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Spring 2011

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The Journal of the Parliamentary and Scientific Committee

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BIVDA

MAKING BRITAIN HEALTHY: UNLOCKING THE POTENTIAL OF IN VITRO DIAGNOSTICS IN THE NHS

Seventy percent of clinical decisions are based on an *in vitro* diagnostic (IVD) test. These have an increasing role to play to deliver cost effective healthcare and improve outcomes for patients.

However, to fully realise these patient benefits and cost efficiencies we need the Government to:

- Encourage increased access to point of care diagnostics in the community - allowing more rapid treatment of patients in a setting convenient for their daily lives
- Address the way money flows within the NHS to reduce perverse incentives which block the use of new tests *or* better use of existing tests
- Ensure that the DH supports NHS organisations in embedding recommendations and guidance for diagnostics from NICE

About BIVDA

BIVDA is the national trade association for the manufacturers and distributors of IVD products in the UK. We currently represent more than 95% of the industry and over a hundred organizations ranging from British start-up companies to UK subsidiaries of multinational corporations. BIVDA members employ over 8,000 people in this country including in manufacturing and R&D, with a total industry turnover of approximately £900 million of direct sales.

Please don't hesitate to contact the Director General, Doris-Ann Williams if you would like any further information about any of the aspects of this issue or about in vitro diagnostics in general. She is always more than willing to visit you in Westminster.

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Parliamentarians with a background in or dedication to Science and Technology are at the forefront in the efforts to encourage and support all those concerned with ensuring that the high quality R&D undertaken in the UK is put to the best possible use, be it fundamental research or applied science.

It is probably no surprise to UK and EU Parliamentarians with S&T backgrounds that the German economy has recently rebounded so rapidly, when compared with the UK, as so much effort is placed not just on "Blue Skies" research but also on those areas where the results of fundamental research are applied directly to ensuring that the industrial base, and especially manufacturing, are both fully supported to ensure global market competitiveness.

Unfortunately, the UK currently generally recognises only one internationally accepted level of attainment in science, and not surprisingly that is where those with the ability to do so have for obvious reasons naturally tended to direct their full attention. Those with the ability to turn new discoveries into economic benefits for the whole of society on the other hand, normally do not receive anything like the attention or recognition devoted to their pure science counterparts.

Martin Rees, the outgoing President of the Royal Society has however made an enormous contribution in advancing the cause for long term planning for R&D in the UK backed up by some of the best scientific brains the world can muster, many of them based at the UK's world class Universities.

How can we begin to put this matter right before it is too late if our economy is to be prevented from sliding down a slippery slope? Who will be primarily responsible for ensuring that the full integration of science, technology and engineering takes place throughout the UK's educational and industrial landscape?

History has shown us with painful results for every one of us that reliance on service industries alone, including high risk banking, will not, as previously thought, provide the basis for a stable long term future for Western style economies. The US and UK have both been vulnerable in this respect.

Much attention is currently being devoted to investigating the need for and future development of Technology Innovation Centres as a way to ensure that the UK considers all the options before us. There is both an urgent need and new opportunity to help supply the Developing World with the products they require from us and to help manage their increasing demands for improved infrastructure and their burgeoning human populations. This is one important area where a new generation of Technology Innovation Centres based in the UK could really make a difference if we get the funding and structures right.

Andrew Miller MP
Chairman, Parliamentary and Scientific Committee

SCIENCE IN PARLIAMENT

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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:
1. to inform the scientific and industrial communities of activities within Parliament of a scientific nature and of the progress of relevant legislation;
2. to keep Members of Parliament abreast of scientific affairs.

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TECHNOLOGY AND INNOVATION CENTRES

Professor Richard Brook OBE FREng
President AIRTO

This article reflects the oral evidence from the author to the House of Commons Science and Technology Select Committee into Technology and Innovation Centres in December 2010.

