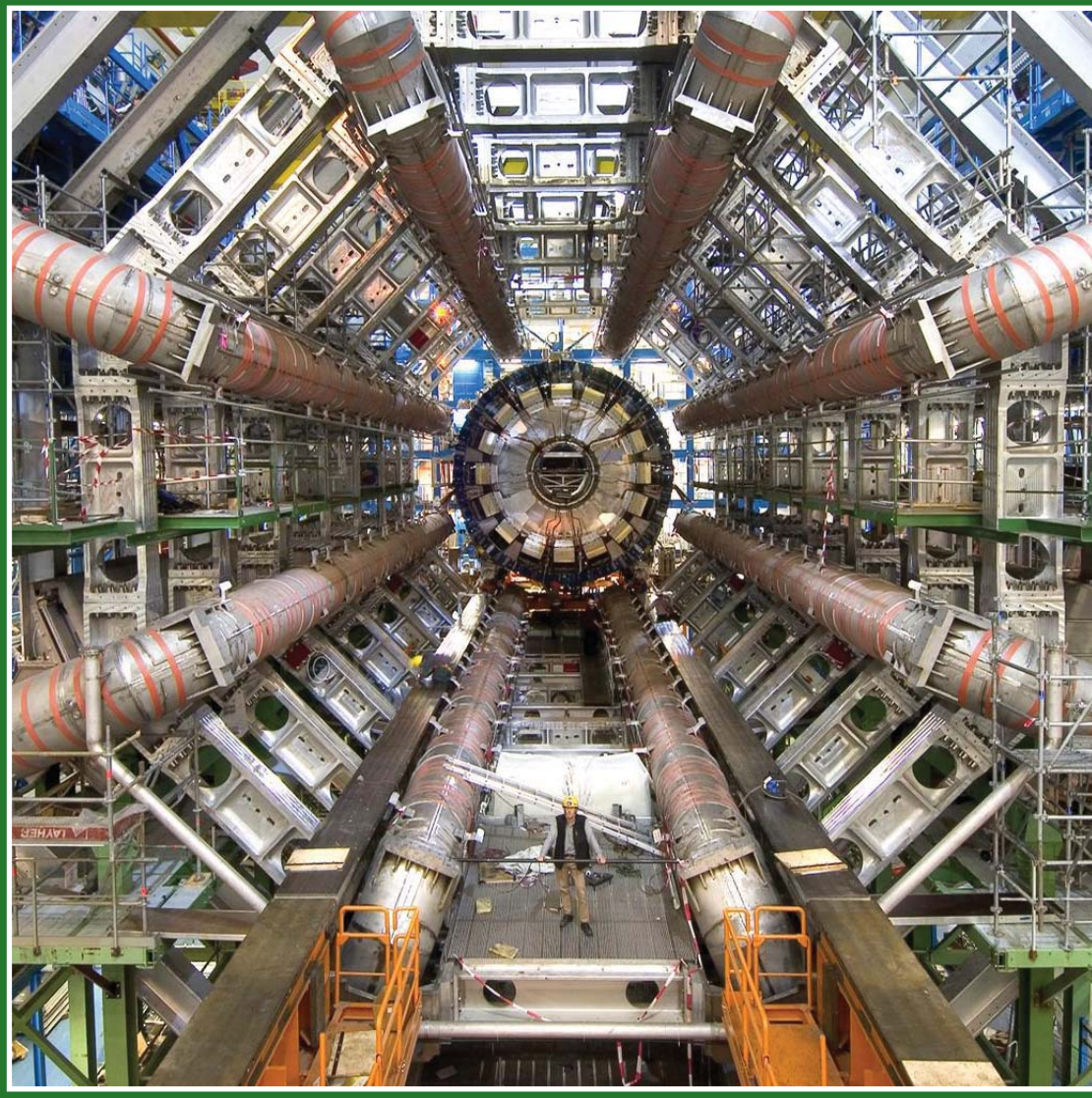
SCIENCE IN PARLIAMENT

Population Growth & Control

Predicting & Mitigating Natural Disasters

Solar Power from Deserts

David King Farewell at Annual Lunch



Atlas Detector for CERN's Large Hadron Collider

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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

Why, when CSR07 increased the budget for the Science & Technology Facilities Council by 13.6%, do they find themselves with an £80 million shortfall in their budget? Application of Full Economic Costs to research grants is being blamed in part, but all the Research Councils are facing that problem. And, why are the Research Councils, who will now provide 80% of FECs, having to find the full amount when other budgets were finding some of these costs previously?

The fact is that the future of Daresbury, a science and innovation campus, is at risk for the second time. If the science disappears off that site, will companies be attracted to set up business there? Changes in the STFC budget appear to be hitting physics departments in universities too. There are a lot of questions to answer.

There have been some excellent debates in the House of Lords on the Human Fertility and Embryology Bill, with the Bill remaining largely intact, even regarding research on 'human admixed embryos' (or cytoplasmic hybrid embryos, as they were previously known). But, why has the Human Fertility and Embryology Authority decided to grant two licences for research in this area before the HoC has even debated the Bill? The HoL has not got embroiled in the abortion debate.

Scientists at the University of Manchester have developed a way of altering the structure of calcium-dependent lipopeptide antibiotics that could lead to novel drugs that are active against superbugs such as MRSA and C. difficile, and others at the John Innes Centre have developed a decoy system for the enzymes released by bacteria that destroy antibiotics, so that existing antibiotics can remain effective.

Today, more than 200 biological medicines, mainly large complex protein molecules, are produced by the biotechnology industry. However, unlike generic copies of conventional drugs, follow-on products in this area of medicine cannot produce products that are identical to the innovator drugs. This raises some problems that are discussed in this edition of SiP.

Dr Brian Iddon MP
Chairman, Editorial Board
Science in Parliament

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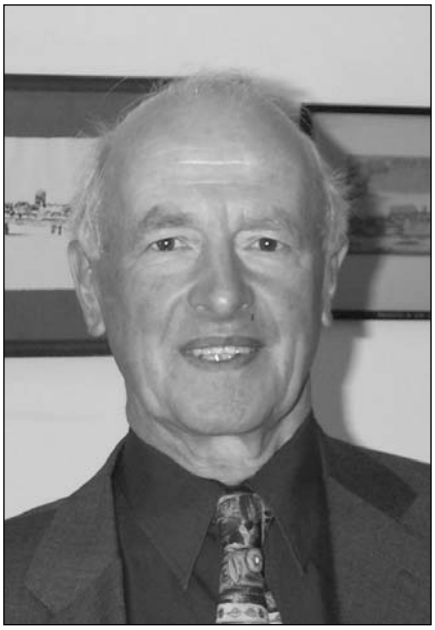
OPINION

Science Policy

Dick Taverne



Generally the Government's science policy, and especially the former science minister, David Sainsbury, deserve high praise. My main concern, however, is with the depth of its commitment to the principle on which all science ultimately depends: the evidence-based approach.

Ministers pay lip service to the principle, but often fail to defend it when they come under pressure from special interest groups. There was, for instance, the decision of the Medicines and Healthcare products Regulatory Agency (MHRA) to license claims for the efficacy of homeopathic products solely on the basis of homeopathic provings. While it may seem a minor issue, for the first time the MHRA abandoned its long-standing principle that medical claims must depend on scientific evidence. Why? According to the Government's explanatory memorandum, otherwise development of the homeopathic industry would be inhibited!

As the President of the Royal Society stated in a House of Lords debate, for homeopathy to work except as a placebo requires the suspension of the laws of science. Nevertheless it is supported by public funds. Whereas the NHS cannot finance many life-saving but expensive new drugs that have been proved to be effective, it supports four national homeopathic hospitals. Some 40 per cent of GPs offer NHS treatment by alternative medicine and 16 universities award science degrees in complementary and alternative medicine (including homeopathy, reflexology, ayurveda, shiatsu and qigong).

Much more important is policy on biotechnology. The Government's record on stem-cell research (except for an early wobble on "chimera" cells) is generally good. But under pressure from green lobbies, Britain like the rest of Europe has virtually opted out of agricultural biotechnology. After years of inaction it has only recently permitted the experimental cultivation of one GM crop, a potato resistant to blight. There could be no greater contrast with China, one of our biggest future competitors, which plans to base its industrial growth firmly on science and especially on biotechnology. It will soon be responsible for over half the world's research into the development of GM crops, particularly new varieties of rice and of other staple crops that will benefit hundreds of millions of poor farmers.

Sir David King, the former chief scientist, recently came out strongly in favour of GM crops. He said they are safe, essential for feeding the hungry and can help mitigate the effects of climate change. Where were the declarations of ministers in his support? Throughout the GM debate, with the exception of one speech by Tony Blair, ministers remained silent.

Pressure from lobby groups, supported by restaurant and supermarket boasts that they are "GM free", has led the public to believe that GM crops are not safe to eat. Yet the experience of hundreds of millions of people who have now been eating food with some GM content for over a decade, has not produced a single case of harm to human health. The findings of every major independent study by independent sources, WHO and numerous national academies of science are unanimous: there is no evidence that GM crops are any less safe to eat than conventional crops.

It is claimed that GM crops are bad for biodiversity and the environment. In fact their cultivation has significantly reduced the use of herbicides and pesticides because they reduce the need to spray them. They can also avoid or minimise the need to plough, which saves energy, prevents the emission of greenhouse gases from the soil and stops soil erosion. Many people object that GM crops mainly benefit big business, but new technologies often do. That is no more reason for rejecting the technology than rejecting life-saving drugs because they are produced by large pharmaceutical companies. In fact over 10 million small-scale farmers in developing countries have already increased their income and improved their health by growing GM crops, mainly cotton. Most of the next generation of genetically engineered crops will be developed by public funds, though chiefly in China.

So what should the Government do? It should fight within the EU to unravel the over-regulation that has made it hugely expensive and time-consuming to develop new GM crops. This regulation not only penalises small companies, but prevents the developing world exporting GM crops to Europe. Next, through DfID, it should follow where the Gates Foundation leads and help agriculture in Africa realise the benefits science can bring to such staple crops as bananas, cassava, rice and sorghum.

Above all, it should recognise publicly, as China and India have, by word and deed, that biotechnology is a key industry of the future, with a vital role in feeding three billion extra mouths, making better use of increasingly scarce agricultural land and mitigating the effects of global warming.

Science Centres

Adam Hart-Davis

What are science centres for? They are places where anyone, especially children and families, can get to grips with science. There are more than 40 science centres in the UK, which in total attract some 5 million visitors each year.

Thirty years ago I went to work at Yorkshire Television, and the first item I put on the screen was about the slipperiness of banana skins*. This was for the series *Don't Ask Me*, starring Magnus Pyke, David Bellamy, and Miriam Stoppard. For six months of the year this programme went out every Wednesday evening, between *Crossroads* and *Coronation Street*, and attracted ten million viewers. At the same time the BBC showed *Tomorrow's World*, which had a similar audience, plus *Antenna, QED*, and *Horizon* - and there was *How*, aimed specifically at children. The total number of viewer-hours of science programmes must have averaged more than five million a week.

There were only three channels then; now there are dozens of channels, but almost no science. All those programmes have gone, apart from *Horizon*, which seems to have become a series of disaster movies. There is no longer any science programme to attract families, and for kids to talk about at school the next day.

Meanwhile in school, teachers are under pressure to steer kids away from difficult subjects like physics, because the league tables have become paramount; any pupil who risks scoring less than A+ is likely to drag the school down the tables.

In the last decade there has been a drastic reduction in the number of university applications to study physics, chemistry, and engineering. As a direct result the country is now seriously short of engineers and physics teachers, which has led to the worst sort of positive feedback loop – fewer physics teachers means fewer physics and engineering students, and so on. I suggest that the disappearance of science programmes from the television screen has been a major cause of this decline.

The future is science. Scientists are vital to the success of the country. How can we persuade young people that science and engineering are worth studying? They need to experience the fascination of science for themselves, and preferably by doing rather than merely hearing. Apart from formal school classes, the best forum we have is the network of science centres, where children and families can indeed interact directly with science.

This is the function of science centres. They have taken over from television as the primary source of scientific ideas and information. Just as the whole family would sit down to watch *Don't Ask Me* and *Tomorrow's World*, so whole families visit science centres to be amazed, delighted, and informed by the interactive exhibits. The centres provide not only family entertainment – and last year at-Bristol beat places like Alton Towers to be voted Family Attraction of the Year – but structured learning for school parties, and continuing professional development for teachers. Their outreach programmes deliver demonstration kits to schools.

As part of the millennium celebrations, £1000 million was invested in 17 science centres, which were then left to sink or swim. Two have already closed, and a third has been forced to close half its facilities and make many staff redundant. This is a terrible waste of money and resources.

No science centre in the world has ever been self-sufficient. They need continual investment, both for maintenance, and in order to build novel exhibits, so that visitors come back. Appealing for capital investment from the Wellcome Trust, from RDAs, and from other local sources is possible, but getting ongoing funding is difficult.

Science centres typically obtain 50 per cent of their running costs from ticket sales, and receive Government subsidy in Wales and Scotland. In England, however, where museums, schools, and libraries are funded by Government, science centres are not, even though they perform several of the same educational functions.

Four hundred years ago Francis Bacon wrote that "Whether or no anything can be known, can be settled not by *arguing*, but by *trying*." In other words he was a pioneer advocate of hands-on science.

Children today want to be hands-on doing things – they expect instant gratification. This is what science centres can provide. By linking up and providing outreach to schools they can feed and spark off each other. Centres shouldn't be expected to be self-financing, but an educational resource, investment in which is an investment in the country's future success – and that is why the country's science centres deserve Government support.

*In case you were wondering, we organised the measurement of the coefficients of friction between shoes and concrete paving, moderated by lubricants. These were the results:

Shoes	dry	on 20/50 motor oil	on banana skins
CoF (μ)	0.70	0.35	0.16

So banana skins really do provide superb lubrication.

A Bridge over Troubled Water – facilitating science into policy

Professor Michael Elves and Mia Nybrant

Chairman and Director, Newton's Apple

We live in a world in which issues such as climate change, disease and poverty require urgent measures that provide a sustainable impact. Policies and strategies to address these issues – whether formulated and implemented by Government, charities or industry – must be based upon evidence and credible modelling. Key to these is a thriving science, engineering and technology (SET) research base, in both academia and industry, which can effectively inform the policy processes.

The difficulties of transferring scientific evidence into policies and strategies have been known for a long time and the process is unlikely ever to be easy. For example, a central and enduring problem is that the scientific method does not give immediate certainty, which often is what policymakers are seeking. Scientific advance seldom comes in tidy black and white blocks. At the cutting edges of SET, initial uncertainty regarding what new research shows, and what it means in the bigger picture, is almost inevitable. New results in one study must be independently verified through repetition by another research group, as well as peer review. Different interpretations of the same results may well be put forward. New hypotheses will be generated and early results will be built upon as new questions are asked, their answers sought and, hopefully, found. Ultimately a consensus may be built up by most experts in the field, although there are often a few who will disagree. To add to this complexity, scientific or technical data, particularly that relating to issues such as risk, hazard or impacts, can be used by different groups to support one position or another. For policy makers this can be confusing – what is fact and what is opinion or even dogma? The long timescales required to reach a consensus in science also often pose a problem as policymakers tend to work in shorter cycles.

Within the policy process a major limitation is the lack of tools to interpret science and its methodology and thus the ability to design effective gateways to feed science into policy. Policymakers come and go, but the processes and the mentality within policy generating bodies, be they Government, Parliament, charities or others, tend to stick. Another serious problem is that many within the scientific community do not realise that their own work and research could have an impact on the development of policy and that they therefore could have an additional role to play in society.

These are not novel problems, but a novel approach is now needed to ensure that the gateways through which policymakers interpret and capture scientific evidence are radically improved. Any attempt to do this must bring together those who produce scientific evidence, with those who are engaged in the policy process. This is **not** about **lobbying**, but about **informing**. Effective and neutral facilitation of understanding is needed so that the crucial evidence base can be used to produce policies on issues which will have a fundamental impact on the wellbeing of society – for example in the areas of environment and health. Not only do we need to bring this realisation to the best of the UK scientists of today, but also to those younger scientists who will form the science base of tomorrow. Practical, easily implemented communication and analytical tools and evaluation frameworks must be developed within policy generating bodies in order to strengthen their ability to consider scientific evidence, or the lack thereof, when developing long-term policies. The gateways through which policy invites science to engage and to share expertise, where policy interprets science, and where the two cultures meet, must be adapted to the constraints and abilities of both the science and the policy arenas. In order to close the gap, novel practical solutions must be developed – and most vitally – implemented and evaluated.

Newton's Apple was established to do just this: to act as a bridge between the science and policy communities and to foster an increase in the use, and effectiveness, of the science-into-policy gateways. Things won't change overnight, but the projects Newton's Apple has carried out thus far have already shown promise. Practical methods, training and applications have to be developed jointly with, and spread within, the two communities. Currently two programmes are under development in these areas. The first aims to develop science policy training for early career scientists enabling them to understand the impact that their research could have on policy as well as how they could access the science-into-policy gateways. The second will provide guides to create useful and practical frameworks and tools in which scientific evidence can be identified, evaluated and used in policy-making. The prime objective of both programmes is to facilitate a smoother flow of outputs from the UK science, engineering and technology base into the policy process. Ultimately this will bring great benefit to all of us in society.

Après le déluge!

Barbara Young
Chief Executive, Environment Agency

The severe flooding that affected much of the country in June and July followed what we now know to be the wettest May to July period since records began in 1766. Much of the flooding occurred because drainage systems and some defences could not cope with the sheer quantity of water.

Whilst little reported, the Environment Agency's activities and previous investment to protect homes and businesses substantially reduced the impacts of this extreme event. Nevertheless, the effects were severe. Several people sadly lost their lives. 44,600 homes and 7,100 businesses were flooded. Transport infrastructure was disrupted, and many properties were without power and water for many days.

Recovery from such an event can take many months, as properties are dried out, cleaned, repaired and redecorated. Rural areas and businesses too have had to face the impacts of flooding, with many farmers suffering significant losses of livestock and crops.

Every flood provides a learning opportunity to examine the causes and identify areas for improvement. The summer floods highlighted a number of issues, many of which we were already tackling. Three of the most important challenges are urban surface water drainage, the need for a strategic overview role for all types of flooding and the need to protect critical infrastructure.

In many places, flooding occurred as a result of prolonged heavy rainfall, leading to surface water run-off and drainage systems being overwhelmed. Most of our sewers were built in Victorian times, for a population less than half as large as it is today. Pressures on drainage infrastructure have also been increased by new development, infill of previously undeveloped land and increased levels of impermeable paving. To compound the problem, climate change is likely to make urban surface water flooding more common as rainfall is predicted to increase by 10-30% by the 2080s, and intensity could increase by up to 20%.

New development, however, offers the opportunity to look more holistically at the drainage issue. Sustainable drainage systems provide a more robust and flexible way to deal with urban flooding. They slow the movement of surface water through the built environment, emulating natural processes and reducing the impact of rainfall on the drainage system. However, such systems require long term maintenance and, at present, there is no legal clarity as to whose responsibility this is or who will fund it.

It is vital that there is clarification of responsibilities for inland flooding. Whilst local authorities and water companies are the key players for urban surface water flooding, no single organisation has a strategic overview role for flooding from all sources, including rivers, seas and surface water.

A national approach would have a number of benefits, co-ordinating methodologies and techniques for risk characterisation; aligning the design capacity of surface water systems with those of river and coastal defences; and maximising the contributions that 'whole-catchment' approaches to water management offers.

The vulnerability of critical infrastructure was also made obvious by experiences at Walham electricity sub-station during the summer floods. Our Receptors Vulnerable to Flooding project (2007) found that significant numbers of critical infrastructure facilities are at risk from flooding. This includes 15% of major energy installations, 14% of fire, ambulance and police stations, 9% of hospitals and health centres, and 57% of water and sewerage works, as well as numerous railway stations and lines, roads, telephone exchanges and schools.

Though the Civil Contingencies Act requires business continuity plans to be prepared, this does not extend to a specific duty to protect critical assets from flooding. For example, our experience suggests that most providers of these critical services do not have appropriate continuity plans in place to address all the potential impacts of major flooding.

To ensure that adequate progress is made, the Environment Agency is calling for a specific requirement for utilities and owners of critical infrastructure to take account of climate change adaptation to be included in the Climate Change Bill.

Of course, it is not only critical infrastructure that is at risk – homes also need to be adapted to climate change impacts such as flooding. For new developments in flood risk areas

we want to see resistance and resilience requirements included in Building Regulations. Over 5 million people, in over 2 million properties, already live in flood risk areas in England and Wales, yet most of these people have not taken any action to prepare for flooding.

We spend approximately £500m a year on flood risk management.

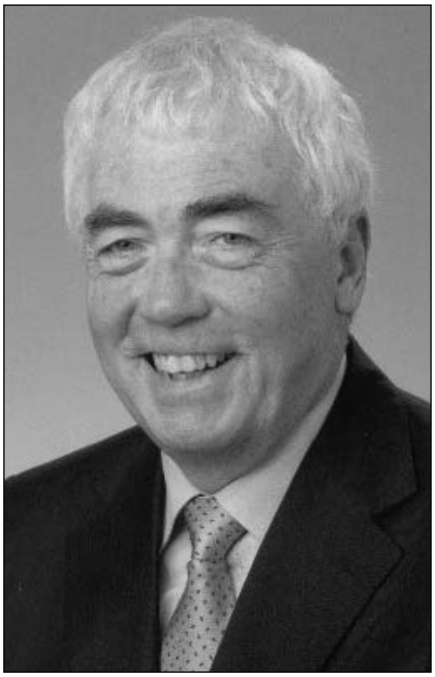
However, even with all the investment we put in, it is impossible to prevent flooding entirely. But by typing in their postcodes to the Flood Map on the Environment Agency website, people can check whether they are in a flood risk area, and can follow advice to reduce the risk of flooding to their homes. Simple resilience measures can reduce the average cost of a household flood from £26,000 to below £10,000.

The summer floods demonstrated some hard lessons.

The biggest lesson is that adaptation to the impacts of climate change, not just floods but also heat and drought and impacts on health, must be as much at the forefront of all our agendas as reducing greenhouse gases to mitigate climate change.

The Draft Human Tissue and Embryos Bill

Phil Willis MP



The 1990 Human Fertilisation and Embryology Act – which built on the outstanding work of Lady Warnock and her committee – created a legislative platform for *in vitro* fertilisation to flourish in the UK for almost two decades. Indeed, despite many legal, ethical and procedural challenges, the Act has stood the test of time and has allowed not only clinical practice in IVF to flourish but significantly embryo research making the UK a world leader in this key area.

The Human Fertilisation and Embryology Authority (HFEA) set up as an arms length regulatory body has generally served the human fertilisation and embryology community well. The HFEA has many critics and its cause was not helped by the recent Taranissi case, but as the former Science and Technology Select Committee found when looking at Government proposals to regulate 'Hybrids and Chimera Embryos', the UK regulatory framework is greatly admired around the world.

The need to re-examine the legislation and the regulatory framework came, not from a sense of failure, but from its success. A highly influential Report, Human Technologies and the Law, produced in 2005 by the Science and Technology Select Committee, urged the Government to review the legislation to take account of advances in research and clinical treatment. Though slow to react the Government was forced into action when the HFEA, faced with potential new research requests for work on human-animal embryos, sought Parliamentary guidance. A Government White Paper produced in December 2006 proposed to ban the creation of cytoplasmic hybrid embryos – an organism consisting of at least two genetically different kinds of tissue as well as other kinds of interspecies embryos.

The outcry that resulted from the research community prompted the Science and Technology Committee to examine the proposals and conclude that regulation within a permissive legal framework was a more satisfactory way to proceed. The Department of Health listened and in July produced a Draft Human Tissue and Embryos Bill which proposed to allow by statute some research on a limited group of interspecies embryos.

Of course the Draft Bill also took the opportunity to update the law with regard to IVF treatment, taking into account research developments and societal changes. The Draft Bill sought to clarify issues as controversial as embryonic sex selection, the welfare of the child and removing the need for a father, IVF treatment for same sex couples, the register and confidentiality, surrogacy, saviour siblings, egg and sperm donation, embryo storage and permission to use techniques such as mitochondrial (cytoplasmic) transplantation.

In addition the Government sought to create a new regulatory authority, the 'Regulatory Authority for Tissue and Embryos' (RATE) by essentially combining the HFEA with the Human Tissue Authority (HTA).

The Government was right to seek pre-legislative scrutiny for such complex and potentially divisive proposals and I was privileged to chair the Draft Bill Committee which

contained some eminent and at times quite 'challenging' Members. After all, to have Lord Winston, the renowned fertility expert, Baroness Deech, a former Chair of the HFEA, and Lord McKay the former Lord Chancellor, (who had been responsible for writing parts of the 1990 Act) examining the proposals was challenge enough. However, combined with the likes of Dr Ian Gibson who chaired the 'Human Fertilisation and the Law' Inquiry, the Bishop of St Albans and the forensic mind of Lord Patrick Jenkin – it is safe to say the Draft Bill received excellent scrutiny from the Joint Committee despite the tight time constraints.

In all the Joint Committee made 31 recommendations to which the Government agreed in principle to 10, rejected 7 and partially accepted, deferred or delegated the remainder.

The flagship proposal to establish RATE was abandoned much to the delight of the BMA and virtually every other stakeholder who gave evidence. The fact that the Government accepted that confidence in IVF and embryo research was best retained through the current regulator, the HFEA, demonstrated, I believe, the spirit in which this crucial area of policy has been approached.

This approach was applied to other highly controversial areas where evidence from the Committee persuaded the Government to alter its position.

The Joint Committee had argued that trying to create different categories of interspecies embryos was misguided – that in effect once animal and human materials were allowed to mix in whatever quantities a line had been crossed and thereafter the quality of the proposal should be decided by the regulator.

Likewise we argued that having accepted the principle of 'saviour siblings' for 'life threatening' conditions using umbilical cord blood stem cells this practice should be extended to 'serious' conditions which would include life threatening by definition.

And as regards access to the register we proposed extending access to cohabiting couples and those planning intimate relationships which we felt was more in line with current societal positions.

However, central to the Joint Committee's thinking was the architecture of the Bill, which we thought should favour a more flexible approach within clearly defined parameters. We recommended that there should be a clear framework based on the principle of devolved regulation, this in contrast to the Government's desire for legal certainty. The strength of the 1990 Act was an element of 'future proofing' which we wanted to build into the new legislation by allowing the regulator greater freedoms. We did so, recognising the speed at which research – particularly that involving the development of embryonic stem lines was progressing. We did not want to create a situation where the regulator would constantly have to come back to Parliament for new permissions.

The Government opted for legal certainty but did accept that the HFEA should have more flexibility regarding licensing decisions with respect to a list of interspecies embryos as defined in the Bill. It further conceded that, provided the research was 'necessary and desirable', the HFEA should be able to license new research bids – a probable 'score draw' to use football parlance. I suspect there could be a breakthrough if both the Committee and the Government's desire to have a single comprehensive definition for all interspecies embryos could be realised.

As expected, the Joint Committee was divided in its views on some of the ethical and societal issues presented in the Draft Bill. The dropping of 'the need for a father' created heated but purposeful debate with well argued support for both positions. The Committee agreed this, like many of the research issues, should be put to a 'free vote' when the Bill comes before the House but suggested the Bill could be amended to incorporate the 'need for a second parent' seeking not to discriminate against single women or lesbian couples.

Of course the Joint Committee found it frustrating not to be able to call on an ethics committee in the House to advise on these hugely important issues. It must be a failing of our Parliamentary system that the Government and Parliament does not have its own committee to advise on ethics issues – which are, after all, at the heart of so much new medical research. The Committee considered access to a national bio–ethics committee but rejected that in favour of a Parliamentary Bio-Ethics Committee. Sadly this was one recommendation that the Government refused to sanction.

The Human Fertilisation and Embryology Bill is now passing through the House of Lords and not unexpectedly many of the arguments heard by the Draft Committee are being rehearsed again. The Bill is far more acceptable that when it began its journey in draft and as yet has not been subjected to amendments on the 1967 Abortion Act - that pleasure awaits the House of Commons. What was clear from the work of the Joint Committee was the need to take heed of Mary Warnock's wise words back in the late 1980s when she said "The law must not outrage the feelings of too many people; but it cannot reflect the feelings of them all. It must therefore be drawn with a view to the common good."

Wise words for scientists and ethicists alike.

Phil Willis MP
Chairman Draft Tissue and Embryos Bill
Chairman of Innovation, Universities and Skills Select Committee

The Institute for Animal Health; its role as a research provider and challenges being faced

Professor Martin Shirley
Director of the Institute for Animal Health

Introduction

The Institute for Animal Health (IAH) plays a central role in the UK's capability for addressing current and future infectious diseases affecting farm livestock, and so supports the UK's farming industry. Scientists at IAH recently provided Government with highly accurate advance warning of the at-risk times of bluetongue (BT) virus being carried across the English Channel by infected midges and first-class investigation, diagnostic service and advice following the outbreak of BT in the UK in September 2007. IAH is working with Defra to develop the best control and eradication strategies for the expected resurgence of BT in 2008 when the midge population again becomes active.

The mission of IAH, which comprises the Compton (Berkshire) and Pirbright (Surrey) Laboratories, is *'to deliver high quality fundamental, strategic and applied science into infectious animal diseases, some of which affect people, and, from that knowledge, to advance veterinary and medical science, enhance the sustainability of livestock farming, improve animal welfare, safeguard the supply and safety of food, and protect public health and the environment.'* IAH occupies a unique niche within the UK with its work being distinct from, but complementary to, that undertaken in other sectors such as the Universities and Government Agencies.

IAH, which is a Charitable Company, is sponsored by, and its science programme closely aligned to the strategic planning of, the Biotechnology and Biological Sciences Research Council (BBSRC), with funding also from Defra.

The Institute has a strong postgraduate training programme and provides science and veterinary graduates with advanced training in all aspects of infectious disease research. IAH has formal research links with approximately 25 UK universities, including all of the Veterinary Schools. In the past year IAH has worked with almost 200 overseas institutions in more than 30 partnering countries.

IAH research delivers benefits to animal health and welfare

Events during August and September 2007 were difficult for the IAH Pirbright Laboratory because the outbreak of FMD in cattle nearby was blamed upon the escape of virus as a result of the inadequacy of the drains at Pirbright site, which are used by both IAH and its tenant, Merial, who manufacture vaccines, including vaccines against FMD. However, as part of the process for UK Government to gain control of the situation, scientists and many others at IAH worked almost 24/7 for very many weeks to deliver a state of the art diagnostic service so that the outbreak of disease could be contained, controlled and eradicated in an informed manner. Whilst the scientific reputation *per se* of IAH Pirbright has not been damaged, public perception of its competence has no doubt suffered.

As amply demonstrated by BSE, FMD in 2001, the recent incursion of highly pathogenic H5N1 avian influenza, and BT in 2007, animal health is a long-term strategic issue for the UK, with international dimensions and implications for human health. The risk to the UK of infection by exotic animal diseases has never been greater and has increased significantly as a result of globalization, climate change and potential malicious acts.

IAH research is a key part of the long-term UK capability to ensure that future control of infectious diseases is effective, timely and sustainable. IAH scientists have 'a brief' to understand the specific interactions between livestock hosts and their pathogens. Only through knowledge of how infectious agents persist, are transmitted and cause disease in their natural hosts is it ever possible to develop better methods of diagnosis, improve husbandry to reduce disease transmission, improve existing vaccines, develop new vaccines, therapies and other control measures, and to optimise the breeding of naturally resistant stock.

- The underpinning strategic nature of much of the science at IAH ensures that it delivers practical outcomes. Just a few of our achievements are described briefly below.
- IAH predicted several years ago the potential for northward spread of BT virus due to global warming and confirmed that midges in the UK were competent vectors for transmission of BT virus – documented by the detection of BT virus in northern Europe in 2006 and the spread of BT virus in the UK in 2007.
- IAH's long and prominent contribution to the global eradication of rinderpest (cattle plague) that is expected in 2010, with a benefit to the developing world of >$1 billion annually and is work that addresses the UN Millennium Development Goal of eradicating extreme poverty and hunger (http://www.un.org/millenniumgoals).
- Faster diagnostic tests for FMD and BT, of proven worth in the outbreaks of 2007. Our new diagnostic tests can differentiate between FMD-vaccinated and FMD-infected animals, a crucial first step for a vaccinate-to-live policy.

- *Paracox*, the first completely safe vaccine against coccidiosis in chickens, now used globally to protect more than 1 billion chickens annually.
- *Torvac*, a vaccine against respiratory syncytial virus, to control respiratory infections in cattle which in the UK alone affect 1.9 million cattle and kill 160,000 calves annually.
- Diagnostics kits and reagents for distribution worldwide.

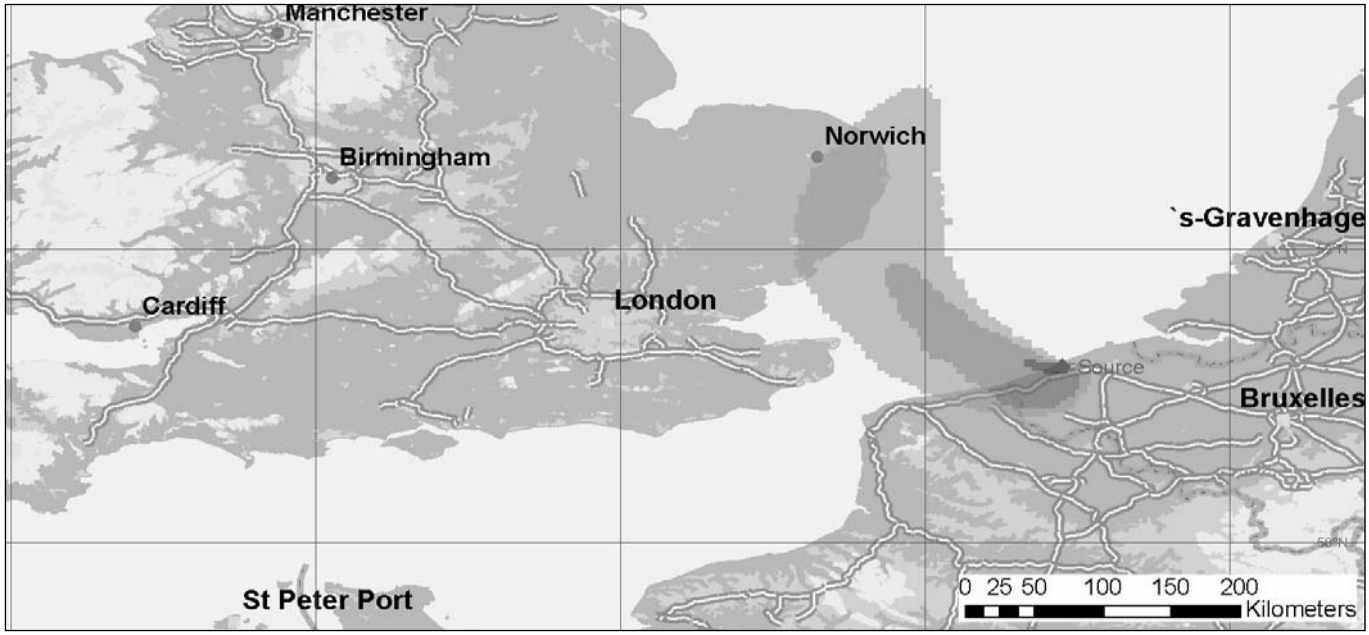
The work of IAH informs and supports policy-makers

A critical aspect of IAH research is that it generates information and advice that is crucial for supporting UK Government and others, including the European Commission; the EC Directorate General for Health and Consumer Affairs; the Food and Agriculture Organisation; the Office International des Épizooties; the Pan African Control of Epizootics programme, and the US Department of Agriculture. IAH can do this because it houses national and international Reference and Surveillance Laboratories. These analyse thousands of samples from more than 50 countries each year. IAH also provides support and training *in situ* to smaller diagnostic laboratories within developing countries, and holds several training courses within IAH for veterinarians and scientists from the UK and all over the world.

Challenges for IAH

The key challenges for IAH in 2008 are more than those envisaged even just one year ago. The Pirbright Site Redevelopment Programme started in 2003 and work on new animal accommodation, an insectary and effluent treatment plant is complete. Construction of the new Laboratory facility (to replace the current 1950s/1960s building) is now our number one priority and greatest imperative and will begin in 2008 as the final phase of the Redevelopment Programme. However, costs for the complete Programme are now expected to increase above the budgeted £121m for reasons that include delays through the summer and a review of the provisions for Biosecurity to implement lessons learned from the 2007 FMD outbreak. Renewed commitment from all stakeholders is now therefore essential if the UK is to have the facility that it needs to help deliver crucial surveillance, diagnosis and control of livestock pathogens that threaten the UK. In his independent review of the safety of UK facilities for handling FMD virus, presented to Government in August 2007, Professor Brian Spratt wrote in Recommendation 11 that "The construction of the new containment laboratories at IAH should go ahead as a matter of urgency. Such facilities are expensive to construct and maintain and Government must ensure that adequate funds continue to be available to enable the highest standards of biological safety for dealing with FMDV and other high risk viruses."

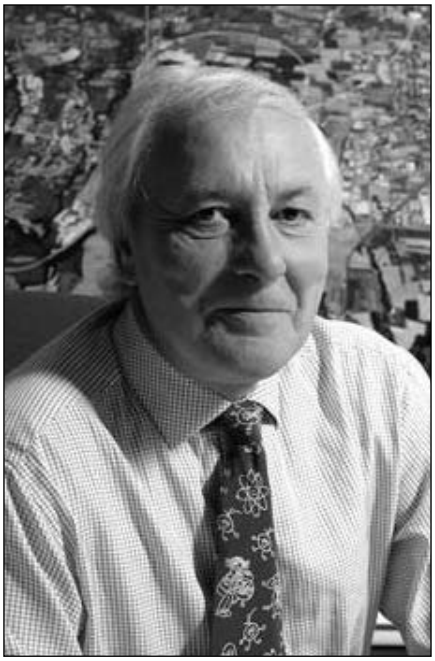
A related challenge for IAH is how to deal with the rising costs of infectious disease research on a day-to-day basis, especially as IAH has an intrinsic requirement for livestock housed in high containment buildings. Increasingly stringent health and safety, environmental, security and biosecurity requirements for our type of research add an enormous overhead onto the work we do. If the budgets of our main funders (currently BBSRC and Defra) were to decrease markedly, IAH would be forced to work on fewer diseases and, for the most part, only those that are an immediate problem. Significant rationalisation of an important programme of work is not desirable because the UK is continually faced with either new diseases appearing or old diseases re-emerging as a result of changes in climate, legislation, trade or animal and human movements. While recent history demonstrates that it is certain that these changes will happen, predicting specifically which diseases will appear next is extremely difficult and it is essential that IAH provides UK with expertise and facilities to deal with whatever nature throws at us. Ideally, IAH should already be working on these disease threats before they happen (as was the case with BT) but not all funders of research are currently prepared to commit to financial support for more than 1-3 years. Short-term funding from any major funder is not compatible with long-term research needs for the national interest, and could threaten the survival of Laboratories such as Pirbright and Compton. Once specialised expertise, livestock and facilities are lost they are unlikely to be recovered – retaining competency in scientific research is not like a tap that can be turned on and off as required. Given the unequivocally strong demand for research into diseases of livestock that can threaten the economic wellbeing of the UK, IAH remains very optimistic for its future.



The modelled plume of air that is believed to have carried bluetongue virus-infected midges to the UK on the night of 4-5th August 2007, precipitating the disease in the UK. Produced as part of a joint IAH/Met Office and Defra-funded collaborative project.

The Large Hadron Collider

Dr Lyndon Evans
LHC project leader



Later this year, Europe will inaugurate mankind's most ambitious scientific undertaking, the Large Hadron Collider (LHC) at the CERN laboratory near Geneva. Continuing a tradition of enquiry that dates back to the dawn of humanity, experiments at the LHC are poised to change profoundly our understanding of the Universe. In doing so, they are also pushing back the frontiers of technology in areas ranging from communication to medical imaging, they are setting a model for international collaboration on a global scale, and they are doing the kind of research that has the power to inspire, attracting a new generation of people into science.

Pure research is CERN's reason for being, but the curiosity that motivates CERN scientists requires them to develop cutting edge technology. The basic tool of particle physics is the particle accelerator, a device invented in the 1920s and 30s for basic research. Today, there are thousands of accelerators in the world, most of them in hospitals where they are used to treat cancer or produce medical isotopes, or in industry where they perform a wide range of tasks. Medical applications of particle physics technologies are in fact a recurring theme. Scanning techniques such as PET and MRI both owe much to research in particle physics. The sensors in PET scanners were first developed for experiments in particle physics, while MRI brings together techniques developed for a range of disciplines including particle physics.

One of the key technologies being developed for the LHC is Grid computing. Experiments at the LHC will produce unprecedented quantities of data, roughly the equivalent of a 20 km high stack of CD-ROMs every year. Analysing this data will be a global community of scientists. The LHC Computing Grid will give them seamless access to globally distributed resources of data storage and processing capacity. Through the GridPP project, the UK is a leading player in developing this new computing paradigm.

Pure research is the fundamental driver of innovation, without it, there would be no science to apply. Many are aware that the World Wide Web was invented at CERN by the British scientist Tim Berners-Lee to address the needs of particle physics. Fewer are aware that most of what we take for granted in today's technological society has roots in basic research. Electricity arose through Faraday's curiosity about a natural phenomenon, not through applied R&D on the candle. Without Einstein's curiosity about gravity, there would be no GPS, and without quantum mechanics, that most esoteric of sciences, we would have no electronic devices. Today, nobody can tell what innovation may arise from the fundamental science that the LHC provides, but it would be a foolish person who said there will be no practical benefit. I for one will not be joining the ranks of scientists like Rutherford, who infamously said that ideas of getting energy from atoms were moonshine.

CERN's founding convention states that the results of the laboratory's work 'shall be published or otherwise made generally available'. This is a message that has shaped CERN's relationship with the world. Throughout its history, the Organisation has always strived to share and exchange its knowledge with all areas of society that might benefit. We placed the basic concepts of the World Wide Web in the public domain on 30 April 1993, thus ensuring that everyone would have non-proprietary access to the Internet. Some of our detector technologies have been transferred to industry, which has further developed them for use in other areas, and in turn made them more attractive to us. Such exchanges are essential for particle physics, and for ensuring that advances made in the name of particle physics benefit society as a whole.

The United Kingdom was one of CERN's founder members in 1954, and has always been a strong supporter of the CERN ideal. Over the years, the UK's science, industry and culture have been enriched by membership of CERN. The UK was the first of CERN's Member States to organise trade fairs at the laboratory under the banner of 'Britain at CERN'. Today, the UK is a key player in the LHC project, with over 20 British Universities involved and UK scientists holding many key positions at CERN.

UK scientists are playing a prominent role in the construction of the large particle detectors that will record the results of particle collisions in the LHC, and are providing some of the most technologically advanced components. Examples include semiconductor particle detectors with fast electronics using deep sub-micron technology, crystals for accurately measuring high-energy photons, a detector for particle identification with unprecedented performance, and the electronics that has the mission of sifting out the interesting data from the millions of particle collisions that the LHC will produce every second.

CERN was founded with the ambition of producing world-leading research in Europe, and on principles of openness and inclusion. Today, CERN is the world's leading laboratory for research into the fundamental mysteries of nature - into the particles that make our Universe and the forces that bind them together. CERN's research has always been conducted with an open-door policy. Throughout the cold war, CERN scientists worked freely with their colleagues from behind the iron curtain. Today, some 9000 scientists from all over the world work together peacefully at CERN, regardless of politics, race or religion.

Their focus is the LHC, a machine that will collide particles of matter, protons, at high energy as a tool to address some of the most puzzling mysteries of the Universe. The LHC's first mission will be to complete a journey that began with Newton's description of gravity. Gravity acts on mass, but so far science is unable to explain why fundamental particles have the masses they have. The British physicist, Peter Higgs, has contributed to the most probable proposal to explain why some particles have mass and others do not. If he is right, there will be a 'Higgs' particle, which should quickly be found at the LHC.

Finding the Higgs particle would bring to a close an important chapter in our understanding of nature. Over the last four decades, physicists have pieced together a comprehensive understanding of the fundamental particles of matter and the forces that act between them. The Higgs particle is the last piece in the jigsaw of this so-called standard model, but as with all good stories, the conclusion of one chapter leads naturally into the next.

A welder closing one of the interconnects between LHC magnets

The standard model gives us a powerful description of the matter that makes up all we can see in the Universe, and the forces that give structure to atoms, people, planets and stars. But cosmological observations have shown that what we can see is only a small fraction of what must be out there. Visible matter seems to account for just 4% of what must exist, the rest is made up of dark matter and energy, about which we know very little. Experiments at the LHC could take our first steps into understanding this unknown 96% of the Universe.

Another fundamental question for the LHC concerns the mystery of antimatter. Big Bang theory tells us that in the first moments of the Universe there were equal amounts of matter and antimatter. Today there appears to be only matter. Matter and antimatter have annihilated, and only a tiny fraction of what was created remains to make the visible Universe. By making antimatter in our accelerators, we can address the question of what mechanism is responsible for this asymmetry. The LHC will also allow scientists to reproduce and study matter as it would have been just a tiny fraction of a second after the Big Bang, the primordial soup that existed when the Universe was too hot for nuclei and atoms to be formed, and that has condensed into the nuclear matter from which we are made.

When the LHC starts up in 2008, and results start to flow in the months and years that follow, the eyes of the world will be on CERN. This is a unique opportunity to attract young people into science, and to address the much-publicised deficit of physicists for UK industry. Society relies on physics. Industry relies on physics. The economy relies on physics. And our ability to attract young people into physics relies on those branches of the field, like particle physics, that are at the frontier of knowledge.

UK participation in CERN is funded by the Science and Technology Facilities Council, an independent non-departmental public body of the Department of Innovation, Universities and Skills

Messages from the Sea

Professor Laurence Mee
Director of the University of Plymouth Marine Institute;
Chair of the Plymouth Marine Sciences Partnership Executive Committee;
Chairman of the Advisory Committee for the Protection of the Seas

Last September, I accepted an invitation to visit the West Coast of Greenland as part of a floating symposium between scientists, religious leaders and politicians who were discussing climate change and other human impacts on the Arctic. This was a poignant occasion because it coincided with the discovery of dramatic shrinkage of summer sea ice to an area that had been predicted for 2040 by the Arctic Council.

As our plane soared across the Irish Sea on its way north, I spotted Blackpool pier, Morecambe Bay, Sellafield and the new 90MW offshore windfarm near Barrow-in-Furness. Fishing boats and cargo vessels were plying their way. Most of the previous night, I had been working to complete an article on the proposed European Marine Strategy Directive and was dealing with correspondence on the Science Select Committee Inquiry on "Investigating the Oceans" for which I was the Special Adviser and which was launched in Plymouth, the home of one of the largest concentrations of marine scientists in the UK working together as the Plymouth Marine Sciences Partnership. Suddenly seeing the sea glimmering below me left me awestruck; it is such an important part of our identity as a nation but how much do we really know about it and are we really protecting it and using it sensibly?

Scientists are sometimes accused of looking at the small details and missing the bigger picture. On the other hand, the finger is often pointed at those with political responsibility for failing to think outside their sector or for pursuing short-termism in the name of political expediency. Our seas certainly provide plenty of evidence of all these failings. For years we have managed our fisheries as a production industry without considering how some activities impact the ecosystem upon which fish and human welfare depends. We have sometimes pursued conservation goals as if humans do not exist. We have given insufficient importance to the key role that the sea has in regulating climate change and to investment in improving our understanding of this vital process. We are surprised when the sea becomes more acidic as it absorbs more CO_2; when new species invade our shores as waters become warmer or they are inadvertently (but avoidably) brought by cargo ships; when seabird populations decline because the sandeels they depend on have been removed by industrial fishing; when bathers find beaches inexplicably covered with green algae.

But the story is not all about doom and gloom. Our beaches are cleaner than they have been for over a century; problems can be solved when awareness is high, feelings run strong and interests coincide. The offshore wind farm near Barrow is a pioneer of many future marine renewable energy projects using tides, wind and waves. There is huge untapped potential for responsible marine biotechnology. We need to revalue our relationship to the sea if the well-accepted concept of sustainable development is to apply to marine areas in the same way as it does to the land. This cannot be achieved by tinkering with existing complex laws and entitlements; we need a radical step change to meet the challenges of a modern society… and any new management scheme should be supported by an appropriate science base.

The case of offshore renewables illustrates the complexities. With plans announced for some 7000 new wind generators and technology that will allow them to be installed in water as deep as 50 metres, vast areas of our continental shelf will be dedicated to energy production. Operators are nervous about other legitimate users of marine space in their farms, particularly fishers with mobile gear (nets, dredges, etc). Where will our fish come from? There is a risk that fishermen displaced from these areas will put even heavier pressure on the remaining habitats. On the other hand, the wind and wave farms may act as protected areas, though there will be disturbance associated with power generation technology. There are difficult choices ahead and these require value judgements based on sound science. Given the limitation in our current knowledge base, they will also need a precautionary approach, conserving or restoring enough marine space to form a network of protected

areas. We simply do not understand enough about the marine environment to exploit it in its entirety; even if deemed ethically acceptable, the risk would be too great.

We are about to witness the biggest change in history in the use of our marine space but the needs for providing sound long-term information have been ignored or understated. We became aware of rising CO_2 levels because of long-term measurements at the Mauna Loa observatory in Hawaii. But few readers will have heard that the only truly long-term (but less celebrated) data series on the marine food chain comes from the Plymouth-based Sir Alister Hardy Foundation for Ocean Science. Many other observations have often been interrupted due to sporadic funding however, and access to data is often difficult. Much new marine technology is being imported from countries where entrepreneurs have seized the opportunity based on well-supported research and development, including blue skies research. The recent Select Committee report showed that the UK has a legacy of excellent marine science and that research councils (particularly the Natural Environment Research Council) are making great efforts to support it within the constraints of their own funding. But overall, the UK's Marine Science is poorly co-ordinated, often inadequately supported and risks falling behind our competitors. We need a national strategy for marine science and a high level mechanism to ensure delivery and optimal use. This will require bold thinking, which is why the Select Committee suggested a Marine Agency with Ministerial level engagement.

Without a new planning process and associated regulations, sustainable development of the UK's marine environment will be unachievable; new technologies will be delayed and conflicts will emerge. This is why the proposed Marine Bill is essential, and, on a larger geographical scale, the European Marine Strategy Directive (MSD). Both instruments pursue marine spatial planning – a different concept from land planning because there are no fences in the sea – and the so-called "ecosystem approach" that accepts management to be of people and not of the environment. Curiously, it is the relationship between human welfare and the sea that we understand the least but people, their representatives and leaders, set a future vision for our seas.

As I watched the melting icebergs in Greenland and listened to local people and saw some of the huge deepwater trawlers that work blindly at unprecedented depths, it was clear to me that we need to radically change our relationship to the sea. With appropriate investment in marine science and its innovative application, the UK has the potential to lead the way towards sustainable seas.

Religious representatives on the foredeck of the MS Fram off the west coast of Greenland conduct a ceremony to launch a floating symposium of scientists, religious leaders and politicians brought together to discuss science and ethical issues of climate change, September 2007.

You can never predict in physics.....

Beth Taylor
Director of Communications, Institute of Physics (IOP)

The law of unintended consequences provides a rather solemn warning against disorder. Not being able to predict the effects of one's actions in a modern and rational society is a matter for concern. Physics however is a discipline that defies this law. Sometimes that which starts as academic research, undertaken purely to extend the boundaries of our knowledge, can result in extraordinary, occasionally life-changing, spin-offs.

There are many examples of how physics has changed society for the better, perhaps with no targeted intention of doing so from the outset. Below are a few illuminating examples.

The iPod

The Nobel Prize for Physics in 2007 is a good place to start. It is a prime example of how fundamental physics research not only affects people's day-to-day lives but can also energise economies. People do not generally connect the existence of MP3 players with fundamental physics research. Frenchman Albert Fert and German Peter Grunberg received the Nobel Prize for Physics in 2007 for their academic research into Giant Magnetoresistance (GMR). Researching GMR made it possible to miniaturise hard disk drives and create, for example, the iPod.

In 1988, both Fert and Grunberg independently concluded that weak magnetic charges which give rise to differences in electrical resistance could help create a perfect tool for reading data from hard disks. The work was initially applied to sensitive read-out heads but has been advanced commercially for a range of different products. The iconic iPod is possibly the best known spin-off from this research. Since 2001 it has been bought by more than 4 million UK music lovers and is often credited by economists as one of the most important new consumer products in national economies.

At the time of winning the award, Albert Fert was asked whether he foresaw how significant his discovery was and whether he had predicted how widely-used it would become. He responded, "You can never predict in physics. These days when I go to my grocer and see him type on a computer, I say, 'Wow, he's using something I put together in my mind.' It's wonderful." Fert and Grunberg provide a very clear example of how fundamental breakthroughs in physics can sometimes have hugely significant effects on national economies and individual lifestyles that go far beyond the original academic purposes of the research.

GPS

Another product that derived from fundamental physics research which has had a dramatic effect on lifestyle, and in particular for drivers, is the proliferation of global positioning systems (GPS). Now more than 1.5 million UK cars have GPS systems fitted but few drivers consider what GPS actually came from. It was research undertaken in stages by organisations such as the United States Department of Defense and the UK's National Physical Laboratory (NPL).

In the mid-1950s, Louis Essen finished work on the first precise atomic clock at NPL. An atomic clock keeps accurate time by keeping track of atomic frequencies. It defines a second as more than nine billion cycles of radiation, corresponding to the transition between two energy levels of the atom caesium-133. This impeccable precision is used to measure the time taken for a signal to be sent from a satellite to a user which allows the global positioning systems to determine an extremely accurate location.