AIRTO has long argued for a UK equivalent of the technological support infrastructure represented by the Fraunhofer Institutes in Germany. This would address a long standing problem with the UK's underperformance in converting world class research into economic growth. The problem stems from a perception at policy level that investing in universities and encouraging closer working with business and industry will of itself bring about significant economic growth. This falls quite a long way short of what's needed in relation to a) boosting research based innovation by facilitating industry to industry working and b) making available a full spectrum of specialised skills and support at every stage of the journey from research through innovation to successful commercialisation.

Adding dedicated research and enterprise resources to universities achieves a measure of success, but struggles to address several important aspects of the challenge, particularly where collaboration and partnership between multiple parties is concerned. More extensive support is required, particularly to help match demand side pull from business and industry with scientific and technological expertise; to co-ordinate access for industry to multiple sources of scientific and technological development; and to proactively stimulate collaborative enterprise, foster technology development and support business incubation.

Until very recently, this had not been recognised; but in late 2009 Lord Mandelson was introduced to the Fraunhofer system. Taking the message seriously, he instigated the Hauser Review. This has moved us a long way forward, helped considerably by the increasing emphasis on high-growth companies to drive job creation and wider economic development and by the need for these companies to leverage new technology.

This isn't the first attempt to enhance the industrial uptake of new technology in the UK. New centres were brought into being after both world wars and, together with Public Sector Research Establishments and privately formed research organisations, these comprise a considerable network of technologically highly skilled resources across the UK.

SO WHAT IS THE PROBLEM?

Governments have repeatedly tried to make these centres financially self-sufficient. This inevitably changed their business models, away from generic research serving the national interest and working with SMEs, towards services and less risky work for larger enterprises worldwide, thereby moving them away from the purpose for which they were established.

A previous attempt to emulate Fraunhofer style institutes gave rise to the Faraday Partnerships that came into being in the 1990s. I ran one of the first of these. Why didn't they last?

The Faraday Partnerships started up very unevenly. First of all, a number of Post-graduate Training Partnerships were established between individual RTOs and research intensive universities. This was modelled on one element of the Fraunhofer system. Those of us involved felt that they were very successful. Later in the decade the Faraday Partnerships proper were launched as the EPSRC provided an initial tranche of ring-fenced research money for university partners. The Department of Trade and Industry could not find the budget at the time to provide what would be the core funding for the partnership infrastructures; that eventually came somewhat later.

When the ring-fenced research money was exhausted, the Faraday Partnerships were

directed to apply through normal research grant application processes to be peer-reviewed competitively, along with the main body of university researchers. As industry began to call for the initial ground-breaking work to be pursued further, the rankings from the peer review system declined, in many instances because, although fundamental to the technological foundations of industry's development programmes, it was no longer the glamorous or break-through research traditionally used to benchmark academic research proposals.

There was (deliberately) no specific or well-defined governance model; some Partnerships were run by universities and some by intermediate organisations. Most resulted from open calls for proposals, rather than developing from a strategic perspective on the UK's innovation landscape. There was little support for brand development in the way now being proposed. Eventually, as policies and responsibilities within government changed, the Partnerships evolved into the Knowledge Transfer Networks which, although extremely useful, do a very different job. It was a valiant effort, but too piecemeal, not helped by difficulties in co-ordinating public funding for them.

The proposals for Technology Innovation Centres have taken on board many of the lessons from that era. Most importantly, the core funding must be maintained in a consistent fashion to anchor each Centre in a strategic role serving the national interest with an activity plan that is not deflected by disproportionate pressures from short term financial imperatives; such pressures will otherwise override other longer term activities to the detriment of the Centre's mission.

Any new Centres must fill gaps in what is currently available from the networks of existing organisations (RTOs, PSREs, universities), otherwise there will duplication of the expertise and support that is already available to industry. The TICs must utilise this existing expertise and capability, both up-stream to additional sources of innovation and research and downstream to new business and industrial constituencies in a hub and spoke model, to deliver new outcomes that cannot currently be achieved. The Technology Strategy Board must avoid duplication and ensure that the new outcomes are delivered. The funding should not be used just to continue what's already being done.