Applying the atomic clock for use in global positioning systems was largely inspired by military activity in the Cold War. During the Cold War, a team of American scientists were monitoring the movement of the Soviet Union's Sputnik and they realised that as they knew their own location, they could pinpoint where the satellite was along its own orbit using the Doppler Effect, measuring the changes in the frequency of the signal being transmitted by Sputnik. Inspiration from military techniques, fundamental physics research and a consumer demand for easy-to-understand navigation systems have changed the way many of us get from a to b.

Space physics is also an integral part of GPS systems as GPS currently uses signals from more than twenty satellites orbiting the globe. This emphasises a further aspect of developments in physics research which lead to the development of modern technology – international co-operation across disciplines. The UK is widely respected in the international science community. Teams of researchers in the UK contribute massively to advances in international science and international science often provides information which underpins UK breakthroughs.

MRI Scanning

An equally striking spin-off from fundamental physics research now dominates the world of medicine. UK physicist Sir Peter Mansfield received the Nobel Prize in 2003 for his work on magnetic resonance imaging (MRI). The technique emerged from fundamental physics research demonstrating that some atomic nuclei which can be aligned by a magnetic field absorb particular frequencies of radio wave and then release characteristic signals as they relax back to their original state. Mansfield is credited with showing how the radio signals from MRI can be mathematically analysed, making interpretations of the signals into a useful image.

MRI scanners have become a crucial tool in early detection of fatal diseases such as cancer. MRI scans allow medical practitioners to visualise the structure and function of the body to help spot dangerous anomalies such as tumours. MRI scanners create a powerful magnetic field which aligns the magnetisation of hydrogen atoms in the body, allowing an image of the body to be constructed. This technique is particularly advantageous because it is non-intrusive, causing minimal physical damage to gain important results.

There are more than 500 scanners at work in Britain and they form a crucial frontline in the NHS's fight to minimise cancer-related deaths. In 2007 alone, almost three quarters of a million scans were undertaken in UK hospitals and, to date, no rival imaging technique has been developed that has such a remarkable success rate with so little harm caused in use.

Climate modelling and green technology

Hard disk drives, GPS and MRI scanners are all perfect examples of how physics research shapes our modern world. When prioritising UK concerns, the economy and health care are certainly somewhere near the top but there is an even more pressing concern that fundamental physics research has made significant headway in addressing – climate change. Some of the most significant advances in our understanding of how the climate is changing stem from fundamental physics research.

Climate modelling has given scientists and environmentalists the most conclusive evidence to prove that our own emission of noxious greenhouse gases is contributing to climate change. The computer models used to predict climate change take account of the range of factors that play a role in modulating the climate, such as solar activity, atmospheric particles, and feedback factors. The models help us predict the future rate of change and have highlighted how urgently action is required. Without fundamental physics research, we would not understand how pressure, volume and temperature interact in our atmosphere, nor would we understand the way the electromagnetic spectrum is reflected and absorbed, and we would not be able to forecast the future.

Politicians have been influenced by one crucial document that drew its conclusions from extensive use of computer modelling systems, the IPCC Summary for Policymakers of the Scientific Assessment. No doubt it was this document that world leaders will have been re-reading on the way to Bali last December.

The problem of climate change can not be solved by physics research alone but physics research can play a key role in helping us understand the scale of the threat mankind is facing. Equally, it can help us in developing new, green technologies. While in the Twentieth Century World Wars and a subsequent Cold War dominated international concerns, if the Twenty First Century continues as it has begun then climate chaos will be the biggest concern. It was physicists and mathematicians that broke the code and helped end the Second World War: physicists can play just as key a role in saving the environment.

A Happy New Year for physics?

Physics enjoyed a good 2007. For the first time in twenty years, the number of A and AS Level Examination entrants saw a small but significant increase. As encouraging were statistics that showed the gender gap in physics classrooms decreasing as the proportion of girls choosing to study physics increased. Lord Sainsbury's 'Race to the Top' Review emphasised the need for us to further develop high-value technologies as part of our knowledge economy if we want to avoid becoming global losers. So, at the grass roots physics is on the rise and there is official acknowledgement from our current Government that physics research needs to be nurtured.

However, funding for fundamental physics research is under pressure. In December 2007 the Department for Innovation, Universities and Skills (DIUS) announced the Science Budget for 2008-2011. While the new budget was welcomed by the majority of the UK's science community, there was alarm among both the fundamental physics research community and astronomers as it became apparent that the Science and Technology Facilities Council (STFC) was being allocated less money than it needed to maintain its current commitments.

STFC was formed in April 2007 through the merger of the Council of the Central Laboratory of the Research Councils and the Particle Physics and Astronomy Research Councils. Its main responsibilities are to fund university departments through grants for research in particle physics, space science, astronomy and nuclear science while managing world-class scientific facilities in the UK and part-sponsoring international science facilities to allow UK researchers access to the very best facilities around the world.

The shortfall in STFC's budget has resulted in a delivery plan that will lead to job losses at universities and three leading research laboratories; a 25 per cent cut in university grants; and withdrawal from a number of high-profile programmes such as the International Linear Collider.

In light of these concerns, the Government has commissioned a review of the health of physics. It is crucial that all concerned keep in mind the importance of fundamental research to both the health of the UK's science base and to the economy.

Meeting the Challenges of Biosimilar Medicines

Dr Richard Fluck

Lead Clinician Renal Services and Consultant Renal Physician, Derby Hospitals NHS Foundation Trust

As science and innovation progress they will require Parliamentarians to examine the changes and opportunities they bring to the NHS. The advent of biotechnology-derived medicines is an example of this progress which brings with it new challenges, in particular those of biosimilar medicines (also known as biosimilars).

Biotech medicines are a ground-breaking development in the treatment of a number of diseases, including cancer, osteoporosis and arthritis. Today there are around 230 biotech medicines available, benefiting over 325 million people worldwide. Some of these innovator biotech medicines are reaching patent expiry, and follow-on, or biosimilar, products are appearing on the market. Unlike generic copies of traditional medicines, these follow-on products cannot be identical to originator products – at most, they are "similar". This may have serious consequences for patient safety through unforeseen adverse drug reactions. Additionally, biosimilar medicines rely on extrapolated data from originator treatments and do not yet have the same robust data of the originator products. This raises concerns as to whether they behave in the same way as the originator products and therefore how they should fit into the current prescribing mechanisms in the UK or if new regulation is required to safeguard patient safety. Biosimilar medicines therefore pose a number of challenges to the NHS and to the health policies in all of the devolved regions of the UK.

The EU and the European Medicines Agency (EMEA) has already started to address the challenge of biosimilars by establishing a new pathway for the appraisal of these biosimilar drugs. They recommend that prescribing decisions should only be made by fully qualified healthcare professionals. In addition, several European countries have since gone further and introduced regulations to ban the automatic substitution of the often cheaper biosimilar treatments. The European Commission director responsible for pharmaceutical policy has written to the heads of national regulatory agencies, outlining a need to improve the pharmacovigilance systems in the countries in order to ensure that the arrival of biosimilar erythropoiesis stimulating agents (ESA or EPOs) will not cause any problems – such as incorrect attribution of adverse events. The Commission also emphasises the need for the prescribing doctor to know which product has been given to which patient.

The UK has yet to decide how to respond to this challenge. Whilst biosimilars open up alternative treatment options that may save the

Case Study – G-CSF and Febrile Neutropenia

Biosimilars are gradually entering the market place in the UK. One that is expected to become available in the coming months in the UK is Granulocyte-Colony Stimulating Factor (G-CSF). This is a growth factor that stimulates the bone marrow to produce white blood cells. G-CSF is used to prevent a low count of a certain type of white blood cell during treatment for chemotherapy. This low white cell count is known as Febrile Neutropenia, or FN.

There are currently a couple of daily G-CSF products that have different biological characteristics and are currently licensed for use in Europe, including in the UK. Comparative studies have demonstrated differences between these two products with regard to their pharmacological properties and clinical outcomes. These two products are not considered to be interchangeable.

Since there will be limited clinical experience with the use of biosimilars when they are first licensed, it is important that healthcare professionals are fully informed about the possible risks of substitution. Automatic substitution, in the same way that is currently seen with generic treatments, may lead to the administration of multiple products. In this scenario it would not be possible to link an adverse reaction, or indeed particularly successful treatment, to a specific product. Furthermore, the identification of biopharmaceutical products might not be possible if multiple products share one International Non-proprietary Name (INN).

In knowing how a biosimilar will work, data extrapolation can be useful and has a rational basis; however, if this is the only way by which indications for a product are approved, this should be well known to all healthcare practitioners and to patients. A particular concern with data extrapolation arises in G-CSF biosimilars, since efficacy and risks may differ in patient populations depending on age, on disease (malignant or non-malignant) and immunosuppression.

NHS money on its drugs bill, it is important that Government, healthcare professionals and patients are aware of the possible associated risks that these treatments may bring with them. It was with these concerns in mind that I accepted an invitation from Dr Brian Iddon MP (Bolton South East) to address the Parliamentary Review on Biosimilars, held in November 2007 and supported by the biotech company, Amgen.

At the Review, which heard evidence from a number of other industry experts, the panel agreed on a number of actions that should be taken forward across all of the devolved health regions in recognition of the increasing number of biosimilar medicines that will become available to the NHS in the coming months and years.

The first recommendation agreed was that biosimilar prescribing procedures should be amended as a matter of urgency. It is common practice to substitute existing generic medicines without discussion with the prescribing clinician. This is because traditional small molecule generic medicines have an identical chemical structure to the innovator, such as aspirin. However, the "similar" nature of biosimilars should now make this an obsolete practice for this particular group of treatments. Much of the clinical concern revolves around both patient safety and treatment efficacy.

The key to ensuring patient safety is an immediate ban on the automatic substitution of biosimilars, which should themselves be prescribed by brand name alone to avoid confusion and inadvertent substitution. With healthcare becoming increasingly personalised, as advocated in the Darzi review, it will be important that people are kept on treatments known to be effective for them. Where a patient has been receptive to a biomedical treatment they should be maintained on that particular treatment and not moved to a biosimilar, which, while designed to treat the same condition, may do so in a slightly different manner.

At the Parliamentary Review into Biosimilars it was explained how the British National Formulary (BNF) would be able to alert healthcare professionals to the complications related to biosimilars. The review panel agreed that the BNF should be responsible for highlighting the difference between biosimilars and the originator products. In addition the panel called for all biosimilar medicines to be marked with black triangle symbols by the MHRA until the available scientific data can provide certainty about the possible implications of biosimilars.

Pharmacovigilance and reporting mechanisms of adverse reactions to medicines is an integral component in improving our knowledge of biosimilars. In the UK this is administered through the yellow card scheme. Concerns were raised that this system may need to be strengthened to deal with the added pharmacovigilance requirements that are necessary with biosimilars. This information needs to be shared between doctors and across the EU. It is important that patients are aware of adverse reactions and what should be reported, together with the possible risks of biosimilars in the first place. Any successful programme to ensure patient safety will educate all healthcare professionals, including doctors, nurses and pharmacists. A crucial part of this education will be to ensure that prescribers are aware that biosimilar data are usually extrapolated from data of the originator product.

The decision to start treatment with biosimilars, as with any potential treatment, should be openly discussed by the prescriber and the patient. Should they chose to prescribe a biosimilar, there should be clear information on Patient Information Leaflets to inform patients about potential adverse reactions to biosimilars that may not occur in the originator product. To assist in this process of discussion with patients, we believe it would be useful for the Government to launch an awareness campaign to educate the public about biosimilars and the importance of reporting any adverse reactions to biosimilars, regardless of their severity, to enable an accurate picture of the efficacy and safety of each biosimilar.

Biotechnology-derived products are at the cutting edge of modern medicine and as their patents expire we enter a new phase which brings new challenges for policy makers. However, biological therapies are complex medications, and variation in both the drug component and the delivery methodology (for example the solution it is delivered in) may lead to unexpected consequences. Therefore, until we have better information with which to answer the questions they pose, we would be wrong to risk patient safety by failing to impose the rigorous safety standards and precautions we have come to expect, as these treatments are gradually introduced to the UK market. Other countries, including France and Spain, have put restrictions on the automatic substitution of biosimilars. To ensure patient safety remains our highest concern, the UK should not hesitate to follow suit.

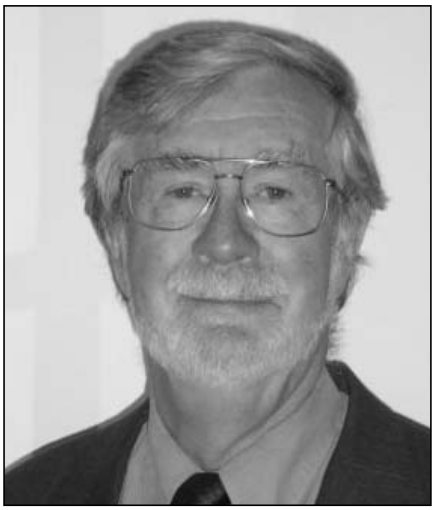
Biography: Dr Richard Fluck

Dr Richard Fluck is a consultant renal physician and clinical lead for renal services at Derby Hospitals NHS Foundation Trust. He trained at Trinity Hall, Cambridge and the London Hospital before carrying out research at St Bartholomew's Hospital, before moving to the Medical Unit at the Royal London Hospital as a Lecturer. He was appointed to his current position in 1996. Over the last 10 years Derby Renal Services has grown from a single-handed practice to an active research and training centre. In addition to local duties, he has been a member of the Renal Association executive, Council member of the British Renal Society, programme chair for the BRS annual conference, member of the Renal Registry committee and most recently national lead for DOPPS. He has been national lead for renal associated infection and vascular access issues and has worked with the HPA and DH on renal associated infections. He has lectured widely on infection, vascular access and patient safety in renal disease. He and his team won the 2007 Hospital Doctor Renal Team of the Year award.

GLOBAL POPULATION GROWTH - IS IT SUSTAINABLE?

MEETING OF THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE ON MONDAY 22ND OCTOBER 2007

Dr Malcolm Potts MB, BChir, FRCOG
Bixby Professor Population, Family Planning and Maternal Health, University of California, Berkeley



Is population growth a problem?

Global population grows more rapidly now (217,000 more births than deaths each day) than in the 1960s (165,000 more). Rapid population growth used to command wide attention, but today it meets a collective yawn.

Ninety-nine per cent of the projected growth in population by 2050 will take place in the developing world. Already 1.2 billion lack access to clean water. By 2025 a staggering 3 billion people will be short of water.

Population projections depend on calculating the total fertility rate (TFR) – the average number of children a woman will have over her fertile life, based on current age-specific fertility rates. The Ethiopian TFR is 5.4. The population has multiplied 15 times since 1900 and unless family planning receives more attention it will reach 145 million in 2050. Already, 8 million Ethiopians depend on external food aid. Niger has a TFR of 8. Four out of 10 children are malnourished and 84% of adults are illiterate. If the TFR falls to 3.6 the population will grow from 14 million today to 50 million in 2050: if it remains constant there will be 80 million.

For the 2 billion people living on 50p a day or less, future population growth is unsustainable. The rich also face formidable problems. World Bank projections suggest a four-fold increase in the global domestic product in the next 50 years. Past growth has depended on doubling oil output every decade. Petroleum geologists suggest oil production could peak as early as 2020. Perhaps less profligate use and alternative sources of energy will keep pace with demand, but if they do not the world economy could spiral downwards.

Some scientists suggest that human activity exceeded the Earth's capacity to support it in 1985. Such predictions have wide margins of error and even bringing today's global population to western standards of consumption and pollution would probably exceed the world's resources. In 1993, a Population Summit of 60 national scientific academies, including the Royal Society, issued a sombre warning, "science and technology may not be able to prevent irreversible degradation and continued poverty for much of the world." The Academies recommended "zero population growth within the lifetime of our children."

Unfortunately, a year later the International Conference on Population and Development in Cairo did not listen to the world's scientists. Women advocates "redefined" population, framing anything to do with "population" as intrinsically coercive, and even the word "demographic" became politically incorrect. Compelling evidence of the success of family planning programmes was ignored, or criticised as "target driven". It was asserted that fertility decline would occur when holistic social and health goals were reached.

In Kenya, prior to Cairo, when family planning was emphasised, the TFR fell from 8 to below 5. After Cairo, family planning budgets dropped, unwanted births doubled, and the fall in the TFR stalled. The population in 2050 could be 83 million instead of 44 million. Unless there is a renaissance of interest and investment in family planning, Kenya will become a failed state, like Somalia and the Congo.

Last year, the All Party Parliamentary Group on Population, Development and Reproductive Health held hearings on the impact of population growth on the Millennium Development Goals. After taking a great deal of expert evidence, they concluded that it is "difficult or impossible" to achieve the MDGs in high fertility countries.

If population growth is a problem can anything be done about it?

In the 1960s offering family planning to lower birth rates in the absence of socio-economic improvements was dubbed "wishful thinking". Now we know that socio-economic changes are not a prerequisite for dropping the birth rate. In fact, some countries cannot get out of poverty unless population growth is slowed. As a result of rapid population growth,

developing countries need 2 million more teachers annually, just to hold class size constant.

Slowing population growth pays what has been called a demographic dividend. Individuals with smaller families have more income to invest and a rapid fall in the birth rate produces a relatively large work force. When all the other parameters are fixed demographic changes by themselves pushed the savings rate in Taiwan higher than in the US or France where the birth rate fell more slowly. It is precisely the countries that have been able to slow population growth, which are now undergoing rapid economic expansion, and often becoming more democratic.

Jeffrey Sachs writes in *The End of Poverty*, ". . . that impoverished families choose to have lots of children." But, the decision to have a child is not like choosing to buy a car, where the person balances their finances against their perceived need. Sex is often irrational and passionate, and human beings have sexual intercourse up to a thousand times more frequently than is necessary to conceive the children they want. Having a child is not a single decision made one night to *turn fertility on*, but a difficult, consistent, prolonged struggle *to turn fertility off*. Impoverished families have "lots of children" not because they want them, but because they do not have access to modern contraceptives to turn fertility off.

Over the past decade the disparities in family size between rich and poor in developing countries have increased – implying less education for the children of the poor, more hunger, more women dying and more infants dying. The poor use contraception less, but the statistics also show that they have a much greater unmet need for family planning, suggesting it is lack of access to contraception, not a desire for bigger families which is driving the disparity. Family planning is often over-medicalised raising innumerable, unnecessary obstacles between women and the methods they need. Providers, fearful a woman might be pregnant, often refuse contraceptive advice unless she is menstruating when she visits the clinic.

India and Iran

India was the first nation to develop a national population policy, but it still grew from 357 million to over one billion in 50 years. The government built a top-down national programme around western trained physicians, while most of India's population growth is in rural areas where there are no doctors. Instead of correcting this shortcoming, Indira Ghandi's government used coercive measures to meet demographic targets, leading to election defeat in 1977. The Islamic Republic of Iran was one of the last countries to confront rapid population growth. In 1988, Ayatollah Khomeini was pursuaded to adopt a national family planning policy: contraceptive factories were built, every newlywed couple is required to attend family planning instruction, and appropriately trained health workers are stationed in the rural areas. Iranian family size fell from six to two - as rapidly as in China, but without any coercion.

The 9/11 Commission Report called "a large, steadily increasing population of young men [is] a sure prescription for social turbulence." Pakistan, which never had a well-organised family planning programme, will more than double its population by 2050 and become increasingly violent. Iran, which now has more women than men in universities, and, along with much slower population growth, is likely to be increasingly stable. Iran demonstrates that a pack of oral contraceptives and access to voluntary sterilisation can help start a social revolution from within. Ultimately, the Pill is mightier than the sword.

Reasons for hope

The wonderful discovery of the past 50 years has been that people all over the world want voluntary family planning. Tragically, 200 million women, almost all in poor countries, cannot get access to the choices they need and deserve.

It is imperative to make as wide a range of fertility regulation options available, through as wide a range of distribution channels as resources permit. Priority must be given to ensuring modern contraceptives and the information people need to use them. Government services are overloaded, have weak logistics and lack incentives, and the very poor tend to use the private/informal health sector. As the All Party Report points out, an emphasis on Sector-Wide Approaches (SWAps) in foreign aid misses some of the poorest and most vulnerable groups.

As the world's scientific academies foresaw a decade and a half ago, and as the All Party Group reiterated in January this year, without a significant slowing of population growth we face "irreversible degradation of the natural environment and continued poverty for much of the world." Building on the All Party Report, there is no better place in the world to make this happen than here, in the mother of Parliaments.

The Report of Hearings by the All Party Group on Population, Development and Reproductive Health *(Return of the Population Growth factor: Its Impact upon the Millennium Development Goals)* is on the web at www.appg-popdevrh.org.uk

Lessons from China

Dr Therese Hesketh

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Currently 1.7 billion people live in countries where the Total Fertility Rate is between three and five children for every woman of reproductive age. A further 740 million people live in countries where the TFR is greater than five. Almost all of these countries are among the least developed and this level of population growth is unsustainable, given limited natural resources. China is the only country to have taken sustained, enforced and sometimes controversial measures to control its growing population. The question is does China's experience of population control have any relevance for those countries facing rapid population growth today?

Before the One Child Policy

China had some lessons for other countries long before the One Child Policy was instigated. When Mao Ze Dong came to power in 1949 he inherited an impoverished country, which had been ravaged by decades of civil war, not unlike many of the countries with highest population growth today. He believed that human resources would have to be China's main weapon in the widely predicted Third World War. So couples were encouraged to have large families with the result that in the early Mao years fertility was very high. From 1950 to 1970 the population increased from 540 million to 850 million, as a consequence of high fertility, and improved survival, resulting from relative societal stability, food security and improved public health measures.

Concerns about this rapid growth and particularly the possibility of food shortages, led to the "Late, Long, Few" policy in 1970. This was a *voluntary* policy focusing on late marriage, a long gap between children and fewer children. This was underpinned by easy access to contraception, and while there was considerable social pressure to comply, there was no coercion. As a result fertility rates dropped dramatically in just a decade from 5.8 in 1970 to 2.9 in 1979. But the population continued to grow because the baby boomers of the 50s and 60s were entering their reproductive years, and by 1979 two-thirds of the population were under 30.

This worried Deng Xiao Ping, who assumed power in 1978, and prepared to embark on a hugely ambitious economic reform programme. He recognised that curbing population growth was essential for economic expansion and improved living standards. So he introduced the One Child Policy.

What is the One Child Policy?

The One Child Policy is a set of rules and regulations governing approved family size. The State Family Planning Bureau sets targets and policy direction, but implementation is the responsibility of local family planning committees, so there is great variation in implementation. The one child rule applies only to urban areas and to government workers. Two children are allowed in most rural areas, which applies to around 70% of the population. There are a number of exceptions to the Policy. This includes ethnic groups, certain occupations like mining, and where the first child has a disability or chronic illness. As with the "Late, Long, Few" policy, marriage is not permitted before certain ages, which vary by location and gender, and second children are generally only allowed after a gap of four to five years. Sometimes this is only allowed if the first child is a girl, clearly acknowledging the traditional preference for boys.

The policy is underpinned by a system of rewards and penalties. The rewards include economic incentives such as payments of cash, low interest loans and preference in schooling. The commonest penalties are very substantial fines, and for those unable to pay, confiscation of belongings. Government employees risk losing their jobs. The Policy is supported by a massive propaganda campaign, stressing the societal benefits and the

personal material benefits of having just one child.

The results of the Policy

The TFR in China has now fallen to around 1.7, so below replacement, although the population is still expected to rise until 2030, because of the baby boom of the 1950s and 60s. On the positive side the Government claims that the Policy has prevented 300 million births (equivalent to the population of the United States) and has helped to lift over 200 million people out of poverty. With women having fewer pregnancies they can acquire skills and training and thus can expect better work opportunities. Abortion is legal and safe with early abortion greatly encouraged, which reduces complications. This is in stark contrast to the situation in many countries where abortion is illegal, and a significant contributor to maternal mortality.

On the negative side the One Child Policy has created a number of problems. First, sex ratios at birth (that is the number of male live births for every 100 female) has risen from 106 in 1979 (which is within normal limits) to an alarming 120 in 2005. However, while the Policy has undoubtedly contributed to this, high sex ratios are not unique to China: India, Taiwan, Singapore, Vietnam, Nepal and South Korea also have high sex ratios, because of the combination of son preference and easy access to sex selective abortion, though they are not as extreme as those seen in parts of China. Second, there is a growing aged-dependency ratio: rapidly falling birth rates leading to growing numbers of elderly people who need to be cared for by the working population. In rural areas where the elderly have no pensions this is a particular concern. But the proportion of the elderly population above 65 will rise to only 18% by 2025, about the same as most Western countries today. Third, there are problems with unapproved pregnancies, with women prevented from delivering in a health facility if a pregnancy is not approved with potential risk to the health of mother and baby. Fourth, there is very little choice in contraception: there is strong reliance on long term forms of contraception (the intrauterine device initially and later sterilisation).

So what are the lessons from the Chinese experience?

The goal for most countries is to achieve a small family culture where the average preferred number of children per couple is around two. This has occurred in most parts of the developed world with East Asia taking the lead. Hong Kong has the lowest TFR in the world at 0.98; Singapore and Japan also have very low TFRs at 1.2 and 1.38 respectively. Evidence from China suggests that it too has become a small family culture with the preferred number of children for women starting families now at between one and two. So the key question is how best can this be achieved? We know from experience elsewhere that wealth and education are key factors in reducing population growth. China shows that population growth can also be brought about through a combination of easy availability of contraception and a strong determination to reduce fertility rates.

Perhaps the most interesting lesson from China is that the *totally voluntary* "Late, Long, Few" policy of the 1970s brought about the most dramatic falls in fertility. Perhaps there would have been further reductions without the strict enforcement necessitated under the One Child Policy, though perhaps not to the levels of today.

Even in China the One Child Policy now seems somewhat anachronistic with something along the lines of the "Late, Long, Few" seeming more appropriate. China has changed immensely over the 28 years since the onset of the Policy. Its GNP has seen sustained two-digit growth for two decades; it is now open to the outside world. The people have freedoms only dreamed-of 30 years ago. The Policy is also now more difficult to enforce: more people can afford the fines, and massive rural-urban migration makes it more difficult to track individuals who might want to flout the Policy. But compliance now relies more on the acceptance of the small family culture than any fear of the penalties.

Despite this the Government will not go as far as allowing two children for everyone, which has been recommended by many demographers, and which would be acceptable to the majority of the population. The Chinese response has been to tinker with the Policy allowing for some relaxation. For example, urban couples consisting of two only children, may now have two children themselves.

To summarise there are two main lessons from China for those countries currently experiencing rapid growth:

- A period of high fertility and low mortality will impact on the population growth for decades and therefore should be avoided.
- To reduce population needs strong leadership, excellent access to contraception and a comprehensive public education programme extolling the benefits of limiting family size.

The Critical Role of Water

The Earl of Selborne KBE FRS

Malcolm Potts has reminded us that 99% of the expected increase in global population of approximately 3 billion will take place in developing countries, primarily in the least developed areas. To what extent is a lack of water availability likely to impact on the potential population of 9 billion and with what consequences? Are there water management options which could mitigate such impacts?