The TSB will need to map the capabilities that already exist and to identify, against the UK strategic needs, what of the current capabilities can form the starting point for TICs and what is missing. AIRTO's members already do quite a lot of what is needed. But they don't currently have the core funding to operate in the manner envisaged for the TICs. They mostly have to behave very commercially, prioritising large company clients for research and providing mainly routine services for smaller companies.

There is merit in preparing a business plan for each TIC, much along the lines of investing in a business. This means identifying market needs; routes to market; strengths and weaknesses of existing players; resources that can be brought to bear; competitive edge; how much it will cost and return on investment, all with supporting evidence. Clearly, TICs, given their remits, are broader enterprises than typical companies, but the process of defining the above parameters in a business-like way is entirely applicable. Such a plan should underpin each TIC.

. . . The facilitation skills to join push and pull are key. . .

Industry wants TICs to be able to take apart their problems, source the science and technology from the best available and put it all back together as a solution. To facilitate this there may well be students, professors and academics on secondment from a number of different universities. There is a compelling argument therefore for TICs to be independent of a particular university or universities, so that they can go to as many world leading scientists as necessary. Centres should look to strong international networking as well as strong connections in the UK. This approach also permits greater choice of geographical location. Perhaps the most sensible place to locate a TIC hub is within a concentration of the industry that it will serve.

Demand pull and technology push need to work together to deliver the TICs' mission. Some Faraday Partnerships successfully brought industries together to articulate their needs. That was the pull. Academics were brought together, in the same meeting, to describe where their research was going. That was the push. Partnership staff then facilitated consortia to take forward work of common interest. Without push, opportunities for innovation will be missed; without pull, technology may be developed for which there is no customer. SMEs were brought in by ensuring that large enterprises (their potential customers) were present. The facilitation skills to join push and pull are key. It is important for TICs to be open to all sources of invention and innovation; although universities contribute a lot, many more innovations come from industry itself. This too needs TIC support, across the many players in the supply chains, calling on university science where needed.

A TIC's precise mode of operation and the push/pull balance will depend on the maturity of the relevant technology and supply chains. Inserting innovation into existing supply chains requires a particular approach with much emphasis on licensing. If the market isn't fully matured and supply chains haven't evolved, a different mode of operation is necessary, with more emphasis on start-up companies. The latter needs technology push, but also a lot of entrepreneurialism. The key is finding entrepreneurs whom investors can back to build businesses into spaces where supply chains don't yet exist.

Intellectual property needs careful handling. Formalised invention disclosure procedures are increasingly being used in universities and elsewhere, helping to determine when and what to patent (and what not to patent) and there is exchange of best practice between AIRTO's members and universities and

. . . A clear, shared vision for what the TIC is trying to achieve is crucial . . .

between the universities themselves. However, the Research Assessment Exercise (now Framework) complicates the position for university partners. Academic researchers strive to produce publications because that is the primary measure of university performance. Delaying publication does not go down well, but it is generally possible to produce a respectable publication while not disclosing information that may prejudice the potential to patent. The more partners involved, the more complicated the handling of these matters becomes. TICs can reach out across the cultural bridges, between universities and small businesses in particular. This is a good reason for positioning and equipping the TICs to serve as brokers in such matters.

There are a number of other important roles for TICs. One is helping to incubate and attract investment to SMEs aiming for rapid growth. Another is helping companies access European funding, through Framework Programmes for instance. The UK does well here on the academic front, but industry does proportionately less well. The TICs can help correct the balance by increasing the return to industry. Applying for Framework projects is difficult and bureaucratically painful in many respects and industry is frequently deterred. SMEs find it particularly hard to bear the risk that they will invest considerable effort in applying and then be unsuccessful in obtaining funding. TICs can do a lot of the work, reducing risk for participants and championing the effort to increase the UK's industrial return.

A clear, shared vision for what the TIC is trying to achieve is crucial, and this must remain consistent for a good period of time and not 'creep' because new people with different visions become involved. It will need a strong drive from the TSB to set up the appropriate terms of reference and success criteria. TICs may come under pressure to address a variety of national, regional, technological, socio-economic and even global goals. It is very important to keep in mind that it is economic growth, wherever that takes place in the UK, that justifies the investment. Individual regions come into play when looking at where new enterprises associated with the TIC hubs and spokes become established. Schemes to support early-stage companies outside the South East are well funded to help attract such enterprises and promote growth in these regions.

The TIC brand will need managing. If performance among the TICs is variable, industry may start to regard some of them as failing. At the highest level, the TSB needs to look after the brand and make sure that the TICs' image and their performance reinforces the brand.

Governance could be based on a number of alternative models. AIRTO members embody several of them. However, particularly when trying to bring something new, like the TICs, into existence, it's important to keep clear of vested interest and to avoid suspicion between potentially competing stakeholders. The model that generally works best in these circumstances is the Company Limited by Guarantee (CLG). A CLG is not driven to satisfy a particular group of shareholders. It re-invests surpluses rather than distributing them. Its assets cannot be acquired, except by another CLG; and it positions the organisation in the 'centre ground', albeit without the ability to raise funds in the way that a shareholder-owned company would. This is probably the structure most appropriate for the TICs.

The main measure of success has to be impact on economic development. The third/third/third funding mix and the amount of private sector funding leveraged is a performance target that TICs have to go for very hard. This won't be achieved overnight if they are starting from scratch, and this is a reason for utilising existing organisations as the starting point for TICs, wherever possible and appropriate. The private funding provides the benchmark that says that the TIC is fulfilling a real need. Most AIRTO members started out being publicly funded but have moved progressively to a position where they are privately funded for the majority of their work. As noted earlier, this is at the expense of providing some of the service characteristics that can only be sustained with consistent public funding, ie engaging heavily in research and dedicating significant time to SMEs. The margins from other work do not provide the necessary headroom to reinvest a really substantial proportion of revenues (ie the 50% that would be required for a purely private sector TIC) on such activities.

TICs, over time, will probably also move towards majority private funding as they grow, but through continuing core funding will be able to maintain the resources to keep up the public service element of their work, at least until the market failure is no longer so pressing. If core funding is removed prematurely, TICs will move towards more commercial models, abandoning the behaviour that supports the national interest and SMEs, and an enduring engagement with research. If this happens, all we will have done is set up another SME.

TICs should also be measured against the additional funding they recover from European programmes; against numbers of patents and successful spin-outs; and development of skills and career paths – TICs are potentially routes for a valuable apprenticeship from which to move on, either to set up a business or to take up a role in an industrial supply chain.

The TIC concept has enormous potential and longevity, but each individual Centre needs to perform at the highest level. The consequences of non-performance should be a change of management, merger with another TIC or even dissolution.

It is critical that this new initiative is well managed and maintained over time, because it will take several years for the true economic benefit to emerge.

But this is a great start.

RISING TO THE CHALLENGE OF RESPONSIBLE INNOVATION

Professor Richard Owen
Chair Innovation, Environment and Health
University of Exeter Business School

Our capacity for creativity and innovation is limited only by our imagination. The society in which we live is the cumulative product of thousands of years of human innovation. This has continuously shaped society since the dawn of Civilization, from the first flint tools to the plough, from the printing press to the internet. I remember when I was studying for my PhD in the early nineties a new technology called 'email': it was slow, with dial up connection and no ability to send attachments. But we academics loved it: it was cheap and great if you needed to communicate almost instantaneously with another isotope chemist in the US or Japan (I'm sure many of you reading this have had this need). Now I can pick up and respond to a work email while shopping in Sainsbury's. There's no going back, it's here to stay, at least until something better comes along. This is what we call 'technological lock in', when new innovations become indispensible to our modern lives.