I am indebted to Professor Brian Hoskins of Reading University for data on global water use by humans. We use for food, households, industry and energy purposes a mere 0.3% of global precipitation, and 1.5% of precipitation over land. We use 10% of the water flowing to the sea. On the face of it these figures may seem reassuring, and indeed there are many parts of the world where water shortage is not a problem now or likely to be in the future. However, demand for water outstrips supply in a growing number of countries. These shortages occur almost exclusively in developing countries, which are ill equipped to adopt the policy and technology measures needed to address the crisis. The United Nations Environment Programme calculated that in the mid 1990s about 1.7 billion people lived in water stressed countries and that 20% (ie 340 million) lacked access to safe drinking water. By 2030 population growth alone could almost double these numbers, assuming a "business as usual" scenario. As Malcolm Potts told us, a staggering 3 billion people could be short of water.

The International Water Management Institute reports that, globally, water usage has increased six times in the past 100 years.

There is already a physical shortage of water throughout North Africa, South Africa, the Middle East, central Asia and in much of India and China. Much of the rest of Africa suffers from what might be described as an economic water shortage. In other words, the countries do not have the financial resources to make optimal use of the available water. Very little water storage has been provided in sub-Saharan Africa where the irrigated area is only 3.7% of the arable area. Investment in appropriate technology could give much of Africa access to safe and affordable water. It is still common for women in parts of Africa to spend several hours each day walking to and from water sources with containers. A modest investment in a treadle pump can often provide a simple, easily maintained low technology solution to the critical problem of access to safe water.

Where physical rather than economic water scarcity exists it is instructive to note how prosperous economies, such as Singapore and Australia, make up the deficit. Singapore is an island state and has to depend heavily on imported water piped from Malaysia. However, for strategic reasons it seeks to maximise, almost irrespective of cost, its own water supplies. It has invested heavily in desalination, in recycling grey water, that is storm water and dirty water and even proudly advertises bottled drinking water which has been purified to the highest standard from sewage waste. Having no agriculture on the island Singapore imports virtual water in the form of food and drink from other countries. Irrigated agriculture currently uses 70% of the world's developed water supplies, which is the proportion of Australia's water supplies used for irrigation. Like Singapore, Australia is now investing heavily in desalination plants and water transfer systems at great cost to the federal and state budgets. It would seem much better value to buy up existing irrigation rights for growing rice or watering pasture and to import any food needed to make up the loss, but that does not seem acceptable to the all-important rural vote.

So for those relatively rare regions where economic resources are available but physical water resources are insufficient there are stratagems for the moment at least to provide adequate water at a heavy cost. For most of the regions of physical water scarcity, lower cost solutions must be sought.

As total population moves to around nine billion by 2050, so absolute demand for food will also increase. Increasing urbanisation means people are likely to adopt new diets, particularly those that involve a higher consumption of meat. Changing diets in China will have massive implications for water demand. A kilo of grain requires about a tonne of water, a kilo of beef requires about 15 times that.

Climate change is one of the factors that is contributing to uncertainties about future water supplies. The Hadley Centre's climate model predictions indicate large reductions in river flows across Southern Europe, the Middle East, the Amazon basin and the Danube. Increased flows are predicted in the River Congo, the Yangtze, and the Ganges. The Hadley Centre has reported that its models

were able to reproduce observed changes in drought. The same models project that an additional 30% of global land mass is likely to experience drought by the end of the 21st century under "business as usual" conditions, though the regional details are still very uncertain. Already more than 40 million people regularly need emergency food aid. The predicted increase in drought areas can only increase this figure.

Most climate change models predict that the dry regions will get drier and the wet regions will get wetter. This would lead to increased yields in some northern latitudes, but decreased yields in most of Africa, the Middle East and India.

Johann Rockstrom, a Swedish hydrologist, has calculated that meeting existing and future demands for food, and with the addition of three billion to the world population, will require an extra annual water supply of 5,600 cubic kilometres, or an additional 80% of existing water availability. The International Water Management Institute makes a higher estimate and believes that water usage will double. Even the most optimistic water engineer would acknowledge that supply management, through the provision of additional dams, exploitation of underused resources and water transfer schemes simply cannot deliver on this scale. If sustainability is to be achieved different solutions are needed. Supply management has to be accompanied by demand management.

As agriculture accounts for 70% of the water consumed it is sensible to look first at the opportunities for producing more food with less water. Typically irrigation systems on extensive cropping systems are 30 to 40% efficient. Most of the water sent down irrigation channels never reaches the plant it is intended for. The demands of that notoriously thirsty crop, cotton, have been responsible for the depletion of the Aral Sea and one of the world's worst environmental disasters. Many other irrigation schemes throughout the world are hopelessly inefficient. Where agricultural systems are based on temporarily flooding the fields to be cropped, most of the water is lost through evaporation.

The Israelis are credited with developing the modern trickle irrigation systems, using black polythene pipes. In Jordan drip irrigation has reduced water use on farms by a third, while raising yields in the past 30 years. Fred Pearce reports in his book *When the rivers run dry* that Israeli farmers have raised water productivity five fold in the same period by using drip irrigation and by recycling urban waste water for crop production.

There is great scope for adopting this irrigation system elsewhere. India drip irrigates less than 1% of its fields. The reason for the slow uptake is cost. To install the full trickle irrigation equipment might originally have required an initial outlay of at least $500 per hectare. Most farmers who pump the water from beneath their fields get their water at heavily subsidised prices, a tenth of the real cost is typical everywhere from India to California. There is little incentive to save water. There are now some much cheaper trickle irrigation systems being developed in India and elsewhere which raises the prospect of wider adoption, provided this technology is backed up by more realistic water pricing.

For some countries it might be realistic to move their agricultural production away from the areas of water shortage. The North East of China has many regions of over-exploitation of water and a decline in water availability for agricultural use. The authorities have been trucking in water to millions of people after wells and rivers ran dry in the east of the country. Rather than truck water it may prove more sustainable to move production away from these over-exploited areas.

The Business Council on Sustainable Development published assessments last year of the implications of water shortage made by forecasters from some of the world's leading corporate users of fresh water. The three published scenarios foresaw growing civil unrest, boom and bust economic cycles in Asia and mass migrations to Europe. But they also believed that water scarcity will encourage the development of new water saving technologies and better management of water by business.

I agree. There is much scope for better use of water by agriculturists, by industry and by domestic users. If suitable investment is made in recycling water and in research into low cost, low energy desalination technology, then a population of nine billion could just prove to be sustainable without unacceptable impacts on our environment.

In discussion the following points were made:

The impacts of HIV and IVF have been negligible in relation to the overall growth of the global population. HIV is currently concentrated in countries with about 3% of the global population. Faith-based views have had variable impacts on population growth, but generally contribute positively. For example, Islam has changed, leading to greater use of natural methods of contraception. Catholicism however has a lot to answer for. For example, from comparable starting points Thailand has moved very rapidly to a smaller family size and a higher living standard compared with the Philippines where poverty is related a large family size. The current situation in Ireland was described as appalling. Greater use of early safe abortion was recommended.

Predictions of population growth beyond 2050 will see further upward momentum. The population growth factor has been a matter for military assessment in order to identify future trouble spots around the globe. Water policy urgently requires governance with unbiased regulation that does not favour urban communities in preference to the countryside. NGOs have a major role to play especially in less populated areas for family planning and in water management, which is the best way to reduce poverty. For example, Rotary International is involved with population issues by educating people, but not telling people what to do. This is more effective than the World Bank buying a billion condoms for which they receive no kudos whatever. People like children, and need information, but not being told what to do.

The Role of Science in Preventing and Reducing Natural Disasters

Professor R S J Sparks FRS
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Science has a central role in the forecasting and mitigation of natural hazards. It underlies technological solutions to early warning, provision of advice to authorities in areas at risk, design of effective mitigation strategies for communities, and provides critical information for policy-makers and the public to help save lives and avoid economic losses. The fulfilment of these roles for science is in practice complex and has not been entirely successful, as recent events such as the 2004 Asian tsunami, the 2005 Pakistan earthquake, and hurricane Katrina illustrate.

Natural disasters are increasing dramatically, principally because of increasing vulnerability of communities due to population growth, globalisation and environmental stresses. Some hazards, such as wildfires, droughts, floods, storm surges and hurricanes, appear to be increasing as a consequence of global warming. Risk from natural hazards can, however, be reduced by improving community resilience and the effectiveness of the application of known science. Science and engineering can help in many ways including: identifying risk, giving adequate warnings of impending natural hazards, designing buildings and structures that protect the public, giving advice to assist decision-making on issues such as land-use planning, sustainable development, mitigation strategies and responses during an emergency.

Rapid advances are being made in understanding natural hazards as a consequence of technological innovation and better models of Nature. There are now many different ways of monitoring the solid earth, oceans and atmosphere, which potentially allow hazards to be identified and forecast so that warnings can be given. Measurements of the Earth from Space provide a synoptic and global perspective that allows, for example, remote volcanoes to be monitored and tsunami waves to be tracked across the ocean. Increased computer power also allows much more sophisticated and intricate models of hazardous processes. Despite these advances the many hazards are not anticipated and the known science is not applied effectively. There are also limits to the ability of science to predict precisely due to the uncertainties that are intrinsic to most natural processes. There are epistemic uncertainties (what we don't yet know) and aleatory uncertainties (natural variability). The science that describes natural events and characterises the inherent uncertainties is complex and also provides great challenges in communication to the public and to decision-makers.

There needs to be much more integration of the social and natural sciences. Natural hazards only result in risk and disaster if there are people living on the flood plain, or next to an active volcano, or near a geological fault. Vulnerability needs to be better understood. It is a complex concept that depends on many factors including: the economy of an affected community; culture; social factors (such as demography, poverty, education, and religious perspectives); awareness of the hazard and its effects;

and politics. People's perceptions of risk also affect how they react to danger. These factors that affect vulnerability need to be combined with understanding of the hazard itself to estimate risk and develop strategies that increase community resilience and reduce risk. Such complexity calls for highly multidisciplinary research and feeding the results of such research into practical applications and methodologies.

Extreme hazards that are infrequent but have very high consequences are a particular problem. As one example the largest explosive volcanic eruptions on Earth have the potential to devastate whole nations, regions and may even threaten global civilisation. Such eruptions, however, only occur every thousand years or so. Several megacities (Rome, Santiago in Chile, and Manila for example) are built on young geological volcanic deposits from immense eruptions, that would destroy the cites were they to occur today. Extreme events are difficult to study because they are rare and the factors that control them are consequently not well understood. In general, the World is unprepared. Communities can gain experience of more frequent smaller hazards and learn to live with them, while they have no experience of infrequent extreme events.

The effects of natural disasters are particularly severe in the developing world where the ability to anticipate and respond to natural hazards is much less than in the developed world. The World Bank analysis suggests that natural disasters commonly reduce GDP in the developing world by 10 to 15%. Major disasters have long term consequences, such as setting back development by many years and even decades. The livelihoods of some poor communities may never recover with the disaster condemning the people to long-term poverty. Many countries lack the resources to support or make effective mitigation strategies, such as earthquake-resistant buildings or rehousing vulnerable communities into safer places with alternative livelihoods. Lack of human and financial resources for the development and application of natural hazard science can be acute. In general the scientists in poor countries do not have easy access to knowledge, facilities, equipment and educational resources that are taken for granted in the developed world. Mechansims to fund and support science in the developing world are completely inadequate. Those that exist are commonly due to the somewhat ad hoc arrangements with scientists from the developed world. Well-intentioned capacity-building schemes by NGOs, government aid programmes are typically too short-term to be very effective or sustainable.

The developed world in general is much more resilient to natural hazards. The same earthquake that kills a handful of people in California may kill tens of thousands in many Asian countries. However, even the wealthy nations appear ill-prepared for the more extreme events as exemplified by Hurricane Katrina and the Gloucester floods. There are also strong tele-connections. A next major earthquake in Tokyo may be the first trillion dollar disaster and the Asian tsunami caused the greatest loss of life for Sweden in its history from a natural disaster. There are more subtle, but hugely significant effects. Natural disasters hold back development and are a significant factor in the persistence of extreme poverty. Natural disasters can exacerbate conflict and cause economic migrations, which have big impacts on the developed world.

To a large extent the focus of aid agencies (such as DFID and the UNDP for example) and NGOs has been on the role of governance, ethnic tensions, sustainable and more efficient agriculture, desease reduction (eg aids and malaria), trade, and education in understanding the causes of poverty and in using funds for poverty reduction. Natural disasters have been largely seen in terms of disaster relief; most of the resources indeed go into short-term relief operations, notwithstanding the World Bank's estimates that for every $ spent on prevention $7 are saved. There are signs that this attitude is changing , but slowly.

Institutions and funding structures are a particular problem. At national levels in the developed world there remain strong barriers to the promotion of multidisciplinary projects, notwithstanding much rhetoric and warm words. Focus on specialist, discipline-based research remains dominant. International structures for science related to natural disasters and hazards are complex and in the UN system have lacked serious levels of funding. There are plenty of short-term projects and initiatives, but many of the key problems require a long-term approach and appropriate commitments. Too many programmes and initiatives have been too short-term to be effective to address chronic and often increasing problems of vulnerability in the developing World.

HOW CAN SCIENCE HELP TO PREVENT NATURAL DISASTERS BECOMING ECONOMIC AND HUMAN CATASTROPHES?

The Role of Science in Preventing and Reducing the Impact of Human-Induced Climate Change

Prof Chris Rapley CBE
Director, Science Museum

The Earth seen from space reveals a small blue orb in the inky darkness of the cosmos. The planet is unique, as far as we are aware, since it is the only location in the universe known to harbour life.

Energy from the Sun is the predominant driver of all activity on Earth. The balance between the energy intercepted and the energy radiated into space is almost exact. Small differences cause the planet to warm or cool.

The planet itself is hugely complex, with its various components – atmosphere, ocean, ice, biosphere, humans and the solid earth – all interacting, with a myriad of interconnections, many highly nonlinear. This makes it a considerable scientific challenge to understand. Progress through "reductionism" – the study of the component parts – is a necessary but insufficient part of the approach. Essential is a "systems" view, in which the planet is also considered as a whole.

A further challenge is the sheer enormity of the object of study, and the vast spread of spatial and temporal scales which need to be addressed. Even by aggregating the entire world's resources of researchers and their equipment, coverage is thinly spread, and priorities have to be sharply focused and addressed. International co-operation and co-ordination are essential.

There is no planetary "Users Manual" and the Earth is finite, without spares. All of life relies upon the "ecosystem services" it supplies free of charge. These include clean air, fresh water, food, fibre, and shelter, as well as more esoteric but high value services such as the pollination of crops. In spite of the self-evident need to care for and protect our irreplaceable "Life Support System", the state of the planet is increasingly unhealthy as a consequence of human activities.

Until the late eighteenth century, human energy use exploited the flows of wind and water and the capabilities of "beasts of burden", including other humans. The transition to fossil fuels has transformed the human condition incomparably for the better. It has also resulted in unprecedented growth in population, which, combined with an equally rapid growth in economic activity, has led to mankind constituting a force at the global scale.

Annual human emissions of carbon have risen from a few million metric tons in 1850 to more than 7 Gigatons (GtC) today (the CO_2 tonnage is 3.67 times greater). What matters to the atmosphere is the total amount of carbon that has been injected, estimated to be about 500GtC, with contributions of 320GtC from fuel burning and cement production, and 180GtC from land use change, mainly deforestation.

The lasting product of fossil fuel energy use is an increased loading of carbon dioxide in the atmosphere. Although the terrestrial biosphere (plants, trees and soils) and the oceans have absorbed roughly half of the human emissions, the atmospheric content has increased rapidly – a thousand times faster than the natural cycles of climate and carbon – and by more than 35% – a magnitude equivalent to the "natural" variations between an ice age and an interglacial.

The "Greenhouse Effect" has been known and understood since the mid-nineteenth century. The phenomenon is highly beneficial, since the Earth's surface is 30°C warmer than would otherwise be the case, making "life as we know it" possible. We have enhanced the effect, both directly and because a warmer atmosphere carries more water vapour. The upshot is an estimated net imbalance between the heat received by the surface and the heat lost to space of approximately 1.5W/m^2.

More than 90% of the heat imbalance is absorbed by the oceans, and this can be seen in changes in the vertical temperature profiles averaged from thousands of measurements over the last 30 years. The measured warming of the land surface of some 0.7°C since pre-industrial times can also only be accounted for by the addition of human-induced forcing to "natural" variations.

The geographical distribution of warming is patchy, with parts of the polar regions showing the strongest increases. This is consistent with the amplification expected as a result of the "ice-albedo" feedback, in which the loss of ice and snow, which reflect about 90% of incoming solar radiation, exposes land or ocean which absorb about 80%. A very dramatic example of polar warming is the reduction over the last 30 years in summer sea ice extent in the Arctic. The record summer minimum in 2007 – some 25% less than the previous minimum in 2005 – caught the science community by surprise.

The Policy-Maker's summary of Working Group I of the Fourth Assessment Report of the UN's Intergovernmental Panel on Climate Change concludes that (i) current atmospheric greenhouse gas concentrations far exceed the levels of at least the last 650k years as a result of human emissions, (ii) warming of the climate system is unequivocal based on a mass of factual evidence, and (iii) the climate forcing is overwhelmingly human. These conclusions are based on an evaluation of thousands of peer-reviewed scientific publications and have been agreed by the politically appointed delegates of 113 nations, including nations whose administrations are "climate sceptic". There are indications that the conclusions of the IPCC tend to be conservative.

Comparisons of past global temperature and sea level show that whenever the world is warmer, sea levels rise. Any initial growth of the cold, high altitude interiors of the great ice sheets due to increased snowfall is more than compensated for by losses through melting and sliding around their peripheries.

Of particular concern, therefore, are the major ice discharges from the Greenland ice sheet and from the Amundsen Sea Embayment of the West Antarctic Ice Sheet (WAIS) revealed in data from spaceborne and airborne instruments. The stability of the WAIS has been a subject of speculation since the 1970s, as the bulk of it lies on bedrock well below sea level and so experiences an "Archimedian" uplift. The concern is that a retreat may accelerate and become unstoppable, resulting in sea level rise worldwide. The "trillion dollar questions" are "How Much?" and "How Quickly?" A major task of the International Polar Year 2007-2008 is to provide improved answers to these questions.

Future sea level rise has the potential to affect the lives of millions and to impact trillions of dollars worth of infrastructure. A single flooding of London would alone cost an estimated £30bn, equivalent to 2% of the UK's GDP. Could a flooded London be the future? The unthinkable can happen as we witnessed with New Orleans – for different reasons – in September 2005.

Looking ahead, the temperature projections from the IPCC show dramatic change. The UN Framework Convention on Climate Change commits nations to avoiding "dangerous" climate change. Some have adopted 2°C global mean temperature rise as the "safe" limit, corresponding to an equivalent CO_2 concentration of 450ppm.

In order to stabilise the CO_2 concentration of the atmosphere, it is necessary ultimately to stop adding it, especially as there is evidence that as the world warms the terrestrial biosphere and the ocean will weaken as carbon sinks, and may even become sources.

No single solution exists. However, multiple approaches, each seeking a reduction of ~1GtC/y by 2050 can in principle achieve the necessary reductions. These include improved energy efficiency and conservation, switching to less carbon intensive fuels, nuclear power, better management of the terrestrial biosphere, especially forests, CO_2 capture and storage, and CO_2 sequestration.

The costs are significant, but the recent Stern report concluded that an ongoing investment of 1% of GDP ($0.6Tn/y) starting now, would avoid a future 20% economic catastrophe. These figures compare well with the $3-5Tn estimated investment in conventional oil production necessary to satisfy the future projected world oil needs on a "business as usual" basis.

A worrying fact is that over the last seven years, despite much discussion, human carbon emissions have continued on the "business as usual" trajectory, which deviates strongly from the path necessary to stabilise at 450ppm. New trajectories can be drawn up, but in the end, if these are not followed, a 450ppm stabilisation level will become impossible to attain unless a means of active (and massive) CO_2 extraction and sequestration is developed.

The challenge facing the human race is unprecedented. The evidence for the problem is complex and technical with uncertainties at the detailed level. The impacts of current behaviour are distributed and distant in time and space. There is inertia in population growth, societal infrastructure and behaviour. Strong vested-interests are threatened. There are significant issues of sharing between the developed and developing world. There is a major mismatch between the jurisdiction, capabilities and motivations of existing institutions relative to what is needed. And as yet, there is no market mechanism capable of "self-correcting" the problem

Leadership is required, to a degree currently absent.

Even so, we should remain hopeful, since: "Our problems are Man made, therefore they may be solved by Man" (John F Kennedy).

HOW CAN SCIENCE HELP TO PREVENT NATURAL DISASTERS BECOMING ECONOMIC AND HUMAN CATASTROPHES?

Geohazards

Professor John F Dewey FRS
University College, Oxford

We live on a "dangerous" Earth with objective hazards of varying duration and magnitude. Hazards become dangers, and a chronic nuisance, disaster or catastrophe, when man interfaces with them. The problem is whether a hazard generates random, episodic, or periodic events. Forecasting the precise location, time, and magnitude of an event is the central issue, which can only come with continuous monitoring on local to global scales. Forecasting involves: hazard identification, monitoring / measurement, modelling, understanding the geology, assessment, risk and vulnerability analysis for the 1, 10, 100, 1000 etc year event, planning, preparedness, warning systems, pre-event mitigation, civil defence, warning, evacuation, and post-event mitigation. These are not sequential but iterative, and involve long-term commitment and money. Many live in and reoccupy, sometimes knowingly, seriously-hazardous sites. The greed and ignorance of developers should be discouraged by compensation schemes paid by those who have not given warnings. Insurance should be refused to those who ignore warnings. Knowledge and responsibility must be encouraged by national, local, and individual understanding in which data and ideas are shared, and warning systems are developed. Science is about testing ideas not about certainty, which can never be delivered to Government and the public. The following is a list of principal geohazards with sketchy notes.

1. Earthquakes: up to about magnitude 9.5, occur on strongly-coupled continental margin subduction zones (Chile 1960, Alaska 1964, northwest US "imminent", Sumatra 2004). Events, up to 8.3, occur in slightly-oblique, locking segments of motion-parallel plate boundaries (San Francisco 1906, Northridge 1994, Kocaeli 1999) and on the thrusts of continental collision zones (Assam 1950). Sophisticated monitoring is now intense in California and Japan, where the engineering standards of building codes and retro-fitting are high, but much less so in risk areas elsewhere where codes and adherence are weaker. Forecasting is still a great problem; most promising is the network-linkage model of Rundle and Turcotte of UC Davis.

2. Tsunamis and freak waves: Tsunamis result from the vertical displacement, by large earthquakes, giant landslides, or meteorite impact, of a column of water that radiates as a long wave-length, low-amplitude, wave at about 750 kph until the water shallows and the slowing column develops a massive amplitude increase. Freak (rogue) waves that impinge on rocky shores are limited in area but pack the same momentum punch (a cubic metre of water weighs a ton). Tsunamis flatten parking meters, drive wood slivers through tyres, and carry 100 ton blocks (destruction of the Adak lighthouse 1946). Monitoring and warning systems in the Pacific are pervasive but, in the Indian Ocean, non-existent (2004 disaster).

3. Floods: Mega-floods result from the rare instantaneous inundation (Black Sea 7500 BC, Mediterranean 6 my ago, Co Durham 250 my ago) of areas below sea level (42 world-wide), by the catastrophic release of glacial meltwater (Lake Missoula), and by catastrophic flows of hot water, ice, mud, and rock from lava melting ice. The greatest problem is the chronic flooding of flood plains. The economic loss and the heartache of ruined homes are profound. Mitigation comes in the form of river channel dredging and cutting of relief channels, and not "concreting and building over". The problem will be solved by the refusal of planners to allow building and of companies to insure losses in flood plains. Government and developers must compensate home-owners who have been cheated; flood plains must become no-go areas, unless developers are prepared to provide very expensive engineering solutions. Narrow valleys with large catchment areas (Boscastle, Lynmouth) are an avoidable source of catastrophic flooding. Hurricane-driven storm surges cause catastrophic flooding of coastal plains (New Orleans 2006), where building should be prohibited.

4. Landslides: Downhill creep of soil and small slow landslides on steep slopes is a chronic problem. Fast-moving catastrophic rock flows (Frank, Alberta, in 1903, Peru 1970) are infrequent killers of hundreds. Cliffed, soft-rock coastlines are greatly at risk (Dorset, Yorkshire Holbeck Hall, 1993). Behind Los Angeles, steep slopes, unstable, poorly-consolidated soils and rocks, forest fires and seasonal heavy rain, are a lethal combination that leads to disastrous mudslides and landslides.

5. Bolides/meteorites: During Earth's existence, the rate and average size of objects striking the Earth has declined exponentially as the planets swept up planetesimal junk. However, if the very rare, perhaps 50 million year, event were to occur of a bolide 10 km in diameter at 25km/sec, a surface blast of air superheated to 4000°C and a long "winter" from the global circulation of impact dust could cause a total disruption of the food chain. We might not survive such an event.

6. Volcanoes: Volcanic hazards are becoming well understood and forecasting is probably attainable. The

fast flow of high-temperature basaltic lava (Hawaii, Iceland) rarely kills. As silica content increases, viscosity increases and temperature decreases to generate more explosive and dangerous volcanism. Mudflows (lahars) are destructive but fast-moving incandescent gas/ash avalanches (Mt Pelee, Martinique 1929) are incinerators. Lateral hot gas/ash surges caused by flank collapse (Mt St. Helens 1980, Soufriere 1995) are extremely fast and dangerous. Eruptions that threaten mankind on a global scale are the mega-eruptions above massive magma chambers such as Yellowstone and the Long Valley Caldera in the western US.

7. Hurricanes, tornadoes, typhoons, storms, storm surges, twisters, spouts: These are mainly seasonal and generally affect well-documented "alleys", and can be monitored and avoided, temporarily or permanently.

8. Water, hydrology, drought: Agriculture in California (Cadillac Desert), depends upon a dwindling water supply in competition with the needs of a growing population. 400,000 year old groundwater is mined! Water wars are not inconceivable.

9. Forest wildfires, coal-bed and culm-bank fires: From lightning strike, exothermic reactions in exposed coals, accident, and arson.

10. Soil erosion, overgrazing, land degradation: Deforestation and intensive agriculture, starting with the US dustbowl in the 1920's, have led to soil loss, and degradation. Overgrazing, encouraged by EU headage subsidies, has led to severe land degradation, soil instability, and landslides.

11. Land heave, subsidence and instability: Caused by seasonal variations in wetness/dryness, and by mining, quarrying, and excavation for roads and railways, and loading by buildings.

12. Gas hydrates: A water/methane combination in the sediments of continental margins. Submarine landslides release pressure causing water-methane dissociation and the massive release of methane through the water column into the atmosphere leading to vast quantities of methane in the atmosphere and, perhaps, the sinking of vessels.

13. Geology and health: Asbestos, arsenic, methylated mercury, radon, heavy metals, garbage disposal, hazardous landfill chemicals, toxic and nuclear waste are very serious environmental problems.