But here's a question: while you are working how often do you quickly check your email? Will you take a quick peek at your Inbox before you finish this article? Some are concerned that by continuously stopping to check our email we are damaging our ability to think in a deep and meaningful way. What has been described as 'divided attention disorder' led one broadsheet to suggest email is making us become 'lab rats craving pellets of social interaction'. Now whether or not this is the case, it serves to illustrate two important things about innovation, particularly that which we call 'disruptive': the future wider impacts of science and technology are always uncertain, and they are usually unpredictable. Who would have guessed that email might result in divided attention disorder, or that coal fired power stations and cars would have significant impacts on global climate? Or that CFCs in our refrigerators would cause a large hole in the ozone layer? Or that a neat little piece of financial innovation called securitisation would cause global chaos in the banking sector. 'We didn't see it coming' a former PM remarked.

The uncertainty and unpredictability of the wider impacts of innovation present a problem for Governments, particularly if they place innovation as a central pillar in their economic growth policy. Back in the 1980's David Collingridge called it the 'dilemma of control'. In essence the dilemma is this: at the early stages of innovation there is sufficient opportunity for control but insufficient evidence of wider impacts to justify this, for example through new regulation. Later on however, once the technology is more fully developed, there may be enough evidence of wider impacts to make the case for regulatory control. But now it is too late: the technology is locked in to society, it has become indispensible and the investment losses would be too great. A ban on mobile phones may have been possible back in the days when they were the size of a brick. But now? They are as locked into society as the internet.

Reflecting this, over the years regulation has attempted to 'move upstream'. We now have 'data before market' legislation for things like industrial chemicals and pharmaceuticals. Regulation is quite good for controlling the type of thing it already knows about eg the registration of a new pharmaceutical active. But it struggles with things it hasn't encountered before, for example a carbon nanotube, or a synthetic organism. These types of innovation increasingly occur at the convergence of established scientific disciplines such as chemistry, biology and engineering and at the margins of current regulation. They do not intentionally set out to transgress the law. It's more that such innovations happen precisely where the law is not well established, where it is incomplete or unclear, where there is a 'regulatory gap'. The result is that innovation leaps ahead, and evidence based regulation follows, years and even decades later.

. . . People get concerned about the sanctity of life, when the boundaries of what is natural and what is synthetic become blurred. . .

I can remember the first discussions about regulation of nanotechnology in 2004 after a major report by the Royal Society and Royal Academy of Engineering. Here the concerns were (and arguably still are) whether, if materials radically change their properties when manufactured at the 'nanoscale', (a billionth of a meter) they also present radically different risks. Carbon as graphite we think of as being rather benign, but what about a carbon nanotube, described by some as 'the hottest thing in physics' and others as having 'asbestos-like properties'? Questions were asked: is this technology safe? Is it properly regulated? These are yet to be fully answered.

So it was with a great sense of *déjà vu* that I heard these questions come up again at a recent Parliamentary and Scientific Committee meeting concerning another radical new technology, synthetic biology. Synthetic biology uses developments in engineering and biology to synthesise genetic material that can be used to create new organisms, or useful parts of them, or to redesign existing organisms. Our ability to synthesise and manipulate DNA, the building blocks of life, moves us from (as Craig Venter described it) 'reading the genetic code to writing it'. From the creation of artificial chromosomes to 'viruses from scratch', the ability to engineer life has huge potential benefits, from biofuels to antimalarial drugs. A recent public dialogue highlighted that, like nanotechnology, while people could see these potential benefits, they also have some big questions: Is it safe? Is it properly regulated? And some others that come up time and time again when new technologies emerge in the public consciousness. Should they be doing it? Could it be misused? What is its purpose? Who benefits? What will the wider impacts be in the future? Are these acceptable? Is it ethical, are they playing God?' Sometimes, as in the case of nanotechnology, these questions take the form a low background hum, but sometimes, as in the case of nuclear power, they can be far more audible. This seems to be particularly the case when scientists delve into the genetic machinery that is the basis of life on this Planet, as we saw with GM. People get concerned about the sanctity of life, when the boundaries of what is natural and what is synthetic become blurred.

These questions are central to people's hopes and fears for new technologies. Wonderment at the potential for innovation to improve our lives is tempered by anxiousness about whether it is safe and ethical, about whether we will actually benefit or simply be burdened with the risks. These questions need to be addressed early on, at a time when there is an opportunity to shape and influence the trajectory of science and innovation. As Jeff Goldblum famously said in the film Jurassic Park: 'scientists were so preoccupied with whether or not they could, they didn't stop to think if they should'.

This is not, I stress, synonymous with stifling high adventure science and creativity. This is a very important point. It's about constructively supporting it in a way that demonstrates a genuine and visible commitment to responsible innovation, opening it up in a way that promotes trust and ultimately means that innovation is sustainable. This is exactly what the public want: a clear message from the synthetic biology dialogue was that the public want scientists to think about the wider impacts of their research, to think about the questions that always crop up, and for those that fund them, particularly with public money, to play an active role. Responsibility cannot be outsourced to someone else at some future point.

But what in practice does this mean? In 2009 I began to explore this with the Engineering and Physical Sciences Research Council (EPSRC), the largest public funder of innovation research in the UK. I had been invited to scope a major research funding call at the convergence of two major fields of disruptive innovation: nanoscience and geoengineering. It was a call for proposals to investigate the potential for nanoscience to facilitate carbon capture from the atmosphere, an ideal opportunity to trial something rather different[1]. For the first time we asked scientists applying for funding to submit a 'risk register' in which they documented what they saw as being the potential wider impacts and risks of their proposed research, how these would be managed and by who. This began to get them to think about the questions 'is it safe, are there any wider risks?' Some of them thought very carefully about these, and when I interviewed them all the applicants said it was something they should be doing. They just needed the mandate and guidance to do it properly.

To my surprise (because they had not been explicitly asked to do so) some of them began to think about the other questions too, proposing public dialogue exercises around the innovation research core, building in mechanisms to identify wider impacts as these emerged and feed these back into the direction of their research. There were grant proposals with not only synthetic combinatorial chemists but social scientists and environmental scientists working as a team, beginning to think these issues through at the outset of their planned research.

Building on this the Economic and Social Research Council and EPSRC are beginning to think about how we could develop a Responsible Innovation Framework, which could eventually be used by Research Councils and those who apply to their funding calls. Some very progressive thinking is being done about this. My hope is that this could provide the guidance and tools to ensure we are in a better position to ensure that innovation is, and is seen to be, responsible, acceptable and ultimately sustainable. Not only that, but if we are clever and ensure there is good communication between this process within the Research Councils and those developing policy we stand the best chance of developing regulation that is proportionate and shaped by debate in an inclusive, open and timely way.

A new model of responsible innovation needs to include regulation, but it needs to acknowledge the issues that radical innovation poses for it. It challenges us as scientists, as funders of science, as Members of Parliament, as citizens, to face the questions that come up time and time again and think about what our roles and responsibilities are in answering these. Rising to this challenge is not easy but is critical for shaping future society and the World we will live in. It is a challenge well worth rising to.

1 Owen R and Goldberg N (2010) Responsible Innovation: A Pilot Study with the UK Engineering and Physical Sciences Research Council. Risk Analysis, Vol 30, No 11, 2010 DOI: 10.1111/j.1539-6924.2010.01517.x

ADAPTATION TO CLIMATE CHANGE: A WATER INFRASTRUCTURE SOLUTION?

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Water is our most basic need, essential for life and intrinsically linked with many of our critical national interests. Future climate change and population pressures present significant challenges for those tasked with ensuring security of supply. However is the current preoccupation with demand suppression inhibiting a fully holistic approach? Should greater consideration be directed towards supply enhancement schemes that both take advantage of climate change, and help increase resilience to its effects?

Public health and well-being, food production, energy supply, industry and the environment all require a reliable supply of water and whilst total available water in England and Wales is sufficient to meet total demand, geographic and temporal variations in availability mean that significant regional water stresses exist, especially in the South East. Added to this problem is the need to plan for an uncertain future. Projections of UK climate predict reductions in summer river flows and increases in winter flows, which is a similar effect to quicker passage of water across the landscape. Assessments of future climate projections by the Environment Agency (2008) have shown that by 2050, annual average river flows may reduce by up to 15%. Local reductions in summer and autumn flows could reach 80% whilst flows in winter could increase by 15%. In addition, depending on Government action, social mindset and lifestyle choice, water demand in 2050 could be between 15% less and 35% greater than that experienced today. Clearly these extremes need to be built into future planning.