14. Planetary exploration/biocontacts: Astrobiology/exobiology is a subject with, as yet, no material to study. This could change if a "malevolent" bug were returned, accidentally, to Earth.

15. Climate change/global warming: Global climate has been changing for 4.55 billion years. Glacial periods (we are in one) occur about every 300 million years and have extreme and rapid variations in climate and sea level, in contrast to the warmer and more stable humid conditions with much higher sea levels of most of Earth history. In the late Ordovician and late Carboniferous, CO_2 levels were ten times those of today, both associated with unstable glacial periods. The present global climatic regime cannot be captured in "frozen time frame". That we can stop or slow climate change is absurd, as are the hysterical headlines of "save the planet" and "stop climate change now". The post-industrial revolution increase in CO_2 and GMT is clearly anthropogenic but there is no evidence that this has or will cause problematic climate change; the models have substantial uncertainties. Sea level has been rising at 1.8 mma-1 for 12,000 years with no change since the immense increase of gas, oil, and coal burning from 1945. Sea level will rise by about sixty metres when the present glacial period ends. Earth has experienced the Medieval Warming and the Little Ice Age; we are back to conditions during the reign of Augustus. Glacier shortening has been constant since long before the 1945 increase There has been no increase in severe tornados, hurricane wind-speed and landfall, in 60 years. Short-term anthropogenic climate change, if it happens, is an opportunity not a problem, and trivial compared with population growth, the shortage of clean water, food safety, obesity, disease, the greed and aggression of the human species, and the catastrophic and chronic problems 1-13 listed above. We should mitigate if possible but it is best to avoid the hazard.

In discussion the following points were made:

The main areas of concern relate to identification, forecasting, mitigation and avoidance. The question is what can politicians do to help? Reference was made to the comparison between the Titanic and Explorer disasters with both ships sunk by icebergs but the latter without any loss of life. Satellite measurements are of great assistance, but greater interaction between science and social research is needed, which raises the question of how Institutions should respond. When you do well, no one notices. In Bangladesh floods people are now trained to go up onto nearby hills whereas 300,000 people were killed previously. Hence good practice needs to be taught and long-term preparations made. Much better research and monitoring is also required.

The UK model of embedding Chief Scientific Advisers in Government Departments is a good way of getting people together to discuss issues. Transfer of responsibility to the international scene raises problems since while there are lots of good intentions at the UN there is no money. UNESCO only has $1m for support of all its science programmes. The Intergovernmental Panel on Climate Change is another potential source of funding.

Floodplain management requires awareness and knowledge based on long term monitoring, whereas it may be possible to obtain a three-year research grant but not over a longer term. Funding for interdisciplinary research is difficult to obtain. Human psychology is adapted to the best bet that tomorrow will be the same as today, and let's just hope I am not unlucky.

Diverse topics were raised such as risks from nuclear waste, the Thames Barrier and Radon. Nuclear waste is an inevitable consequence of the use of nuclear power and therefore must be dealt with effectively as nuclear power will form an integral part of the mix of power sources in the future. The exposure to radiation from the nuclear industry is insignificant in comparison to variations in the natural background and medical sources of radiation. The current estimate for sea level rise at the Thames Barrier in the next 100 years is 40cm but this takes no account of the fate of icesheets, or of rare extreme events superimposed on sea level rise. Training to respond to the dangers from tsunami in Japan forms part of every child's basic education. The history of extreme events can be very variable. More recent events may leave a clear mark in the geological record whereas older events may be under-recorded.

ANNUAL LUNCHEON OF THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE

The Annual Lunch was held on Wednesday 5th December at the Savoy Hotel

Lord Soulsby, the President, welcomed everyone to the Annual Lunch in the Committee's 68th year as an Associate All Party Parliamentary Group and extended a special welcome to the guests, including John Beddington, Sally Davies, Michael Kelly, Paul Wiles and twenty-three guest speakers at discussion meetings, seminars and breakfast briefings in 2006 and 2007.

"Last year we were delighted to welcome Lord Rees, President of the Royal Society, Astronomer Royal and Master of Trinity College, Cambridge, and prolific author or co-author of about 500 research papers, mainly on astrophysics and cosmology, as well as seven books. His book *Our Final Hour - a scientist's warning:* describes how terror, error and environmental disaster threaten humankind's future in this century. Indeed the message he presented becomes stronger rather than weaker with the passing of time with the stark realisation that humanity is more at risk than at any earlier phase in history. The United Nations Environment Programme finds that the speed at which mankind has used the Earth's resources over the past 20 years has put 'humanity's very survival' at risk, followed by an 'urgent call for action' as the 'point of no return' is fast approaching. Climate change is identified as one of the most pressing problems, but the condition of fresh water supplies, agricultural land and biodiversity are also considered of equal importance. Climate change is recognised as the greatest market failure the world has ever seen, resulting from a complex interaction of economic and population pressures that are encouraged by countries that focus on the short term need for economic growth as important for their survival. Reassuring statements in the Stern Report proposed that a commitment of only 1% of GDP will stabilise emissions of CO_2, provided strong action is taken now. This must have come as a relief to decision makers more familiar with the financial terminology used there than that of a more scientific approach.

Earth System scientists, on the other hand, are used to working with risk and uncertainty and the probability that many of the vital factors have been significantly underestimated or remain unconstrained within reasonably manageable limits. They have concluded that we should consider planning for the worst case in 'the last chance saloon', as a matter of top priority, and as Lord Rees and latterly the United Nations have both predicted. The European Space Agency's Venus Express recently described as a warning the surface environment on our sister planet, as 'the most hellish planet in the solar system' with scorching rocks and downpours of sulphuric acid."

Lord Soulsby then turned to and introduced distinguished member and Guest of Honour, David King, who, as Chief Scientific Adviser, has taken every opportunity afforded to him to raise the profile of science during his highly influential tenure of that uniquely important post in Government.

In response he began,

"Lord Soulsby, Colleagues, Friends, this is a wonderful celebration of Science and Technology in Government! The United Kingdom is the most intensive nation in the world in terms of science and technology action. By intensive, I mean the output per member of the population, and it is also a country that is becoming comfortable with what science and technology can offer in terms of better advice to Government. I am delighted to have this opportunity to spend a few minutes talking to you, not least because my office has just texted me to say 'get on your way'.

I was extremely privileged to be parachuted into Government from outside in October 2000. That was a

very different time from now, 9/11 had not happened, climate change was barely being discussed as an issue, we had the Kyoto protocol but nothing was really happening there. We had not had an outbreak of Foot and Mouth Disease for 23 years. Government was recovering from the repercussions of the BSE outbreak, absolutely critical for me because the first Commission Report into the BSE outbreak was my mentor. I am not suggesting that John Beddington, my successor, should read the whole thirteen volumes, but volume one is absolutely, immaculately, important for any Government Chief Scientific Adviser. So my determination to develop openness, honesty and transparency in my role as Chief Scientific Adviser really derives from reading that report.

And if I may say with Ian Taylor MP sitting so close to me, the country was still recovering from a period of massive cutbacks in science funding. We had seen science funding as a percentage of GDP halved over that period. That is what I walked into in Government. Since then the £1.38 billions per year of annual funding for the Research Councils has grown to £3.6 billion per year. We have re-funded the Science base in the UK to the point where the infrastructure has been re-established to be attractive to the world's scientists. We are now a magnet to the top scientists in the world. Although it is fashionable in the media to focus on the closure of chemistry departments, actually the fact is that the Research Assessment Exercise that I am a great fan of has meant that excellent departments have flourished at the expense of others. Don't believe everything you read in the media. We now have the second highest proportion of 20 year olds in the world studying Science, Technology, Engineering and Medicine and related subjects, after South Korea. We have the highest percentage increased participation of women in these topics and especially in psychology and medicine, but not engineering yet, which will require more persuasion. They now form 56% of our university population and young men should get back to university.

Animal Health

The UK based team that responded to the Foot and Mouth outbreak of 2001 also handled the incoming threats from SARS and the H5N1 bird flu. We deployed the best science in the world based on exponential growth in relevant skills employing massive amounts of computer time for modelling in real time the outcomes that were all brought to bear on these problems in a very short time period. That was a big demonstration to Government that science is highly relevant to the issues of the day, and for me it was the only reason therefore why I have had more significant impact than my predecessors when giving science advice to Government and Parliament.

Sheep with BSE?

The question of the possibility of BSE occurring in sheep had resulted in seven years of enormously detailed analysis, however when I asked the simple question 'Have you conducted a DNA test on the samples we sent you?' it transpired that not one of the scientists had done that and when we sent it off for a DNA test it turned out that there had been a muddle eight years before and a batch of sheep brains had been mixed up with a batch of cow brains so that the samples that had been sent around the world contained absolutely no ovine material, and it was pure cow brains that had been determined to have BSE. That was the occasion when David Sainsbury, who was not overly generous with his praise, said 'I think you have earned your salary!'

Avian Flu

There have been two outbreaks in the UK. I think the response has been tremendous. We have a well orchestrated system in place of containment. If it develops into a human pandemic we will have something very difficult on our hands and what the Government now recognises is that the biggest single risk facing us as a country and as a world is of the potential for H5N1 becoming a human-to-human infective virus.

If that happens somewhere in the world, within three months it will have reached every country in the world. The avian virus has not yet reached the Americas but will do so eventually. However, if it becomes a human-to-human transmissible virus, because of the number of people travelling by air, it will already have arrived and there is no point in closing down ports and airports. We have to plan not only for a UK epidemic which might have the proportions of

the 1918 Spanish flu epidemic unless we manage it extremely well. We have to prepare for the low probability that this will happen because the impact will be enormous. For example, one parent will have to stay at home to look after children being kept away from school, causing disruption to our economy. Science has put us in the lead resulting to a robust response to this risk.

Tuberculosis in Cattle

The biggest threat to animals in the UK at the moment is TB in cattle. Currently we are taking out 20,000 cattle annually at a cost of £80 million to the taxpayer. That number is increasing and will continue to increase unless we introduce new measures. Because of the 1972 protection of badgers, we are not taking out any badgers despite the fact that we have found not only a very high prevalence of TB in badgers but we have now very clear evidence that badgers and cattle interaction and TB infection is a high proportion of the problem. In other words, that epidemic which started out in Devon and Cornwall is now spreading eastwards across the country and northwards and will continue to spread until we manage to stop it, not only by taking out cattle but also by taking out badgers.

Now I know that there is a very effective Badger Trust. I have just been in the House of Commons being cross-examined by somebody who I suspect was fully briefed by this organisation called the Badger Trust. I just hope there is a Cattle Trust somewhere that is going to try and stop us from culling 20,000 cattle. Why we are so sensitive about culling badgers and so insensitive about culling, for example, dairy cattle? If you were a dairy cattle farmer and you had all your cattle taken out for TB, and you know there is a badger sett on your farm, and you know from road accidents nearby that the analysis of dead badgers shows that you have TB in your badgers, would you restock your farm with dairy cattle? If the message is that we are not going to deal with the problem, that we should actually simply shrug and say we can import all the milk we need or require, I am afraid that I have no other solution to offer and I would be delighted if somebody could give me one. There are no vaccines in the arsenal to deal with this problem. We have to deal with it quickly because it is spreading from its point of origin. It is very clear that it is spreading largely because of wildlife and the wildlife is called badgers. I just note that it is possible for human beings to pick up TB from cattle and badgers.

BSE and Cows

Ten years ago, any cow over the age of 30 months might have BSE. If we put it in the food chain we might be feeding people with BSE. As a result cattle over 30 months old were removed from the food chain. But a few years ago we estimated that this programme was probably costing about £1.3 billion per life saved. We were spending £400 million per annum. No way is that a sensible operation. It took expenditure of a further £800 million before we managed to overturn the old 30-month rule. The Chief Medical Officer was very clear. Once you had set in train a policy such as the 30-month rule, you have to live with it. We should think very carefully therefore before we take on a policy like this. When the rule was eventually lifted there was not a murmur, not even from The Daily Mail!

GM Food

We are not going to feed the predicted 9.5 billion people by 2050 without GM technology. We will need another Green Revolution. GM is a remarkably good technology, of no threat to human health if properly regulated. GM was invented here and is a British technology. Our companies such as Astra Zeneca and Unilever shut down their GM laboratories when we said 'No' to GM technology. Let us see to it that we don't just leave it in the hands of Monsanto. We are already looking at a third generation of GM products. We will need this technology to combat climate change and feed the world's growing population.

The New Foresight Programme in Government

This is an in-depth process, taking the enormous reservoirs of information available in the UK and splitting them up into 8 different process. Each process takes two years with a minimum of 100 scientists and engineers, with about 450 people on a project. The 30-40 Ministers in Government that were involved valued and enjoyed these projects. For example, as a result we have the most sophisticated programme in the world of Climate Change adaptation in place. We also need to invest vastly more in energy research, especially since the recently privatised gas, water and electricity industries had all closed down their research departments. We therefore developed the Energy Technology Institute to bring these privatised industries together with the public sector, in order to undertake energy research that was required to combat climate change. When Gordon heard about this he stood up in Parliament one week later last April saying we would raise half the money from the private sector. Half a billion pounds was raised in six months. We are the first country in the world to create a market-based research institute which pulls on the research in low carbon technologies in universities around the world.

International Development

My focus on international development has been single-minded. I am not British but African with a desire to raise the profile of Africa where Primary, Secondary, Tertiary schools, Universities and Centres of Excellence are urgently needed. Clearly Africa needs capacity building to enable it to undertake work leading to clean water and sanitised conditions for everyone, which we take for granted. DfID is now investing £1.2 billion a year in African development.

Civil Service

This is where we still have a little way to go. There has been, through my predecessor Bob May and, I hope, during my period, progress in the right direction. But it requires constant surveillance. Neither a wet finger in the air nor Classics point the way forward. We need to transform the culture and that is a job that still needs to be done by John Beddington, my successor.

Finally let me say a word about Climate Change. My statement, 'Global warming was an even more serious threat than terrorism' was published in Science in 2004. That statement certainly got me into trouble. But as a result I have literally travelled the world and given 600 lectures on Climate Change to many Parliaments, acting as an unofficial Government ambassador on Climate Change and thereby significantly raising the profile as a result. With respect to Bali, I don't expect too much from a meeting of talks about talks. Where do I think action will take place? Heads of States, G8 +5, that's what we set up at Gleneagles, and we began to move that. Angela Merkel, bless her, took this forward massively, much to our surprise, since when I first went out to Germany after her election she did not seem to care about Climate Change. In Germany this year we had a very big step forward. If we can get the Heads of States of India, China, Britain and the United States to agree on action, we can take it to the United Nations and get the agreement of 172 nations.

There are many challenges with some progress in some areas. We have had 10 years since Kyoto but hardly any progress. The European Union has made the best progress so far. Elsewhere in the world there has been very little. On that rather sad note may I end by thanking the audience for their attention."

Dr Doug Naysmith MP, the Chairman, proposed a vote of thanks to David King for his speech and the P&SC Secretariat for their organisation of a memorable Annual Lunch.

CONCENTRATING SOLAR POWER AND THE PROPOSED HVDC SUPERGRID

PARIAMENTARY AND SCIENTIFIC COMMITTEE BREAKFAST BRIEFING ON TUESDAY 13TH NOVEMBER

Dr Gerry Wolff CEng
Coordinator, TREC-UK

Neil Crumpton
Friends of the Earth and TREC-UK

Overview

The Trans-Mediterranean Renewable Energy Co-operation (TREC) – an initiative of the Club of Rome – is a group of scientists and engineers developing a collaboration amongst countries in Europe, the Middle East and North Africa (EUMENA) to take advantage of the truly monumental quantities of energy falling as sunlight on the world's hot deserts – and wind energy in those regions too. TREC-UK is a group of volunteers who are interested in the 'DESERTEC' concept developed by TREC and aim to raise awareness of it in the UK and beyond. Further information about TREC and TREC-UK may be found at www.desertec.org and www.trec-uk.org.uk, respectively.

The DESERTEC concept

Every year, each square kilometre of hot desert receives solar energy equivalent to 1.5 million barrels of oil. Multiplying by the area of deserts worldwide, this is several hundred times the entire current energy consumption of the world. The key technology for tapping in to this energy is 'concentrating solar power' (CSP), which means using mirrors to concentrate sunlight to create heat. The heat may be used to raise steam to drive turbines and generators in the conventional way or it may drive Stirling engines with generators. CSP is very different from the better-known photovoltaics (PV) and should not be confused with it.

Less than 1% of the world's hot deserts, if covered with CSP plants, could produce as much electricity as the world currently uses.

Solar heat can be stored in melted salts or other media so that electricity generation may continue at night or on cloudy days. Also, gas may be used as a stop-gap source of heat when there is no sun.

Efficient, long-distance transmission of electricity

To transmit electricity from renewable sources to where it is needed throughout EUMENA, TREC proposes the creation of a 'Supergrid' of highly-efficient, high-voltage DC transmission lines (HVDC). This would not replace the existing HVAC transmission grids – it would reinforce them and integrate with them.

With HVDC, transmission losses are no more than about 3% per 1000 km. Solar electricity may, for example, be transmitted from North Africa to London with less than 10% loss of power. It is feasible and economic to transmit electricity for 3000 km or more. 90% of the world's population lives within 2700 km of a hot desert and could be supplied with solar electricity from there.

There are several other good reasons, described below, for building a Europe-wide or EUMENA-wide HVDC transmission grid.

The 'TRANS-CSP' report from the German Aerospace Centre calculates that solar electricity imported from CSP plants in North Africa and the Middle East could become one of the cheapest sources of electricity in Europe, and that includes the cost of transmitting it. That report shows in detail how Europe can meet all its needs for electricity from a wide variety of low-carbon sources, make deep cuts in CO_2 emissions from electricity generation, and phase out nuclear power at the same time.

The scenario described in the TRANS-CSP report provides for greater security of energy supplies than we have now.

Potential benefits of the DESERTEC concept include:

- Plentiful and inexhaustible supplies of inexpensive, clean electricity.
- The DESERTEC concept may be applied in many places around the world and could have a huge impact in cutting worldwide emissions of CO_2.
- Jobs and earnings in a large new industry.
- The creation of fresh water by the desalination of sea water using the waste heat from CSP plants – a welcome bonus in arid regions.
- The partially-shaded areas under the solar mirrors have many potential uses including horticulture (using desalinated sea water) – a source of food and other products.
- CSP horticulture can bring land into productive use that would not otherwise be suitable for cultivation.
- By alleviating shortages of energy, water, food and land (at least some of which may be made worse by climate change), the DESERTEC technologies may reduce the risks of conflict over those resources. Also, a win-win solar collaboration amongst countries of EUMENA can help to improve relations amongst different groups of people.

A UK Perspective: How the UK may benefit from the DESERTEC proposals:

Plentiful and inexhaustible supplies of clean electricity: the UK may benefit directly or indirectly from 'clean power from deserts'

Imports of solar electricity on short timescales

On relatively short timescales, the UK may import solar electricity via existing HVAC transmission grids in Europe, even before any HVDC

transmission lines have been laid. It seems likely that as much as 2 GW could be imported in this way, possibly more. More information may be found at www.trec-uk.org.uk/elec_eng/cascade.html. In this connection, a single European market for electricity – like the one which we have in the UK – would facilitate the trading of electricity. The European Commission and the British Government have both called for the creation of such a market.

Imports of solar electricity on longer timescales

On longer timescales, the UK may import progressively larger quantities of clean solar electricity as HVDC transmission lines are installed, as bottlenecks in the existing transmission grid are removed and as existing transmission grids are upgraded with technologies of the Flexible Alternating Current Transmission System (FACTS).

Location of energy-intensive industries

Some of the pressure on UK supplies of energy may be eased by appropriate siting of new energy-intensive industries. For example, the large amounts of heat and electricity needed to convert bauxite into aluminium could, with advantage, be supplied from CSP plants in the Australian desert, close to where the bauxite is mined.

Credits via the Clean Development Mechanism or European 'green certificates'

The development of CSP plants in sunny regions may, via the Kyoto 'Clean Development Mechanism' (or its successor), help the UK to meet its obligations under the Kyoto protocol (or its successor), and may help it to meet European targets for renewable sources of energy.

Security of supplies

The TRANS-CSP scenario up to 2050 provides for greater security of European energy supplies than we have now:

There would be an overall reduction in imports of energy. CSP imports – not more than 15% of European electricity supplies – would be an exception to that rule.

There would be a greater diversity of sources of energy. CSP adds to that diversity.

The HVDC Supergrid can be designed to accommodate damage (like the internet).

The HVDC Supergrid would, in itself, improve the security of energy supplies: HVDC cables may be laid under the sea (as proposed by Airtricity) where they would be relatively safe from attack or other disruption.

A wide range of countries have hot deserts (not like oil or gas).

CSP plants are hard to disrupt and easy to repair.

There can be strategic stores of solar energy in chemical form.

Benefits from the creation of an HVDC Supergrid

Apart from the import of solar electricity from desert regions, the proposed HVDC Supergrid has several other advantages:

Security of supply: a shortfall in any one area can normally be met by spare capacity in one or more other areas.

Reduces wastage: surplus power in any one area may be moved to where it is needed.

A Europe-wide or EUMENA-wide Supergrid would reduce the variability of wind power by integration across a wide area.

A Supergrid would provide access to large-scale but remote sources of renewable energy such as offshore wind farms, wave farms, tidal stream generators, tidal lagoons-and CSP!

A large-scale HVDC grid is needed to enable the single European or EUMENA-wide market for electricity to operate at full capacity.

The Supergrid will allow the UK to become a net exporter of clean electricity from the renewable sources (wind, waves, tides) with which it is so richly endowed.

Many opportunities for "UK plc"

The worldwide potential of CSP and HVDC transmission is huge. There are many opportunities for business, investment and employment in the design, manufacture, installation, management, and maintenance of these technologies.

Bringing down worldwide emissions of CO_2

CSP has great potential to help bring down worldwide emissions of CO_2 and this would be a major benefit to everyone, including people in the UK.

Global Security

An indirect but potentially important benefit for the UK from the DESERTEC proposals would be a strengthening of global security:

Reducing the risks of conflict over shortages of energy, water, food and land.

A win-win collaboration amongst countries of Europe, the Middle East and North Africa can help to improve relations amongst different groups of people.

During discussion the following points were made

The HVDC Grid is not seen as a replacement or alternative to either existing gas or electric grids but as an additional facility that will complement these grids and also, wherever possible, integrate with locally based CHP micro-generation networks. This is not an either/or situation but one where all available energy sources are needed with a gradual shift in time and as rapidly as possible from the more wasteful grid-based model in which fossil fuels are burnt in remote coal-fired power stations without beneficial utilisation of any of the waste heat thereby generated. Many of the renewable sources of energy, such as wave and wind, are also remotely generated in relation to their ultimate destination and will be dependent on a grid facility for delivery to customers. The use of a grid enables security of supply to be guaranteed from the integration of electricity supply from a wider area and range of renewable resources. The downside experience of grid use in the Californian desert is low although sandstorms may be a problem as in northern Nigeria.

Submarine cables could provide a transport system with low environmental impact though the high cost of this solution was challenged. AC lines could be converted to DC lines or added to AC pylons. The power density from solar power is high and only requires the utilisation of 1% of the world's deserts which thereby enables protection of much larger areas of

the world's ecosystems such as tropical rainforests. One square mile of desert will generate as much electricity as 100 square miles of organic crops grown specifically for energy production. Electricity generation from biomass is therefore far less efficient than it is from solar power.

There are major unresolved issues relating to the involvement of industry in a European supergrid. However, this would be dependent on the prior existence a single European market for electricity. In addition to Africa, Spain is also a potential source of solar power and the Spanish and German Governments have been working together on this project for over ten years. In the USA, California and Nevada are currently very interested.

The use of low technology solar energy electricity generation is considered preferable to the development of high technology, fourth generation Pu-based reactor systems.

The timescale required to install the grid was not presented which indicated the need for incentives based on contraction and convergence to help promote the greater use of solar power. The supply and demand system for solar electricity across the grid will also require careful management. The UK should be on a war footing in relation to climate change and this could accelerate the wider use of solar power in Europe as it only takes three years to build a solar power plant with an energy pay-back time of only five months compared with a total of 20 years for a nuclear plant built in the UK. However, wider public acceptance of solar power is currently expected to take several years.

PARLIAMENTARY AND SCIENTIFIC COMMITTEE VISIT TO VICTORIA AND ALBERT MUSEUM

TUESDAY 11TH DECEMBER 2007

Report by Dr Douglas Mills, Technical Secretary, Institute of Corrosion

On a lovely sunny day (it seems a visit by the Committee guarantees good weather!) seventeen members of the Committee visited the Conservation Department of the V&A Museum. It was only a three hour visit – not enough time really to obtain more than a glimpse of what goes on. However what a fascinating glimpse it was! This correspondent's interest is in corrosion and a fellow Committee member (Stephen Benn) asked him early on whether the standard definition of corrosion would include the majority of objects in the V&A. Well, a broad definition states that corrosion is the deleterious interaction of the surface of any material with its environment. Hence it is occurring on the V&A objects just as strongly as it is on the steel hulls of ships or an aluminium alloy bridge.

We were welcomed with coffee and biscuits by Sandra Smith, Head of Conservation, who gave a brief presentation on the role and activities of the Conservation Department in the V&A. Only since WW2, ie the last sixty years, have those working in the Department been known as conservators. Before that they were known as repairers and certainly in Victorian times most of their activities were conducted in dark, dingy basements. However, things have improved and now sixty people work in well-lit laboratories and studios trying to help preserve the seven million items (or 4.6 million objects) that the V&A and its sister museums have. A very important aspect is education and the sharing of knowledge. Work is published whenever and wherever it can be and expertise exchanged with other museums and galleries throughout the world.

Within the conservation group there is a Science section. Silver, sculpture, paper, stone, textiles and plastics are all "corroding" away at different rates and it was part of the job of the science section to try to understand the mechanism and hence try to come up with ways of ameliorating loss (this dovetails with what a corrosion scientist and engineer does). Graham Martin, Head of the Science section, then introduced the tour. Much of what his group does is analysis, ie working out what an object is made of. This is necessary to enable the conservator to suggest the best approach to preserve it. Sometimes this analysis enables what purport to be very old items to be exposed as fakes, eg five papyrus claiming to date from Ramysses III's time (which if they had done would each have been worth upwards of £1million) were found to date from some 3000 years later than that (1960 rather than 1000BC). Problems associated with the lacquer degradation on the Mazarin chest (qv) and the battle between the clothes moth and the "Great Bed of Ware" were other examples or work that the Science section got involved with.

We then went on a studio visit. Some of the analysis techniques used by the V&A include FTIR, NMR and Raman spectroscopy. During this part of the tour we also met people involved in a major project (OCEAN) which is designed to monitor the environment within the museum. (It was suggested that the most destructive source in a museum is the people that come around it!) The V&A is increasingly utilising daylight to display its collections and is increasingly moving away from air-conditioning to more sustainable ways of using the building and controlling the environment. The success of these developments in minimising the impact of the environment is something the V&A is justifiably proud of. However, more could be done with more money!

This was followed by a visit to the paper and books studio where we saw the techniques involved in the preservation of a unique "gradual" (an Italian music manuscript which is being prepared for the Medieval and Renaissance gallery). Also being worked on was a Round the World in 80 Days mid-18th century Theatre by Philippe Jacques de Loutherbourg and wallpaper from the Festival of Britain. Very interesting were some Indian papers including a 15th century edition of the Kama Sutra. The

darkening on these latter is difficult to remove.

The visit concluded with a series of short talks in the board room and a question and answer session. Graham Martin gave an overview listing the stakeholders etc. He also described a couple of products that the V&A had developed for environmental monitoring which are now commercially available: AMECP which is a glass-based dosimeter that monitors pollution at heritage sites and LIDO a light dosimeter (marketed under the title of "Lightcheck"). He also pointed out the need to develop monitoring devices to protect human beings (both visitors and museum workers) from possible hazards within the collection, eg mercury in hats. So there is no shortage of challenges. He concluded with a picture of the Guernsey carpet beetle which, if left to itself, would consume much of the carpet collection!

Shayne Rivers then went into some detail about the conservation of Mazarin chest, particularly the intricate lacquer work. This object originates from the first half of the 17th century and there is an incredible level of detail in the design. The aim with this project is to combine Japanese and Western approaches to conservation. *Inter alia* an artificial method for ageing the lacquer was being developed. Further information about this amazing object can be found by googling "Mazarin chest".

Brenda Keneghan discussed preserving modern materials. An early example of plastic "corrosion" occurred when the case containing a rare and valuable 1927 Naum Gabo sculpture was opened and it disintegrated. Sometimes plastics or resins (eg amber) can cause metals in the same case with them to corrode. Work in Denmark is being done on reintroducing plasticizer into plastics to prevent brittleness. So this is quite a big field and educating museums that they need to pay attention to this (most think that they do not have any plastic materials in their collections) is paramount.

In the Question and Answer session a questioner asked whether the museum was still acquiring objects (it is – budget of £400,000) and whether some objects are being disposed of (they are). Another question was, "When something is acquired how much is spent on maintaining or conserving it?" The answer was "normally not a lot but occasionally the amount is considerable, eg for a Christian Dior ball dress costing £20k, that same amount was spent again to preserve it". There is also a huge lending programme.

Overall then we were left with the impression of a world-class conservation team doing a grand job with somewhat limited funding. A useful pack was given to each delegate with outlines of the talks, a copy of the latest issue of the Conservation

journal and also a copy of the 2007 Conservation Symposium.

And so it was outside once more into the sunshine carrying a feeling, at least in this correspondent's case, that he would have liked the visit to have gone on longer! Without doubt all those who took part and who subsequently visit this or any other museum will look at the objects on display with a bit more knowledge about their conservation than they would have had before this excellent visit.

Global leadership in science and innovation alive and well in the San Francisco Bay Area

Dr Maike Rentel, Vice-Consul Science & Innovation, and Dr Charles Emrich, San Francisco

The San Francisco Bay Area is renowned as the centre of the high-tech world. It dominates established tech industries like computer hardware and software, as well as more recent fields like biotech. How well is the Bay Area keeping pace in the latest areas of innovation?

Silicon Valley, located just South of the City of San Francisco, began its rise to dominance in the IT sector in the early 20th century. It was here where Stanford University graduates William Hewlett and Dave Packard applied their grit and genius, and grew their company out of a modest garage in 1934 into today's computer giant Hewlett-Packard. Over the past three decades, the SF Bay Area has continued to be a leader in innovation and turned itself into a hub for biotech. It is home to the world's largest concentration of biotech companies (more than 600), including biotech pioneers such as Genentech, Chiron (now part of Novartis) and Gilead Sciences. The area's newest endeavour is the blossoming clean-tech industry which benefits from the blend of silicon and life science-based and entrepreneurial talents in the area.

A large part of the Bay Area's innovative spirit stems from the **world class research and education institutions** that call the area home, including Stanford University, the University of California at Berkeley, and the University of California San Francisco (UCSF, one of the US' leading medical institutes). The three schools have garnered 54 Nobel prizes between them, received a total of $2 billion in R&D funding in 2007, and produced some of the brightest scientific and technical minds, including the founders of Google, Yahoo!, Cisco, Apple, Sun Microsystems, Intel and Genentech. Both Berkeley and Stanford rank at or near the top of universities worldwide for excellence in the science and arts in 2007 (Times Higher Education Supplement). The Bay Area is also home to the Lawrence Berkeley National Laboratory which was key in the development of nuclear technology in the 1940's. The lab is now heavily dedicated to research into biology, genetics, nanotechnology, and alternative energy.

The Golden Gate Bridge - gateway to tech heaven

The Bay Area's entrepreneurial spirit is fed by its **strong venture capital (VC) community**. Within the US, the area remains the most desirable place for VC financiers, who poured close to $10 billion into the local economy in 2007 – about one third of total US financing. Sand Hill Road, near Stanford University, has become to private equity what Wall Street is to the stock market. This triangle of research institutions, commercial spirit and venture capital has created the Bay Area's exceptionally vibrant and diverse science community.

Scientific innovation is enhanced further by generous **private and philanthropic funding,** including several major foundations set up by Silicon Valley entrepreneurs. Major gifts in 2007 included a $200 million commitment from the San Francisco-based Gordon and Betty Moore Foundation (co-founder of Intel) to the University of California for a telescope, and a $150 million donation from an anonymous Bay Area donor to the UCSF Cancer Centre for cancer research. The private sector is also directly involved in an impressive range of research based programmes targeting international development problems eg in global health. These include non-profit and for-profit endeavours which draw on the scientific excellence of Bay Area institutions. In December 2007, the FCO Science & Innovation team in San Francisco brought together leaders and scientists from a number of such organisations, including the Gates Foundation Global Health programme, to explore the potential for stronger international collaboration in global health research and development. Follow up discussions are planned for Spring 2008 when the FCO Science and Innovation team will bring a delegation of West Coast global health experts to the UK.

A Stem Cell Revolution in California

California has become a new hub for stem cell research, drawing researchers and companies to the state. Among them is Shinya Yamanaka from Japan, who shot to stardom in 2007 after publishing his success in reprogramming ordinary skin cells into stem cells. Dr Yamanaka recently opened a lab at the Gladstone Institutes, San Francisco.

California's rapid rise as a centre of stem cell technology is a response to the federal ban on most human embryonic stem cell research. Three years after President Bush's 2001 clamp down on embryonic stem cell research, California voters passed a law creating the California Institute for Regenerative Medicine (CIRM). The institute is housed in San Francisco and will disburse $3 billion of public funds for stem cell research over 10 years. To date, $260 million have been

allocated, nearly 30% of which will go to laboratories at Stanford University and UCSF. California's bold initiative is now being copied by many other states, including Connecticut and Massachusetts.

The FCO Science & Innovation team in San Francisco has been engaged in promoting co-operation of UK and California stem cell policy makers and researchers. Building bridges, including through a new FCO Collaboration Development Award programme between the fast growing California stem cell research community and the UK's strong research base in this field is paving the way for extensive collaboration. Ultimately, this will accelerate stem cell science in both countries and speed the development of cures for disease.

The S&I team assisted a collaboration between Newcastle University researchers and Shoukhrat Mitalipov's high-profile research group in Oregon – the first to successfully derive stem cells from monkey embryos.

Getting paid to be the steward of the earth

California has taken an important lead in addressing the challenge of climate change including through ground breaking legislation mandating economy wide greenhouse gas emission reductions (equivalent to 25% economy wide reduction in emissions by 2020). The need to reverse the US "addiction" to oil has become a major focus of the science and innovation effort.

The San Francisco Bay Area, true to its environmentalist traditions, is leading the clean-tech revolution through a remarkable combination of public and private sector initiatives. In the public realm, three of the most recent major initiatives dedicated to alternative energy have been clustered around Berkeley. BP established the Energy Biosciences Institute at UC Berkeley with a $500 million endowment for research into sustainable fuels. Further up the hill at Lawrence Berkeley National Lab, two projects are using government funding to spur development of solar technology and biofuels. There are also exciting research initiatives taking place at Stanford University, eg the Global Climate and Energy Programme (GCEP) supported by around $250 million from the private sector.

Perhaps the best indication of just how significant clean-tech is in the tech economy is VC funding. Clean-tech funding from US venture capitalists has risen to over $2.5 billion in the first 9 months of 2007, up 50% from the previous year. $730 million went to California firms. The three biggest clean-tech investors – Khosla Ventures, Draper Fisher Jurvetson, and Kleiner Perkins Caufield & Byers – are all headquartered in the Bay Area. Al Gore, champion of the environmental movement, recently joined Kleiner Perkins to push forward clean-tech investments. Indicative of the clean-tech boom, the solar panel manufacturer SunPower was the fastest to grow among the Bay Area's top 200 companies in 2007 (since going public two years ago, SunPower's stock price has increased by about 450%). The company's founder, Dr Richard Swanson, developed SunPower's solar technology with his students while he was Professor of Electrical Engineering at Stanford University, completing yet another Bay Area university – company – VC circle.

In 2006 then Prime Minister Tony Blair and Governor Arnold Schwarzenegger established UK-California collaboration on climate change and clean energy. This has led to a busy two-way flow of information, ideas and expert visits, co-ordinated by the FCO Science and Innovation team. Activities in the last year have included discussions between Sir Nicholas Stern and California experts on climate change economics, between the King review team and California experts on low carbon transport, and a best practice exchange on sustainable energy options between local government leaders from London, Woking and Southampton and Western USA cities. The collaboration is still going strong and ranges from climate change communication to clean technology.

With so much talent, dynamism and research funding, the Bay Area will continue to be an important partner region for the UK and a focus of activity for the FCO Science and Innovation network, particularly in the areas of stem cell research, clean tech, science for development and wider innovation.

The San Francisco Science & Innovation team: Annabelle Malins (Consul), Maike Rentel (Vice-Consul), Theresa Djirbandee (Research Associate) and Charles Emrich (Intern). For further information, please e-mail scitech.sf@fco.gov.uk .

Silicon Valley's Google campus, the Googleplex. The internet giant uses massive amounts of electricity to power and cool its data centres. The company installed solar panels on its rooftops in 2007, projected to "produce enough electricity for approximately 1,000 California homes or 30 per cent of Google's peak electricity demand in our solar powered buildings", Google reports.

House of Commons Select Committee on Innovation, Universities and Skills

Under the Standing Orders, the Committee's terms of reference are to examine "the expenditure, administration and policy" of the Department for Innovation, Universities and Skills and its associated public bodies. This includes the Government Office for Science, headed by the Government Chief Scientific Adviser.

The new Committee was nominated on 8 November 2007. The current Members of the Committee are: Dr Roberta Blackman-Woods (Lab, City of Durham), Mr Tim Boswell (Con, Daventry), Mr Ian Cawsey (Lab, Brigg and Goole), Mrs Nadine Dorries (Con, Mid Bedfordshire), Dr Ian Gibson (Lab, Norwich North), Dr Evan Harris (Lib Dem, Oxford West and Abingdon), Dr Brian Iddon (Lab, Bolton South East), Mr Gordon Marsden (Lab, Blackpool South), Dr Bob Spink (Con, Castle Point), Ian Stewart (Lab, Eccles), Graham Stringer (Lab, Manchester, Blackley), Dr Desmond Turner (Lab, Brighton Kemptown), Mr Rob Wilson (Con, Reading East) and Mr Phil Willis (Lib Dem, Harrogate and Knaresborough). Mr Phil Willis was elected Chairman of the Committee at its first meeting on 14 November 2007.

A new Committee

The House of Commons passed a motion on 24 July 2007 to replace the former Science and Technology Committee with a Committee on Innovation, Universities and Skills with effect from the State Opening of the current session of this Parliament (6th November 2007). The new Committee has decided to exercise its powers to establish a sub-committee. The sub-committee will undertake inquiries on an ad hoc basis, taking its title from the inquiry and have an ad hoc chairman. Cross-cutting science inquiries will be undertaken by either the main Committee or a sub-committee as appropriate.

Inquiries

Since its formation in November 2007 the Committee has announced three new inquiries which will start in 2008.

Renewable energy-generating technologies

On 28 November 2007 the Committee announced an inquiry into renewable electricity generation technologies. Building upon the inquiry previously announced by the former Science and Technology Committee, the new inquiry will focus on issues common to all renewable technologies. It will consider the state of renewable electricity-generation technologies in the UK including their funding and support, technology transfer and their commercialisation, intermittency of supply and connection with the national grid. In addition, it will consider the establishment and role of the Energy Technologies Institute, Government policy towards enabling existing technologies to meet targets and the UK skills base to underpin the development of renewable technology.

Funding for Equivalent or Lower Qualifications (ELQs)

On 6 December 2007 the Committee announced an inquiry into the Government's decision to phase out support given to institutions for students taking second qualifications of an equivalent or lower level to their first qualifications. The inquiry will focus on the arguments for and against this decision, its timing and implementation, the exemptions from the withdrawal of funding proposed by the Higher Education Funding Council for England and the impact upon students and institutions, particularly specialised institutions such as the Open University and Birkbeck College London.

Biosecurity in UK research laboratories

On 6 December 2007 the Committee announced an inquiry into biosecurity in UK research laboratories. The inquiry will focus on the capacity for research on dangerous pathogenic material in the UK, the state of biological containment facilities, inspection regimes and the licensing system, maintenance and recording practices, storage and transportation of dangerous pathogens, the measures implemented when pathogenic material cannot be accounted for as well as both biosafety training and the role of universities in overseeing security clearance for research students working with dangerous pathogens.

Oral Evidence

The Innovation, Universities and Skills Committee began its programme of work with a series of single evidence sessions looking into important areas within its remit.

The Sainsbury Review

On 21 November 2007 Lord Sainsbury of Turville gave Oral Evidence on his Review of science and innovation policy, "The Race to the Top".

Higher Education Issues

On 28 November 2007 the Committee heard Oral Evidence from Bill Rammell MP, Minister of State, Lifelong Learning, Further and Higher Education, Department for Innovation, Universities and Skills and Professor David Eastwood, Chief Executive, Higher Education Funding Council for England on Higher Education Issues.

Role of the Government Chief Scientific Adviser

On 5 December 2007 the Committee heard Oral Evidence

from Professor Sir David King on the role of the Government Chief Scientific Adviser.

Government Chief Scientific Adviser designate: Introductory hearing

On 12 December 2007 the Committee heard Oral Evidence from Professor John Beddington following his appointment as Government Chief Scientific Adviser from 1st January 2008.

The UK Centre For Medical Research And Innovation

On 17 December 2007 the Committee heard evidence from Sir Leszek Borysiewicz, Chief Executive, Medical Research Council, Dr Mark Walport, Director, Wellcome Trust, Professor Malcolm Grant, President and Provost, University College London and Mrs Lynne Robb, Chief Financial Officer and Executive Director of Corporate Resources, Cancer Research UK on the plans for the UK Centre For Medical Research And Innovation.

Science And Innovation Investment Framework 2004-2014

On 23 October 2007 the former Science and Technology Committee heard Oral Evidence from Ian Pearson MP, Minister for Science and Innovation, and Professor Sir Keith O'Nions, Director General, Science and Innovation, Department for Innovation, Universities and Skills on the Science and Innovation Investment Framework 2004-2014, HC 1079

Reports

The Innovation, Universities and Skills Committee is yet to publish a Report. However, four Reports were published by the former Science and Technology Committee in October and November 2007:

Investigating the Oceans

On 18 October 2007 the Science and Technology Committee published its Tenth Report of Session 2006-2007, *Investigating the Oceans*, HC 470.

The Funding of Science and Discovery Centres

On 22 October 2007 the Science and Technology Committee published its Eleventh Report of Session 2006-2007, *The Funding of Science and Discovery Centres*, HC 903.

Scientific Developments Relating to the Abortion Act 1967

On 31 October 2007 the Science and Technology Committee published its Twelfth Report of Session 2006-2007, *Scientific Developments Relating to the Abortion Act 1967*, HC 1045.

The Last Report

On 7 November 2007 the Science and Technology Committee published its Thirteenth Report of Session 2006-2007, *The Last Report*, HC 1108.

Government Responses

A number of Government Responses to Reports by the former Science and Technology Committee have been received since the summer recess:

2007: A Space Policy

On 23 October 2007, the Science and Technology Committee published its Fifth Special Report of Session 2006-2007, *2007: A Space Policy: Government Response to the Committee's Seventh Report of Session 2006-07*, HC 1042.

Chairman of the Medical Research Council: Introductory Hearing

On 24 October 2007, the Science and Technology Committee published its Sixth Special Report of Session 2006-2007, *Chairman of the Medical Research Council: Introductory Hearing: Government Response to the Committee's Eighth Report of Session 2006-07,* HC 1043.

International Policies and Activities of the Research Councils

On 25 October 2007, the Science and Technology Committee published its Seventh Special Report of Session 2006-2007, *International Policies and Activities of the Research Councils: Government Response to the Committee's Ninth Report of Session 2006-07*, HC 1044.

Scientific Developments Relating to the Abortion Act 1967

On 29 November 2007, the Government Response to the report from the House of Commons Science and Technology Committee on Scientific Developments Relating to the Abortion Act 1967 was published as CM 7278 by the Department of Health.

Further Information

Further information about the work of the Innovation, Universities and Skills Committee or its current inquires can be obtained from the Clerk of the Committee, Dr Lynn Gardner, the Second Clerks, Glenn McKee and Edward Waller or from the Committee Assistant, Ana Ferreira on 020 7219 2792/8367/0859/2794; or by writing to: The Clerk of the Committee, Innovation, Universities and Skills Committee, House of Commons, 7 Millbank, London SW1P 3JA. Inquiries can also be emailed to iuscomm@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/ius where all recent publications, terms of reference for all inquiries and press notices are available.

House of Lords Science and Technology Select Committee

The members of the Committee (appointed 13 November 2007) are Lord Colwyn, Lord Crickhowell, Lord Haskel, Lord Howie of Troon, Lord Krebs, Lord May of Oxford, Lord Methuen, the Earl of Northesk, Lord O'Neill of Clackmannan, Lord Patel, the Earl of Selborne, Lord Sutherland of Houndwood (Chairman), Lord Taverne and Lord Warner. Baroness Walmsley and Lord Soulsby of Swaffham Prior were co-opted on 14 January 2008.

Personal Internet Security

The Committee's report on *Personal Internet Security* was published on 10 August 2007, and was widely reported in the broadcast and print media. The inquiry, chaired by Lord Broers, looked at a broad range of security issues affecting private individuals when using the Internet. Key recommendations included:

- Increasing the resources and skills available to the police and criminal justice system to catch and prosecute e-criminals;
- Establishing a centralised and automated system, administered by law enforcement, for the reporting of e-crime;
- Incentivising banks and other companies trading online to improve data security by establishing a data security breach notification law;
- Encouraging better security standards in new software and hardware by taking the first steps towards the establishment of legal liability for damage resulting from security flaws;
- Encouraging Internet service providers to improve the security offered to customers by establishing a "kite mark" for Internet services.

The Government's response to the Committee's report was published as a Command Paper (Cm 7234) on 24 October 2007 and it is expected that the report will be debated by the House during the current session.

Allergy

The Committee's report on allergy made national headlines when it was published in September 2007. The inquiry looked at the increasing prevalence of allergic diseases across the United Kingdom, the reasons behind this, and associated social and economic costs. The report set out a series of recommendations on topics ranging from NHS allergy services and the co-ordination of allergy research, to food labelling, catering establishments and the management of allergy in the school and work environment. The Government published its response on 27 November and the Committee is now awaiting an opportunity to debate this in the House.

Radioactive Waste Management

The Select Committee's report *Radioactive Waste Management: an Update* was published on 4 June 2007 and Government's response was received on 25 June. The Committee's report was debated on 29 October. The Government response has been published and is also available on the Committee's website.

Air Travel and Health

The Committee's report *Air Travel and Health: an Update* was published on 12 December 2007 and was widely reported in the media. The inquiry examined the current regulatory arrangements, the research carried out since the Committee's original report in 2000, the cabin environment, infectious diseases, air crew occupational health, contaminated air events and information and education. Key recommendations included:

- The United Kingdom must not transfer any further responsibilities from the UK's Civil Aviation Authority to Europe until it is clear that the European agency is competent to exercise such responsibilities.
- Research to study flight-related factors which may increase the risk of venous thrombo-embolism and effective preventive measures should be fully supported.
- The regulatory minimum distance between seats should be increased from 26 inches to 28.2 inches and the level of air passenger duty levied on "premium economy" seating should be reviewed.
- The amount of time that passengers can remain in an aircraft when the ventilation systems are non-operational should be limited to 30 minutes.
- Airlines must ensure that pilots protect their hearing and get appropriate rest periods.
- The manner in which information on fitness to fly is offered should be reviewed.

The Government's response to the report is due at the end of February.

Waste Reduction

In August 2007, a Sub-Committee, chaired by Lord O'Neill of Clackmannan, launched an inquiry into waste reduction, the first level of the waste hierarchy. The inquiry will examine ways in which products and production processes can be made more sustainable and thereby produce less waste. During November and December oral evidence was taken from civil servants, academic experts, the Environment Agency and the Institute for European Environmental Policy on the regulatory aspects of waste reduction and the current challenges faced by businesses. Over the course of the next few months the inquiry aims to examine the roles that better design and the use of novel technologies can play in reducing waste, as well as take a look at the fiscal and regulatory incentives that might encourage businesses to embrace these. The Sub-Committee will continue to hear oral evidence until Easter and expects to publish its report in the summer of 2008.

New inquiry: Genomic Medicine

The Select Committee has appointed a second sub-committee, chaired by Lord Patel, to hold an inquiry into genomic medicine. It is expected that the call for evidence will be published in early February and that the report will be published later in 2008.

New inquiry: Systematics and Taxonomy

The Select Committee has launched a short inquiry into systematics and taxonomy. The inquiry will follow up on the Committee's past inquiries into this subject (in 1991 and 2002) and will investigate the UK's capacity in this field including the state of research, data collection and management, and the skills base. The inquiry will also examine new developments in the field such as in what way systematics contributes to ecosystem services, as well as the impact of genomics and internet databases. The call for evidence was published in December and the deadline for responses is 4 February. The Committee will begin taking evidence in February and it is expected that the report will be published in July 2008.

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 Office of Science and Technology

Recent POST Publications

Public Opinion on Electricity Options
October 2007 *POSTnote 294*

The 2007 Energy White Paper states that the UK needs an extra 40 to 45% of electricity generating capacity over the next 20 years. However, there is increasing debate about the proposed development of new power plants. Given recent public interest in new technologies, it is important to understand this debate not just in a technological framework, but also within its social context. This POSTnote considers the social acceptability of different forms of electricity generation (mainly measured through opinion polls).

Climate Change Science
November 2007 *POSTnote 295*

In February 2007 the United Nations Intergovermental Panel on Climate (IPCC) concluded that most of the observed increase in global average temperatures since the mid-20th century is "very likely" to result from the observed increase in human caused greenhouse gases. This POSTnote examines the uncertainties of climate science, and the attribution of recent climate change.

Next Generation Telecoms Networks
December 2007 *POSTnote 296*

Traditional telecommunications (telecoms) networks were developed to carry a single type of service, such as voice calls. In contrast, Next Generation Networks (NGNs) carry all types of services, including voice, video and e-mail, on a common platform. BT's planned rollout of its £10bn "21st Century Network" (21CN) by 2012 will make the UK the first country to replace its incumbent telephone network with an NGN. NGNs offer significant cost savings to operators and new services to consumers,

but there are also challenges in maintaining the quality, reliability and security of communications. Their introduction has been described as "the most significant change to telecoms networks since competition was introduced two decades ago".

HIV in the UK
December 2007 *POSTnote 297*

HIV and Aids are one of the four most expensive areas of infectious disease, costing the NHS £400m a year for treatment alone. New HIV diagnoses in the UK continue to rise. The populations most affected by the virus have shifted considerably in recent years. "Men who have Sex with Men" remain at most risk of contracting HIV but diagnoses are also particularly concentrated among Black Africans. UK-born heterosexuals are also at increasing risk. This POSTnote presents current infection and diagnosis trends, and discusses whether policies for HIV testing, education, and prevention reflect these changing patterns.

Synthetic Biology
January 2008 *POSTnote 298*

Synthetic biology aims to design and build new biological parts and systems or to modify existing ones to carry out novel tasks. It is an emerging research area, described by one researcher as "moving from reading the genetic code to writing it." Prospects include new therapeutics, environmental biosensors and novel methods to produce food, drugs, chemicals or energy. This POSTnote outlines recent developments and the possible applications and risks of synthetic biology and examines policy options for the development and regulation of the research.

Smart Materials and Systems
January 2008 *POSTnote 299*

"Smart" materials and systems sense and respond to their environment and have applications in areas as diverse as health, defence and packaging. The UK has a long track record of research in this area and the Government has launched a number of initiatives to encourage exploitation of this research. This POSTnote gives an overview of current research and potential applications. It also examines the factors driving smart materials research and those holding back its exploitation.

Current work

Biological Sciences and Health - Alternatives to Custodial Sentencing for Young Adult Offenders, Assisted Reproduction, Autism, Animal Cruelty and Interpersonal Violence, Ethical Oversight of Biomedical Research in Developing Countries, UK Vaccine Industry Capacity.

Environment and Energy - Ecological Networks, Smart Metering, Electricity Storage Systems, Invasive Species.

Physical Sciences and IT - Digital Preservation.

Science Policy - International Migration of Scientists and Engineers.

Seminars

Changing Health Behaviour

On 15 October POST, in conjunction with the British Psychological Society, held a seminar on changing health behaviour, the subject of a recent POSTnote. Participants heard from leading figures in the areas of health psychology and public health, who outlined the characteristics of successful health behaviour interventions. A lively debate, chaired by Lord Rea, discussed the challenges facing UK policy in this area.

Climate Change

On 15 November POST, in conjunction with the Natural Environment Research Council (NERC), held a seminar on Climate Change, the subject of POSTnote 295. The seminar was also the parliamentary launch of the NERC's new research strategy.

Staff, Fellows and Interns at POST

Dr Stephanie Baldwin, who has been on an exchange placement with the New South Wales Parliament, has decided to take a three-year career break from POST, as her husband has obtained a position in Australia.

POST doctoral fellows:

Shanna Marrinan, Middlesex University, Economic and Social Research Council Fellowship

Fiona McEwan, Kings College London, Medical Research Council Fellowship

Jessie Ricketts, University of Oxford, Economic and Social Research Council Fellowship

Teil Howard, University of Bristol, Engineering and Physical Sciences Research Council Fellowship

Adele Langlois, Open University, Wellcome Trust Bioethics Fellowship

Simon Evans, University of Bristol, Royal Society of Chemistry Fellowship

Aidan Rhodes, University of Durham, Royal Society of Chemistry Fellowship

International Activities

In October the Chair and Director participated in the 4th Science and Technology in Society Forum, in Kyoto, Japan. POST organised a highly successful workshop at the Forum on "Brain Drain or Brain Gain?" which attracted over forty participants, including the science

ministers of several developing countries.

In October Dr Nath visited the Parliament of Uganda to discuss parliamentary capacity building activities in science and technology in the Parliament of Uganda as part of POST's Africa programme. Collaborative activities identified included trialling an MP-scientist pairing scheme in Uganda in collaboration with the UK's Royal Society, and the organisation of a workshop on science communication for African parliamentary staff in Autumn 2008. Dr Nath also attended meetings with the British Council in Kampala, the Ugandan National Academy of Sciences, and the Ugandan National Council for Science and Technology (Kampala) to update them on the programme and to discuss collaboration.

In November a technology assessment of Safety in Tunnels in Europe, co-ordinated by POST, conducted for the European Parliament's technology assessment unit, STOA by Dr Alan Beard, of Heriot Watt University, was submitted to the European Parliament's transport committee. The study will be published in early 2008.

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 Bill

Research Paper 07/84

This Bill would establish an Infrastructure Planning Commission (IPC) to decide development consent for major infrastructure projects in England and Wales. This procedure would introduce a single consent regime for a wide range of infrastructure projects currently approved under separate pieces of legislation. It would replace the need for consent under the Town and Country Planning Act 1990 and other legislation, such as the Electricity Act 1989, for parts of the same project. The IPC decisions would be based upon statements of national policy issued by the Government.

The Bill would also introduce a new procedure for planning appeals for minor applications like householder development.

The Energy Bill

Research Paper 08/05

The Bill contains the legislative provisions required to implement UK energy policy following the publication of the Energy White Paper 2007.

Key features of the Bill include the creation of the legal framework to require power companies to cover waste and decommissioning costs in the event of new nuclear build; banding of the Renewables Obligation to differentiate levels of support to renewable technologies; and encouragement of investment in gas supply and carbon capture and storage.

Planning and Energy Bill

Research Paper 08/06

The Bill is a Private Members' Bill introduced by Michael Fallon MP, who drew first place in the 2007/08 ballot for Private Members' Bills. The Bill would enable local planning authorities to set requirements for energy generation and energy efficiency in local plans. The paper shows how that would relate to existing Government policy, particularly in the Planning Policy Statement on Climate Change of December 2007.

Aviation and Climate Change

Research Paper 08/08

Aviation is a growing industry. Government and the aviation industry recognise a link between aviation emissions and climate change, although there is uncertainty about the measurement of the exact effects. Given the predicted growth in the aviation sector, it seems likely that unless emissions are curbed, they will cancel out efforts made to reduce emissions in other sectors.

The paper sets out to explain: the effects of emissions from aviation; the difficulties in making accurate calculations about how these emissions effect climate change; and what proposals and actions are being taken at various levels to reduce these emissions.

Selected Debates and Parliamentary Questions & Answers

Following is a selection of Debates and 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 3rd September to 18th December 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

Agriculture, Fisheries and Food

Organic Food
Debate in Westminster Hall on Tuesday 16 October

Dr Brian Iddon (Bolton, South-East): The debate about food has become extremely polarised in recent years, with those who advocate organic farming condemning so-called conventional farmers for their use of chemicals and their damage to the environment, not realising that conventional farming has changed for the better in recent years. The reality is that the two sides of this polarised debate are closer together than they sometimes think they are. The debate coincides with the Soil Association's organic fortnight, the National Consumer Council's greening supermarkets project and the introduction of new laws on pesticides by the European Commission. Organic farming is based on a belief system that has its roots in the anti-science backlash propagated by the vitalists, who believed that life arises from, and involves, special life forces. The teaching of an Austrian spiritualist and mystic called Rudolf Steiner in the early 1920s gave rise to the modern organic farming movement.

The pioneers of organic farming believed that the synthetic nitrate fertilisers created by the Haber-Bosch process in Germany in the early 20th century, which fix nitrogen directly from the atmosphere as nitric acid and to which about 60% of the people alive today owe their existence, actually lack vital forces imparted by animal manure. Steiner believed that these special forces come from far-away planets. That is where the movement began. However, to produce all the manure required to replace synthetic nitrogen fertilisers would require an additional 5 or 6 billion head of cattle, all emitting methane, the greenhouse gas, and the destruction of countless forests to provide their grazing land and food. The Soil Association, which is the largest organic trade and certification group in the UK today, is a powerful and popular movement, perhaps largely because of the influence of Prince Charles and Lord Melchett, the policy director of the Soil Association. Nevertheless, we need a healthy debate about organic food and the often spurious claims made by organic farmers. Sales of ethical foods, such as Fairtrade, Leaf, Freedom Food, Red Tractor, and Duchy Originals and organic food have grown to £5.5 billion and are expected to rise to £7.5 billion by 2011. Organic food is described by the FSA as a holistic approach to food production, making use of crop rotation, environmental management and good animal husbandry to control pests and diseases, with restricted use of fertilisers or pesticides and with emphasis on animal welfare and soil health. In August 2007, the Crop Protection Association welcomed the Soil Association's acknowledgement that organic farmers use pesticides which it had denied for most of its existence. Indeed, copper sulphate, pyrethrum – a nerve toxin and potential carcinogen – and other chemicals used by organic farmers are probably more dangerous to the environment than the pesticides used by modern farming. I am not against organic farming, but the public should not be misled by confusing information. The central message is that a diet high in fresh fruit and vegetables, safely produced and affordable, and low in processed foods with their high sugar and salt contents is better for us all.

Mr James Paice (South-East Cambridgeshire): Organic food is the fastest growing sector of the food market, albeit a very small share of the market at present. Much of this increase is due to the recognition of market opportunity driven by consumer demand rather than personal conviction by the farmer and it is right and proper that farmers should be able to do so.

The Minister for the Environment (Mr Phil Woolas): Ten years ago in 1997 the area under organic management in the United Kingdom was a little less than 51,000 hectares. By the beginning of 2007 that figure was 620,000, of which just over 120,000 are under conversion, resulting in a 12-fold increase. In 1997 there were fewer than 1,000 farmers of organic produce in the United Kingdom, but by the beginning of 2007 the number had increased to 4,600. The changes have been brought about by consumer demand, clearly, but also by Government action. In the Government's view organic farming is beneficial to biodiversity. Mixed farming also

contributes to landscape quality and the beauty of rural areas and generally incurs less energy than conventional systems. Organic farming has its proponents, of whom the Government are one because of the environmental benefits of producing organic food and the benefit of the farming methods used, many of which could also be used in conventional inorganic farming as indicated by the Member for Bolton, South-East.

It contributes to the economic sustainability of rural areas. Generally organic farms are better connected with those whom they supply and therefore with local consumers, food processors and wholesalers. So in rural economies, organic production generally provides more employment opportunities.

Sea Bass
Debate in the House of Commons on Thursday 22 November

Martin Salter (Reading West): The Minister's announcement on retaining the minimum landing size for bass at 36cm, rather than increasing it to 40cm and then to 45cm by 2010 as recommended by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) just two years ago, flies in the face of scientific evidence and has been greeted with understandable anger and dismay by hundreds of thousands of sea anglers, as well as by conservationists. He himself admitted that his decision was based on looking after the short-term interests of the inshore fleet rather than the long-tern interests of the species and the environment. It is worth reminding the House that the recreational sea angling sector in England and Wales is worth more than £1.3 billion a year to the economy and provides 19,000 non-subsidised jobs. The entire commercial fleet employs only 12,000 people, with considerably fewer in the under-10m inshore fleet. The nub of the argument is that we were promised that Britain's most popular fish in terms of its sporting and eating potential would be managed sustainably and primarily as a recreational species. That was a promise made in Downing Street and it should be kept.

The Minister for the South East (Jonathan Shaw): Before making this decision I was aware that the consultation on the issue had generated some 2,800 responses. That is a large postbag for a fisheries issue. The replies demonstrated that views were generally polarised between anglers who were strongly in favour of an increase in size and commercial fishermen who strongly opposed it. Whatever decision was reached was likely to be contentious. My approach was to ensure that my decision took proper account of the science. I am also particularly concerned about the impacts on the under-10m fleet in the short to medium term. It is difficult to quantify the impact on the profitability of individual vessels, but it is clear that bass between 36cm and 40cm makes up an important share of the catch for these vessels.

Fisheries
Debate in the House of Commons on Thursday 6 December

The Parliamentary Under-Secretary of State for Environment, Food and Rural Affairs (Jonathan Shaw): The fisheries sector continues to make a significant contribution to the UK economy. Total landings of fish from UK vessels have increased for the second year running. Their value rose to £610 million last year – up 7 per cent on 2005. The increase was shared across the UK and was mainly accounted for by an increase of almost a third in the value of the shellfish sector. Figures show that species such as crabs and lobsters are growing in value as a proportion of the total UK catch.

Bill Wiggin (Leominster): The Minister needs to confirm that the demands for the forthcoming electronic recording and reporting requirements are met. Like the Centre for Environment, Fisheries and Aquaculture Science, the Marine Fisheries Agency needs financial stability to function and meet its targets. If the Government cannot provide it, I suspect that our fisheries will suffer. The questionable financial management of the Department for Environment, Food and Rural Affairs means that in forthcoming years the number of Royal Navy fisheries protection service control days has been slashed.

Mr Robert Goodwill (Scarborough and Whitby): The cod fleet is much depleted with ten full time trawlers in Whitby and a similar number in Scarborough. The message from the fishermen that discards are a criminal waste is loud and clear. They do not just resent the money that they see being thrown away, but the fact that it is good fish that are being thrown back. This year the scientists recommended a 15 per cent increase in cod quota, but the Fisheries Council went for a freeze and that may be one reason why there have been so many discards.

Agriculture:Defra
Debate in the House of Lords on Thursday 6 December

Baroness Shephard of Northwold rose to call attention to the role of the Department for Environment, Food and Rural Affairs in securing the efficient and effective delivery of policies and funds that support and promote the farming industry in the United Kingdom. How are we to judge the efficiency of Defra? Is it well run? Is it able to cope with the crises that are part of its daily expectations? Does it help or hinder? Sadly, we have examples over the past year or two of problems for farmers arising from Defra itself. The most obvious are the single payment scheme and this summer's double outbreak of foot and mouth emanating from the Government-licensed laboratory at Pirbright. The financial loss to English farmers from the adoption of a dynamic hybrid system to make single payments against EU advice amounted to between £18 million and £22 million. At Pirbright the two leaks of foot and mouth virus have done little to enhance the department's reputation for efficiency. Given

that Defra deals with issues of enormous national and international importance adequate resources are clearly essential to deal with issues such as climate change, flood defences, in-year finance cuts on the Environment Agency, and bovine TB costs running at £90 million a year with no resolution in sight. Biofuels have revealed that although Defra's intentions were undoubtedly good, its effectiveness in practice proved wanting since there has been resistance in every sphere of Government towards the development of biofuels in the past 10 years.

The Minister of State, Department for Environment, Food and Rural Affairs (Lord Rooker): I acknowledge that there are significant difficulties. We have to focus on being a smarter regulator in order for the department to be able to deliver. The number of people in the department is not the issue that counts. The summer flooding provided a stark reminder of what we face if climate change becomes a regular feature, particularly in the middle of the growing season. No amount of planning could have prevented that. The members of the emergency team from the Environment Agency never received proper thanks for the work they did at the switching station at Waltham, near Gloucester. Had Waltham failed it would have knocked out electricity for half a million homes. The Stern review on the economics of climate change pointed out that agriculture accounts for 14 per cent of global greenhouse gas emissions. That is why we need farmers to adapt to climate change.

The England Rural Development Programme has a budget of £3.9 billion of which £3.3 billion will be allocated to agri-environment and other land management schemes, including the environmental stewardship scheme, which is open to every farmer in the country. Some £600 million will be made available to agriculture and forestry to make them more competitive and to enhance opportunity in rural areas. Currently over half of English farmland is under agri-environment schemes and under those schemes farmers are managing in excess of 180,000 kilometres of hedgerows. We have to ask ourselves whether we want the countryside maintained and if so be prepared to put a value on it and pay for it in the public interest.

Education

Education: Science and Mathematics
Debate in the House of Lords on Thursday 18 October

Lord Bilimoria asked the Government how they propose to develop teaching of science and mathematics in the UK so that future generations may be equipped to compete effectively in the emerging global marketplace. The Minister will have read the report, *Science Teaching in Schools*, published by the Science and Technology Committee which observed that the number of young people opting for science subjects at the age of 16 has remained flat or has declined over the last decade. Evidence indicated that around a quarter of state school pupils aged 11 to 16 had no access to a qualified physics teacher, and 12 per cent had no access to a qualified chemistry teacher. Furthermore the Government had failed to deliver £200 million for school science laboratories promised before the 2005 election. Half of all A grades achieved in physics were from candidates from independent schools – a sector that educates only 8 per cent of our young children but enjoys far superior facilities in the teaching of science. The recent report of Her Majesty's Chief Inspector of Schools has ranked almost half of our schools as either unsatisfactory or inadequate. Is it any wonder that just 200 of our independent schools account for 48 per cent of Oxbridge admissions, with 3,500 additional schools accounting for the balance of 52 per cent? Even more troubling are the findings in Ofsted's report that 200,000 of our teenagers remain outside education, training or employment. Lord Leitch's report on skills revealed that 17 million adults in the UK have difficulty with numbers and that more than one in six young people leave school unable to read, write or add up properly. As a result the UK risks increasing inequality, deprivation and child poverty, and a generation cut off permanently from labour market opportunity. I am therefore eager to hear from the Minister what progress he believes has and will be made in the future.

Lord Rees of Ludlow: The Royal Society has become more engaged with school-level education and has convened the main learning societies into a group chaired by Sir Alan Wilson to co-ordinate views and make it more effective in its advice to Ministers. One reason why many pupils in the crucial 14-16 age range are turned off science is because they never encounter an enthusiastic science teacher. Science must attract the talented young, but we should not focus only on the education of would-be professionals. For an informed public debate all young people need at least some feel for science and some engagement with its concepts.

The Parliamentary Under-Secretary of State, Department for Children, Schools and families (Lord Adonis): Lord Bilimoria, one of this country's outstanding entrepreneurs, is right to emphasise the huge importance of mathematics and science education to our economic and social prosperity in the next generation. Lord Sainsbury's excellent review of science and innovation, *The Race to the Top*, followed a huge piece of work designed to get to the roots of the challenge facing us in science and mathematics education and is an important part of the Government's answer to the question before us. The report presents eight main recommendations as follows:

1) Pay a £5000 incentive to general science and biology teachers who take physics and chemistry courses.

2) Change to the self-evaluation form prepared by schools

prior to the Ofsted inspection, prompting them to highlight recruitment and retention issues in relation to science and maths teachers.

3) Provide long-term Government funding for the 10 new science learning centres, with special support to enable teachers from schools with a shortage of science teachers to attend.

4) Expand the science and engineering clubs attached to schools that are geared to 11 to 14 year-olds who show interest and promise in science.

5) Give all pupils who would benefit the chance to study the new further mathematics GCSE.

6) Improve science and mathematics-related careers advice. This will start from 2008 when a contract will be awarded for the provision of such advice to schools.

7) Annual monitoring of progress towards the targets for physics, chemistry and mathematics teachers.

8) Continue to expand the opportunity for separate physics, chemistry and biology GCSEs which is a key Government priority.

From September 2008 all 310 science specialist schools will offer triple science. At the same time all higher achieving pupils reaching level 6 or above in the science key stage 3 tests taken by all 14 year-olds will have an entitlement to study triple science at GCSE, irrespective of the schools that they attend.

Schools
Debate in the House of Lords on Thursday 6 December

Baroness Perry of Southwark rose to call attention to an action plan to make opportunity more equal in the UK by raising school standards and increasing the number of good school places. We have suffered for a decade from the belief in Whitehall and of politicians that the way to improve standards was central control, bureaucratic directives, oppressive targets and a punitive inspection regime, which has demoralised and disempowered teachers. The evidence is starkly clear that the top-down approach has not worked. Something quite different is needed. A third of a million pupils fail to gain five good GCSEs including English and maths every year, while 130,000 young people each year fail to obtain a single C grade. Clever children from the poorest backgrounds fall progressively behind less clever children from higher socio-economic backgrounds. By the end of compulsory schooling at key stage 4, children eligible for free school meals are on average 40 per cent behind their contemporaries. That is unacceptable in any society and policy must address that issue not only for the sake of the future economy but, above all, for the sake of social justice. I therefore welcome the Conservative Party's commitment to shifting the balance of power in the classroom back in favour of the teacher, and in the school back in favour of the head.

The Parliamentary Under-Secretary of State, Department for Children, Schools and Families (Lord Adonis): It is a particular concern to the Government that more than 600 secondary schools failed to achieve our new ambition for every secondary school of 30 per cent or more pupils achieving five or more good GCSE passes, including English and maths. The figure was 1,600 in 1997, so there has been a great improvement. We need to see a more significant improvement still. An extensive and detailed account of proposed improvements was then presented.

Energy and Climate Change

Energy: Radioactive Waste Management (S&T Report)
Debate in the House of Lords on Monday 29 October

The Earl of Selborne rose to move that this House takes note of the report of the Science and Technology Committee on *Radioactive Waste Management: An Update* (4th Report, HL Paper 109). This is the fourth time that the committee has returned to the subject of radioactive waste management since the first report in 1999 concluded that phased disposal in a deep geological repository was the most feasible and desirable method for dealing with radioactive waste. It called for the establishment of a new, statutory body with responsibility for developing an overarching and comprehensive implementation strategy, and recommended that implementation proposals should be subject to explicit endorsement by Parliament at regular intervals. After four years' delay the Government appointed the Committee on Radioactive Waste Management (CoRWM) in 2003 to review options and make recommendations.

We welcomed their report in 2006 as it echoed our report seven years earlier. However, although CoRWM recommended an independent body to oversee implementation, they did not envisage either a statutory basis or accountability to Parliament. Hence their proposals were watered down. The Government's response was further diluted by the proposal to establish an independent overseeing body by their decision to give responsibility for the implementation of radioactive waste management to the Nuclear Decommissioning Authority (NDA) under its responsibilities derived from the Energy Act 2004, which does not explicitly mention geological disposal, thereby increasing the potential for conflict and confusion in the institutional arrangements. CoRWM's successor will be constituted as an independent advisory board.

We are firmly persuaded that this dilution of successive recommendations is not the way to build up public trust. In view of the division of responsibilities between the Government, the Nuclear Decommissioning Authority and

the regulators, it is critical that the remit, responsibilities and lines of accountability of the key players in the programme are clear. The Energy Act does not appear to have been drafted with these extended responsibilities in mind and the role of the NDA in geological disposal has never been debated or endorsed by Parliament. It is therefore recommended that the Energy Act be amended accordingly. Our Committee has been critical of the years that it took Government to determine a radioactive waste disposal policy. Much will now depend therefore on the right mix of skills and expertise in the membership of CoRWM under its chair designate, Professor Robert Pickard. If we do not rebuild our specialist nuclear skills capacity required for the long-term geological disposal programme, the radioactive waste management programme will be at risk and public confidence in the programme will be impossible to maintain.

The Minister of State, Department for Environment, Food and Rural Affairs (Lord Rooker): So many people have been determined not to find a solution to the waste as a means of stopping any discussion on new build. First, you do not want to discuss the waste because you might find a solution and, if you do, that knocks on the head any arguments about possible new build to cope with climate change. The Government have conceded that the Energy Act may well need amending to take account of the extra remit of the NDA. It is suggested that there has been dithering and procrastination. The Government will set the policy and take final decisions and the Government through Ministers will be fully accountable. The NDA will be a strong, effective implementing organisation. The regulators will ensure that the process is safe through robust, independent regulation. CoRWM will provide independent scrutiny and advice on the programmes and plans. Local communities in this country that are interested in hosting a geological disposal facility will work with the NDA and others in a partnership approach. Local government will be fully engaged in the partnership approach and will play its part in decision-making and the operation of the planning system.

Climate Change

Debate in the House of Commons on Thursday 22 November

The Minister for the Environment (Mr Phil Woolas): It is appropriate that climate change has been chosen for one of the first topical debates, because in the Government's view it is the greatest challenge of our time. The report from the intergovernmental panel on climate change has given the world the loudest possible wake-up call and comes two weeks ahead of the meeting of the world's Environment and Finance Ministers in Bali as part of the UN framework convention on climate change. At that meeting, along with our EU colleagues, we want to see the launch of comprehensive negotiations to deliver a post-2012 agreement to tackle climate change, that being the end of the first period of the Kyoto agreement. There are four key principles that the Government believe should underpin a post-2012 regime. Firstly, the post-2012 regime must fit the scale of the challenge. To avoid the dangerous impacts of climate change, global greenhouse gas emissions must peak within 10 to 15 years and fall by at least 50 per cent by 2020. Secondly, the agreement must be fully effective, involving all countries with significant emissions. A global carbon market needs to develop for that to be real. Placing a price on carbon is essential to incentivise new investment in energy efficiency and clean energy sources, not just for the developed world but for the developing world as well. Thirdly, the principle of fairness: developed countries have the greatest responsibility and the greatest capacity to reduce emissions. The larger emerging economies also need to adopt new commitments that reflect their growth. Richer countries should play their part in supporting developing countries as they transfer to clean energy technologies. Fourthly, a post-2012 agreement must be comprehensive, addressing emissions from energy at the same time as controlling emissions from land use, including deforestation.

Gregory Barker (Bexhill and Battle): The Conservative party welcomes this topical debate on climate change. However, the Government dropped their own commitment, made in three consecutive manifestos, to cut British carbon emissions by 20 per cent by 2010, and replaced it with a target of 15 per cent. The Government have ordered a U-turn on the Merton rule, having caved in to the House Builders Federation. The Government have chronically underfunded and are now scrapping the farce that is the low-carbon buildings programme, causing huge problems for the microgeneration industry. They have underspent, cut and then redirected budget commitments for energy efficiency and failed to support plans to build the world's first carbon capture and storage power station in Peterhead, Scotland, opting instead for yet another iterative round of consultation and a competition instead of just getting on with it. They were caught red-handed trying to water down Britain's commitment to the EU renewable energy target of 20 per cent by 2020. The Minister was remarkably short on solutions proportionate to the task. If we judge the Government's performance this year by deeds and not words, UK carbon emissions are still higher today than when the Labour Government took office 10 years ago.

Colin Challen (Morley and Rothwell): Over the past 650,000 years the highest level of carbon alone in the atmosphere was 280 parts per million, and now that figure stands at 384 parts per million. Carbon equivalent gases are perhaps over 430 parts per million now. It is obvious to me that we are well into uncharted territory already. We do not have a window of opportunity to see how much further we can test the system. I would not accept anyone saying that we have another 10 or 15 years to sort the problem out. We do not.

Energy Policy
Debate in Westminster Hall on Tuesday 27 November

Mr William Cash (Stone): The UK desperately needs an energy policy. Despite the length of this summer's energy White Paper – it runs to 342 pages – it dealt much more with what we need to do than how to do it. It was largely mute on how investment from UK companies is to be stimulated and encouraged in order to build new power stations and energy infrastructure. Our over-dependence on expensive gas, imported from Russia, the middle east and north Africa, for the generation of electricity is placing more households in fuel poverty, which is when more than 10 per cent of household income is spent on energy bills. We must incentivise new clean coal and nuclear build since the days when Britain could rely on plentiful gas from the North Sea are gone. I vigorously opposed the closures of Silverdale and Trentham collieries, both of which had substantial reserves and also challenged Arthur Scargill when he was doing an enormous amount of damage to our local industry in Staffordshire and told him to lay off my miners. I was aware then that those pits represented a part of Britain's future energy security. If we are to be able to exploit our domestic coal resources in future we must place clean coal at the heart of our future energy policy and stimulate investment in the development of our substantial reserves.

The Minister for Energy (Malcolm Wicks): The UK's remaining coal resources are a valuable national asset that we need to put to the best possible use. The coal authority estimated that reserves at existing and potential sites amount to more than 2 billion tonnes. The principal customer for that coal is the electricity generating industry. Coal-fired generation supplies around a third of UK electricity and can rise to more than 50 per cent, often at very short notice when demand peaks in winter. The Government are committed to carbon capture and storage (CCS) which is absolutely vital, as is the emissions trading scheme which is an important European way in which to pay for CCS in future.

Health

HIV/AIDS
Debate in Westminster Hall on Wednesday 28 November

Dr Gavin Strang (Edinburgh, East): The world first became aware of AIDS at the beginning of the 1980s, when it was observed that young gay men in the US were dying from rare illnesses. The first documented case in the UK was in 1981. While scientists worked to piece together how the condition was caused, Governments had to work out how to respond to the new public health challenge. The main sources of infection varied in different parts of the country. In some places, AIDS was a disease among the gay population. In other areas HIV/AIDS was primarily a problem among injecting drug users. That was the situation in Edinburgh where we had a major epidemic in the 1980s, predominantly among our injecting drug users. It is thought that a clampdown on the availability of needles led to an increase in needle-sharing, and that in turn led to the explosion of HIV infection among Edinburgh's drug-taking population. That interested me, and under the private Member's Bill procedure, I successfully introduced the AIDS (Control) Act 1987 which requires health authorities to publish reports annually, setting out the numbers diagnosed with HIV/AIDS and to provide details of the work being done in their area on prevention, treatment and care. In the past year, the Government have indicated their intention to discontinue the central requirement of the Act. Health authorities would no longer be required to produce annual reports.

Of the 73,000 people in the UK estimated to be living with HIV, about a third are unaware of their status. There is a great deal of work still to be done in reducing the number of people who are unaware of their HIV positive status. Some 37 per cent of HIV positive people visiting a genito-urinary medicine (GUM) clinic still leave the clinic unaware that they have the virus and there are now calls for GUM clinic HIV tests to be conducted on an opt-out basis universally, and to be provided for every attendee every time they attend with a new condition. There is also a funding issue as the additional £300 million pledged in the 2004 "Choosing Health" White Paper to transform England's sexual health services has been diverted from sexual health to alternative causes, notably paying off Primary Care Trust (PCT) financial deficits.

The Minister of State, Department of Health (Dawn Primarolo): The understanding of HIV is now much greater than when he introduced the Bill that led to the AIDS (Control) Act 1987. In prevention, we now focus in the UK on the particular sections of our communities that are most at risk: gay men and African communities – the groups most at risk of sexual transmission of HIV. Funds that were previously ring-fenced for prevention are now included in the baseline for the National Health Service, and have been since 2002. We now also have focused delivery of treatments.

The global estimates of HIV are shocking with 33.2 million people estimated to be living with HIV in 2007, 2.5 million new HIV diagnoses and 2.1 million deaths. However, the UK situation has had some successes where antiretroviral therapy (ART) has reduced deaths from 749 in 1997 to 497 in 2006. Today, 90 per cent of HIV-infected women are diagnosed before delivery, enabling treatment to be given to prevent HIV transmission to the child. However, gay men remain the group most at risk of HIV transmission in the UK. The Health Protection Agency expects a figure of 2,700 for new diagnoses among gay men in 2006. For African communities we are working on interventions to increase awareness of the

benefits of HIV testing and the importance of using condoms. We are working to achieve consensus on prevention priorities, as well as strengthening the evidence base for HIV health promotion in African communities in England.

NHS: Drugs
Question and Written Answer on Tuesday 18 December

Dr Iddon (Bolton South East): To ask the Secretary of State for Health:
how many biosimilar medicines are licensed for use in the United Kingdom; (2) if the Government will take steps to preclude the automatic substitution of brands with similar biological medicines to ensure patients are not put at unnecessary risk from potential adverse drug reactions; (3) if he will hold discussions with (a) the Medicines and Healthcare Products Regulatory Agency and (b) the European Medicines Agency to ensure that manufacturers of biosimilar medicines submit full clinical trial data on each indication for their products rather than extrapolated data from the reference product; (4) if he will ensure that biosimilar medicine packaging and accompanying patient information leaflets (a) contain details of the formulation and manufacturing process for the biosimilar agent and (b) make reference to the potential risk of not being able to determine which drug resulted in an adverse drug reaction as a result of interchanging similar biological medicines.

Dawn Primarolo: The relevant European Union (EU) legislation requires that packaging and leaflets include information on the qualitative composition for active substances and excipients and the quantitative composition for active substances, the pharmaceutical form and content of the active drug substance in weight, volume or units of dosage, the name and address of the manufacturer, the name and address of the marketing authorisation holder and, where applicable, the name of his appointed representatives in the member states.

They must also include a description of the relevant adverse reactions which may occur under normal use of the medicinal product and, if necessary, the action to be taken in such a case. The patient should be expressly asked to communicate any adverse reaction which is not mentioned in the package leaflet to his doctor or pharmacist.

Details of the manufacturing processes are commercially confidential and are subject to intellectual property rights and cannot be made publicly available.

The demonstration of the similar nature of two biological medicinal products may not always be required for each indication applied for. European legislation does not exclude extrapolation of evidence based on the biosimilar product. Existing guidance provided by European Medicines Agency (EMEA) allows such extrapolation, when demonstrated in an appropriate clinical situation, as long as it is justified on a scientific basis. Therefore the type and amount of additional data to be provided shall be determined on a case-by-case basis in accordance with relevant scientific guidelines.

The Medicines and Healthcare products Regulatory Agency has not issued a specific guideline to clinicians on substitution. All medicines, including biological medicines, should be prescribed by clinicians in accordance with the approved advice provided in the Summary of Product Characteristics which provides full information about the product, including its side effects and its use.

The Royal Pharmaceutical Society of Great Britain's Professional standards and guidance for the sale and supply of medicines provides advice to pharmacists on switching from innovator biological medicines to biosimilar medicines and states that except in an emergency, a specifically named product should not be substituted by any other product without the approval of the patient or carer and the prescriber, and in the case of hospital drugs, the approval of the therapeutics committee, or in line with other similar locally agreed protocols.

To date there are five biosimilar medicinal products approved for use in the EU. This includes two preparations of the recombinant growth hormone, somatropin, namely Omnitrope and Valtropin and three preparations of epoetin alfa; Abseamed, Binocrit, and Epoetin alfa Hexal.

There are several more biosimilar medicinal products currently under assessment.

Science Policy

Animal Experiments
Question and Written Answer on Tuesday 18 December

Mr Jim Cunningham (Coventry South): To ask the Secretary of State for Innovation, Universities and Skills what steps the Government have taken to reduce the numbers of animals used for research purposes.

Ian Pearson: In 2004 Government established the National Centre for the Replacement Refinement and Reduction of Animals in Research (NC3Rs) to advance and promote the replacement, refinement and reduction of the use of animals in research. This is the first such centre to be established in the world and it receives funding from the Department for Innovation, Universities and Skills (DIUS) via the Medical Research Council (MRC) and the Biotechnology and Biological Sciences Research Council (BBSRC). In September this year, I announced NC3Rs would receive £2.4 million, an increase of £1 million, for 11 new 3Rs projects. The CSR

period will see further increased funding rising from £2.3 million in 2007-08 to just over £5 million in 2010-11. The centre also received £250,000 funding from the Home Office in 2007-08. Home Office funding after 2007-08 will be confirmed in due course.

The Animals (Scientific Procedures) Act 1986 (ASPA) regulates the use of animals in scientific procedures in the UK. The principles of the 3Rs are implicit in the ASPA; all UK scientists are therefore legally obliged to use alternative approaches to the use of animals where possible, to use the minimum number of animals, and to use protocols which cause the least pain, suffering or distress.

Nanotechnology: Finance
Question and Written Answer on Tuesday 18 December

Dr Gibson (Norwich North): To ask the Secretary of State for Business, Enterprise and Regulatory Reform how much funding the Technology Strategy Board plans to allocate to nanotechnology in each of the next five years.

Ian Pearson: The Technology Strategy Board, established as an executive NDPB in July 2007, has inherited a number of nanotechnology-focused activities from the former DTI, including collaborative R and D projects, nanotechnology centres, and knowledge transfer network.

It is currently in the process of developing its strategic and delivery plans for the next three years starting April 2008, and the role of nanotechnology will be fully considered in developing these plans. During this period, the Technology Strategy Board will overall co-ordinate public sector investment worth more than £1 billion (including contributions from the English RDAs and the Research Councils), to provide business with a coherent package of technology and innovation support, to help companies turn good ideas into new products and services.

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

Parliamentary and Scientific Committee News

New Members

We are delighted to welcome a new Parliamentary member, **Mr Ian Taylor MP**, and two new Individual Members, **Professor Robert Pickard** and **Dr John Dudeney OBE.**

The Committee's Website
www.scienceinparliament.org.uk

Members' Noticeboard
There is now a Members' Noticeboard on the Committee's Website.

If any member of the Parliamentary and Scientific Committee wishes to publish on the website brief details of a meeting, of a report which has recently been published, or any other information which they wish to make known to other members, please contact Annabel Lloyd at the secretariat on 020 7222 7085 or by e-mail to lloyda@pandsctte.demon.co.uk.

Photo Gallery
Some photographs taken at the Committee's recent Annual Lunch and at the visit to the V&A Museum are also available on the Committee's website.

Forum
Members are encouraged to contribute to the Forum which is established for their exclusive use.

Dinner Discussions
Summaries of discussions over post-meeting dinners are now available on the website.

Euro-News

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

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

European scientists awarded 2007 Nobel Prizes

The 2007 Nobel prizes will go down in history as an exceptional vintage for European scientists and their pioneering scientific breakthroughs. Two German, one French and one British scientist scooped this year's prestigious awards, winning the prize in three out of six categories: physics, chemistry and medicine. The physics award was the most impressive, as the discovery of giant magnetoresistance (GMR) by Germany's Professor Peter Grunberg and France's Professor Albert Fert has paved the way for what is now the ubiquitous Apple iPod. It also led to the increasingly small hard disk drives found in computers and digital devices. The phenomenon of GMR is where weak magnetic changes in magnetic resistance give rise to big differences in electrical resistance. As it involves structures consisting of very thin layers of different magnetic materials, the Royal Swedish Academy of Sciences considered it "one of the first real applications of the promising field of nanotechnology". "Applications of this phenomenon have revolutionised techniques for retrieving data from hard disks," the prize citation said. "The discovery also plays a major role in various magnetic sensors, as well as the development of a new generation of electronics."

Equally remarkable was the groundbreaking work in gene technology by one Italian-born and two British-born scientists. Two of the three are now American citizens (Professor Mario Capecchi and Professor Oliver Smithies), but, together with Briton Sir Martin Evans, these European-born scientists successfully developed a technique known as "gene targeting." The technique enables scientists to silence specific genes and monitor the effect, so that they are able to build a picture of embryonic development, adult physiology, ageing and disease, gene by gene. On awarding the Nobel prize in medicine, the Nobel committee said that the pioneering work had led to many new insights into conditions such as cancer and heart disease. In its citation, it heaped praise on the technique as "an immenseley powerful technology", which is now being used in virtually all areas of biomedical research.

The third Nobel prize, in chemistry went to the German researcher professor Gerhard Ertl, chosen by the Royal Swedish Academy of Sciences "for groundbreaking studies in surface chemistry." His work has enhanced areas as diverse as the process used to make fertilizer, the production of catalytic converters and hydrogen fuel cells.

Galileo should be financed through EU budget, says European Commission

The European Commission has recommended that the European Community take complete responsibility for funding the deployment of Galileo, Europe's satellite navigation system, warning of the consequences of shelving the project. Galileo is a joint EU-European Space Agency (ESA) initiative, and was to be financed through a public-private partnership (PPP). It will see a network of 30 Galileo satellites beaming radio signals to receivers on the ground, enabling users to pin-point exact locations. Unfortunately the companies within the Galileo consortium were unable to agree on how to share the financial risks involved in the project, and so this method of financing the deployment phase was abandoned. Since the early summer of 2007, the Commission has been looking into alternative funding scenarios. The Commission, European Parliament and Council of the EU have rejected calls for the project to be written off on account of its inherent costs. The Commission suggests that the €3.4 billion that is needed to get Galileo up and running could come from EC funds. The funding could also come in the form of direct contributions from EU Member States. These revised funding proposals, entirely from public sources, arise as a direct result of "unforseen circumstances" such as the the failure of the negotiations on the concession contract within the private consortium

New at the top: Dr Anneli Pauli talks about her vision for the JRC

The European Commission Joint Research Centre (JRC) has a new Deputy Director-General, and she has a vision: a JRC that is known throughout Europe and beyond for its scientific excellence, independence and high societal relevance. Dr Anneli Pauli took up her position in April 2007, having previously worked as Vice President of the Academy of Finland, responsible for research. The organisational chart of the JRC has been divided in two with half of the seven research institutes and three directorates reporting to the to JRC Director-General Dr Roland Schenkel, and half to Dr Pauli. She appreciates the additional responsibility that this gives her, and has already visited each institute.

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Research Councils UK

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Each year the Research Councils invest around £3 billion in research covering the full spectrum of academic disciplines from the medical and biological sciences to astronomy, physics, chemistry and engineering, social sciences, economics, environmental sciences and the arts and humanities.

Research Councils UK is the strategic partnerships of the seven Research Councils. It aims to:

- increase the collective visibility, leadership and influence of the Research Councils for the benefit of the UK;
- lead in shaping the overall portfolio of research funded by the Research Councils to maximise the excellence and impact of UK research, and help to ensure that the UK gets the best value for money from its investment;
- ensure joined up operations between the Research Councils to achieve its goals and improve services to the communities it sponsors and works with.

Arts and Humanities Research Council

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Each year the AHRC provides approximately £100 million from the Government to support research and postgraduate study in the arts and humanities, from archaeology and English literature to dance and design. Awards are made after a rigorous peer review process, to ensure that only applications of the highest quality are funded. The quality and range of research supported by this investment of public funds not only provides social and cultural benefits but also contributes to the economic success of the UK.

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 Government's Science Budget. 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.

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.

Engineering and Physical Sciences Research Council

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EPSRC invests more than £740 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.

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.

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

Science & Technology Facilities Council

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Formed by Royal Charter in 2007, the Science and Technology Facilities Council is one of Europe's largest multidisciplinary research organisations supporting scientists and engineers world-wide. The Council operates world-class, large-scale research facilities and provides strategic advice to the UK Government on their development. It also manages international research projects in support of a broad cross-section of the UK research community. The Council also directs, co-ordinates and funds research, education and training.

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.

The 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 into healthcare benefits for society. The Academy's Fellows are the United Kingdom's leading medical scientists and scholars 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 20,000 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

Contact: Dr Chris Kirk
Chief Executive,
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Tel: 020 7280 4133 Fax: 020 7280 4170
Email: chris.kirk@biochemistry.org
Website: www.biochemistry.org

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

Contact: Dr Richard Dyer, Chief Executive
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PO Box 502, Cambridge, CB1 0AL
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E-mail: rdyer.bsf@physoc.org
Website: www.bsf.ac.uk

The Biosciences Federation is a single authority representing the UK's biological expertise. The BSF directly represents 51 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.

British Association for the Advancement of Science - the BA

Contact: Sir Roland Jackson Bt, Chief Executive
The BA, Wellcome Wolfson Building,
165 Queen's Gate, London SW7 5HD.
E-mail: Roland.Jackson@the-BA.net
Website: www.the-BA.net

The BA (British Association for the Advancement of Science) 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 is a registered charity which organises major initiatives across the UK, including the annual BA Festival of Science, National Science and Engineering Week, programmes of regional and local events, and the CREST programme for young people in schools and colleges.

The British Ecological Society

Contact: Ceri Margerison, Policy Officer
British Ecological Society
26 Blades Court, Deodar Road, Putney, London, SW15 2NU
Tel: 020 8877 0740 Fax : 020 8871 9779
Website: www.BritishEcologicalSociety.org
Ecology into Policy Blog
http://ecologyandpolicy.blogspot.com/

The British Ecological Society's mission is to advance ecology and make it count. The Society has 4,000 members worldwide. The BES publishes four internationally renowned scientific journals and organises the largest scientific meeting for ecologists in Europe. Through its grants, the BES also supports ecologists in developing countries and the provision of fieldwork in Schools. 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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Email: c.price@nutrition.org.uk
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2007 was 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

Today's science, tomorrow's medicines

Contact: Kate Baillie
Chief Executive
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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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Parliamentary Officer
The British Psychological Society
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Website: www.bps.org.uk

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

Contact: Tracey Guest, Executive Officer
British Society for Antimicrobial Chemotherapy
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Website: www.bsac.org.uk

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

BVA

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www.bva.co.uk

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

www.cabi.org

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Website: www.cabi.org

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

CCFRA

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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

UNIVERSITY OF CAMBRIDGE

The Administrative Secretary, The Cavendish Laboratory,
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E-mail: dhp24@cam.ac.uk
http://www.phy.cam.ac.uk

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: 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. Quantum optics.

Chartered Institute of Patent Attorneys

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Secretary & Registrar
The Chartered Institute of Patent Attorneys
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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

CLIFTON SCIENTIFIC Trust

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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

C-Tech Innovation

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Website: www.ctechinnovation.com

An independent innovation and technology development organisation. Activities range from contract and grant funded research to commercialisation of technology, exploitation of intellectual property, multi-disciplinary innovation consultancy and process and product development.

C-Tech now has almost 40 years experience of the management and delivery of major technology and innovation based business support projects both nationally and regionally.

The Engineering and Technology Board

Contact: Clare Cox
2nd Floor, Weston House
246 High Holborn, London WC1V 7EX
Tel: 020 3206 0434
Fax: 020 3206 0401
E-mail: ccox@etechb.co.uk
Website: www.etechb.co.uk

The Engineering and Technology Board (ETB) is an independent organisation that promotes the vital role of engineers, engineering and technology in our society. The ETB partners business and industry, Government and the wider STEM community: producing evidence on the state of engineering; sharing knowledge within engineering, and inspiring young people to choose a career in engineering, matching employers' demand for skills.

Freshwater Biological Association

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Freshwater Biological Association, The Ferry Landing, Far Sawrey, Ambleside, Cumbria, LA22 0LP, UK.
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
London WC1V 7PP
Tel: 020 7759 2700/2701
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

Contact: Tim Whitaker
21 Bloomsbury St
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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

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76 Portland Place, London W1B 1NT
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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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www.icheme.org

Institution of Civil Engineers

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Website: www.ice.org.uk

ICE aims to be a leading voice in infrastructure issues. 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, evidence and comment, on a wide range of subjects from energy generation and supply, to sustainability and the environment.

Institution of Engineering and Technology

Contact: Tony Henderson
Institution of Engineering and Technology
Savoy Place, London WC2R 0BL
Tel: 020 7344 8403
E-mail: tonyhenderson@theiet.org
Website: www.theiet.org

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.

KEW GARDENS

PLANTS PEOPLE POSSIBILITIES

The mission of Kew is to inspire and deliver science-based plant conservation worldwide, enhancing the quality of life. Kew is developing its breathing planet programme with seven key activities:

- creating global access to essential information
- identifying species and regions most at risk
- helping implement global conservation programmes
- extending the Millennium Seed Bank's global partnership
- establishing a global network for restoration ecology
- identifying and growing locally appropriate species in a changing climate
- using botanic gardens as shop-front opportunities to inform and inspire

Contact: Prof Simon J. Owens
Tel: 020 8332 5106
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Email: s.owens@kew.org
Website: www.kew.org
Two stunning gardens-devoted to building and sharing knowledge

LGC

Queens Road, Teddington
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E-mail: info@lgc.co.uk
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 Standards (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 the 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 has its headquarters in Teddington, South West London, and other UK operations in Bury, Culham, Edinburgh, Leeds, Risley, Runcorn and Tamworth. It also has facilities in France, Germany, Italy, Poland, Spain, Sweden and India.

London Metropolitan Polymer Centre

Sir John Cass Department of Art, Media & Design

Contact: Alison Green,
London Metropolitan University
166-220 Holloway Road, London N7 8DB
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E-mail: alison@polymers.org.uk
Website: www.polymers.org.uk

The London Metropolitan Polymer Centre provides training, consultancy and applied research to the UK polymer (plastics & rubber) industry. Recently, LMPC has merged with the Sir John Cass Department of Art, Media & Design (SJCAMD) to provide a broad perspective of materials science and technology for the manufacturing and creative industries. SJCAMD contains Met Works, a unique new Digital Manufacturing Centre, providing new technology for rapid prototyping and manufacture. The new department will offer short courses in polymer innovation, print technology and silversmithing & jewellery.

Lilly and Company Limited

Answers That Matter.

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Lilly UK 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, heart disease and many other diseases.

Marks & Spencer Plc

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Main Business Activities
Retailer – Clothing, Food, Home and Financial Services

We have around 760 stores in 33 territories worldwide, employing 75,000 people.

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

MERCK SHARP & DOHME

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

NESTA Making Innovation Flourish

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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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The National Physical Laboratory (NPL) is the United Kingdom's national measurement institute, 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 has the responsibility to enhance biodiversity, landscape and wildlife in rural, urban, coastal and marine areas; promote access, recreation and public well-being, and contribute to the way natural resources are managed so that they can be enjoyed now and by future generations.

Natural History Museum

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The Natural History Museum is the UK's premier institute for knowledge on the diversity of the natural world, conducting scientific research of global impact and renown. We maintain and develop the collections we care for and use them to promote the discovery, understanding, responsible use and enjoyment of the world around us.

Newcastle University

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Newcastle University has a well-balanced portfolio of research funding with one of the highest levels of research projects funded by UK Government Departments, as well as a very significant portfolio of FP6 EU activity of more than 140 projects involving some 1,800 partners. A member of the Russell Group, Newcastle University is committed to 'excellence with a purpose' - a commitment it is taking further through the development of Newcastle Science City and as a partner in the N8 group of Northern research-intensive universities.

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
http://www.pharmaq.co.uk/shop

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

Plymouth Marine Sciences Partnership

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The Plymouth Marine Sciences Partnership comprises six leading marine science and technology institutions representing one of the largest regional clusters of expertise in marine sciences, education, engineering and technology in Europe. The mission of PMSP is to deliver world-class marine research and teaching, to advance knowledge, technology and understanding of the seas.

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. 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.

The Royal Institution

Ri The Royal Institution of Great Britain

Contact: Dr Gail Cardew
Head of Programmes
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21 Albemarle Street, London W1S 4BS
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The core activities of the Royal Institution centre around four main themes: science research, education, communication and history. It acts as a unique forum for engaging people in scientific debate, and has a UK-wide programme of informal science learning and mathematics enrichment. The building has been closed for the last three years, and will open in summer 2008 when the public will have access to an extended museum, new social spaces and upgraded facilities in the historic lecture theatre. There will also be a new focus for the Davy Faraday Research Laboratories.

The Royal Society

THE ROYAL SOCIETY CELEBRATING 350 YEARS

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Email: peter.cotgreave@royalsociety.org
Website: www.royalsociety.org

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 future scientific leaders and in innovation
- Influence policymaking with the best scientific advice
- Invigorate science and mathematics education
- Increase access to the best science internationally
- Inspire an interest in the joy, wonder and excitement of scientific discovery.

RSC Advancing the Chemical Sciences
The Royal Society of Chemistry

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Parliamentary Affairs
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Website: http://www.rsc.org
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 a leading source of independent advice, comment and discussion on statistical issues. It plays a crucial role in promoting public understanding of statistics and acts as an advocate for the interests of statisticians and users of statistics. The Society actively contributes to government consultations, Royal Commissions, parliamentary select committee inquiries, and to the legislative process, most notably during the passage of the Statistics and Registration Service Act 2007.

semta

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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, and currently contributes over £74 billion per annum – about ten per cent – of total UK GDP.

society for general Microbiology

Contact: Public Affairs Administrator
Marlborough House, Basingstoke Road,
Spencers Wood, Reading RG7 1AG.
Tel: 0118 988 1843 Fax: 0118 988 5656
E-mail: pa@sgm.ac.uk
Website: http//www.sgm.ac.uk

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

Contact: Andrew Ladds,
Chief Executive
SCI International Headquarters
14-15 Belgrave Square, London SW1X 8PS
Tel: 020 7598 1500 Fax: 020 7598 1545
E-mail: secretariat@soci.org
Website: www.soci.org

SCI is an interdisciplinary network for science, commerce and industry. SCI attracts forward-thinking people in the 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 our published journals , books and the respected magazine *Chemistry & Industry.*

Society of Cosmetic Scientists

FOUNDED 1948 SCS SOCIETY OF COSMETIC SCIENTISTS

Contact: Lorna Weston,
Secretary General
Society of Cosmetic Scientists
G T House, 24-26 Rothesay Road, Luton, Beds
LU1 1QX
Tel: 01582 726661
Fax: 01582 405217
E-mail: ifscc.scs@btconnect.com
Website: www.scs.org.uk

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

Contact: Dr James Kirkwood,
Scientific Director
The Old School, Brewhouse Hill
Wheathampstead, Herts. AL4 8AN.
Tel: 01582 831818. Fax: 01582 831414.
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
020 7222 7085:
lloyda@pandsctte.demon.co.uk
www.scienceinparliament.org.uk

Tuesday 26 February 17.30
Science in the Regions
Dr Ed Metcalfe, Chief Scientific Advisor, SEEDA
Dr George Baxter, Director of Science & Innovation, NWDA
Professor Colin R Whitehouse FREng, Deputy Chief Executive, STFC

Thursday 13 March 10.00-14.00
National Science and Engineering Week Seminar
What does British Industry want from our Scientists and Engineers?
jointly chaired by Ian Pearson MP and Dr Douglas Naysmith MP

Dr Tim Bradshaw, Head of Innovation Group, CBI

Sir Robin Saxby FREng,
Past President, IET

Dr Ralph Rayner,
Vice-President, IMarEST

Dr John Morton, Chief Executive, ETB

Professor Julia King CBE FREng,
Vice Chancellor, Aston University

Tuesday 22 April 17.15
Annual General Meeting
Followed by Discussion meeting - subject and speakers to be confirmed

Tuesday 19 May 17.30
Discussion Meeting - subject and speakers to be confirmed

The Royal Institution

The Royal Institution's lecture theatre has reopened, and the rest of its refurbished building will open in summer 2008. All events take place at the Royal Institution unless otherwise stated. See www.rigb.org or telephone 020 7409 2992 for full details and to book tickets.

Friday 22 February 20.00
Solar variability and climate
Prof Joanna Haigh

Thursday 28 February 19.00
Blogging science
Dr Ben Goldacre, Dr Jennifer Rohn and Ed Yong
The Apple Store, Regent Street

Friday 29 February 20.00
Looking for life on Mars
Prof Max Coleman

Friday 7 March 20.00
The polar oceans and climate change
Prof Peter Wadhams

Wednesday 12 March 18.30
Love factually
Prof David Perrett and Dr Lucy Vincent
Institut Français Cultural Centre

Thursday 13 March 19.00
Tracing memory: how we remember
Prof Alan Baddeley and
Prof Richard Morris
The Dana Centre

Friday 14 March 20.00
The quest for motility
Prof Tony Ryan

Tuesday 1 April 09.15
Access not excess: novel ways to nourish the world
Various speakers
Magdalen College School, Oxford

Friday 4 April 10.00
The world in eleven dimensions
Prof Michael Duff

Saturday 5 April 18.00
Peak performance
Dr Hugh Montgomery
National Museum of Scotland, Edinburgh

Tuesday 8 April 14.00
Ri and U3A out and about
Prof Frances Balkwill, Prof Jocelyn Bell Burnell and Dr Denny Levett
Friends Meeting House, Euston Road

Friday 11 April 20.00
The vagus nerve: a window on consciousness and disease
Dr Chris Pomfrett

Tuesday 15 April 18.30
About blooming time: a plant's response to changing climate
Dr Judith Irwin and Amy Strange

Thursday 17 April 19.00
An evening with Robert Winston
Baroness Susan Greenfield and Lord Robert Winston

Friday 18 April 20.00
Truth and beauty: why numbers really matter
Andrew Dilnot

Thursday 24 April 19.00
Flying green: making air travel more sustainable
Bill Glover and Prof Ian Poll

Friday 25 April 20.00
Everest intensive care: from mountainside to bedside
Dr Mike Grocott

The Royal Society

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 17 and Tuesday 18 March 2008 (all day)
From computers to ubiquitous computing by 2020

Monday 7 and Tuesday 8 April 2008 (all day)
The environmental e-science revolution
Sponsored by NERC

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

The Royal Academy of Engineering

3 Carlton House Terrace, London SW1Y 5DG

www.raeng.org.uk/events or
events@raeng.org.uk
020 7766 0600

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 3 March 17.30
New Antibiotics from the Sea Bed to the Hospital Bed
Dr Andrew Mearns Spragg

Monday 10 March 17.30
Optos: The Design Challenges and Business Tribulations
Mr Douglas Anderson

Monday 28 April 17.30
Robert Cormack Bequest Lecture 100 Years of Radio Astronomy: Past, Present and Future
Professor Michael Garrett

Monday 12 May 17.30
Exploring the Mysteries of the Universe with the Large Hadron Collider
Professor Fabiola Gianotti

The BA (British Association for the Advancement of Science)

Friday 7 - Sunday 16 March
National Science and Engineering Week
As part of National Science and Engineering Week scientists, engineers, science communicators and the general public host thousands of events across the UK, in order to engage as many people as possible with science, engineering, technology and their implications. It is co-ordinated by the BA in partnership with the Engineering and Technology Board (ETB) and funded by the Department for Innovation, Universities and Skills (DIUS). Further information: http://www.the-ba.net/nsew

Monday 19 & Tuesday 20 May
The BA Science Communication Conference
at the Institution of Engineering and Technology, Savoy Place, London
Further information and bookings: http://www.the-ba.net/ScienceCommunicationConference.

Royal Pharmaceutical Society of Great Britain

Contact: science@rpsgb.org
www.rpsgb.org
Events are held at the Royal Pharmaceutical Society of Great Britain, London

Wednesday 30 January
The control of Infectious Diseases: Virulence, Antibiotics and Bacterial Infection

Monday 10 March
Cannabinoid Medicines

Monday 31 March - Wednesday 2 April
Thirteenth Arden House European Conference
Driving innovation, control and performance improvement on the critical path - the pivotal role of particle and power technologies in dosage form manufacture - 2008

Thursday 1 May
Biologically-Active Compounds in food

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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