The growing appreciation of UK water stresses coupled to the fact that domestic consumption dominates abstracted water has led to a focus on reducing this demand. The proliferation of metering and efficiency initiatives is now widespread and growing; however do such measures represent a suitably holistic solution? Whilst the Environment Agency Water Resources Strategy (2009) advocates a 'twin-track' approach, it is made clear that demand suppression measures should be considered as a priority. UK citizens currently use an average of 148 litres of water per day (l/p/d) compared to 493 l/p/d Australia, and 575 l/p/d in the USA. Defra's aspiration is to reduce this further, to 120 l/p/d.

Water storage represents an often overlooked option. By capturing the predicted increases in excess winter river flows, schemes that store more water take advantage of future climate change. By slowing down water transfer across the landscape, they also act against the trends of climate change, storing excess winter water for use in summer, and also increasing the resilience of the built environment to other potential future impacts such as flooding.

- Reservoir construction enables the storage of excess water and therefore permits maintenance of supply during periods of relative water scarcity. Whilst large dams and reservoirs have traditionally been opposed by large proportions of society, their construction can have multiple benefits, not just for water resource security, but also for the environment and economy. Many water companies identify reservoir construction as essential to meet future water demands and corroborate their economic viability against a variety of alternative measures.
- Smaller scale water storage can also provide broad benefits, especially within the agricultural sector. Whilst generally constituting only a small proportion of total water use, on hot summer days

Farm storage - Mullens irrigation lagoon, Wiltshire (Source: Halcrow)

Large scale storage - Graig Goch reservoir, Mid-Wales (Source: Halcrow)

agricultural use can dominate. Small reservoirs permit the capture of excess winter flows and therefore ensure summer supply without environmental conflict. The farmer can then plan cropping and product supply with far greater certainty.

- Sustainable drainage systems (SUDS) comprise a variety of localised interventions that mimic natural catchment responses. In order to slow water passage over seasonal time frames to provide benefit for water resources, SUDS that direct runoff into the ground such as permeable paving, should be prioritised.
- Aquifer storage and recovery (ASR) describes the process of pumping excess surface water flows below ground to be utilised in the future, often in response to droughts. Several schemes exist, contributing small additions to the supply resource, although larger schemes are present in the Lee Valley and at Enfield-Harringey in London.

A primary constraint upon the application of supply enhancement measures is the common requirement for high upfront investments that may initially outweigh financial gain. Securing funding is therefore of key importance, and in this respect consideration should be given to the price we assign to water. When compared against the cost of other household outgoings, notably those for energy, water comprises such a small proportion that for all but the poorest, any incentive to reduce usage is small or absent. An increase in annual household bills of £100, whilst pricing water still a long way short of its true economic value, would provide additional potential annual investments to the water industry of £2.4 billion, an amount not inconsistent with infrastructure investments in other sectors. Clearly, the value of safeguarding our future water security is incalculable. However, as an indicator it is estimated that the Environment Agency's regulation of abstraction protects resources worth some £72 billion.

The above discussion demonstrates how consideration of water storage measures provides a viable means of increasing water resource security and resilience to future climate change. Furthermore, by combining intervention measures that act at different geographic scales, alignment can be achieved both with the general concept of slowing down water throughout the catchment, and with the widely prophesised aim of a 'big society' in which integrated communities consider their wider environment. In view of the long time that storage projects take to promote we should be considering options now.

RESEARCH AND TRAINING: UNIVERSITY PARTNERSHIPS FOR A BETTER RAILWAY

John Amoore
R&D Specialist, Network Rail

Britain's railway is a world leader in research and innovation. The company is advancing research and developing engineering talent at all levels – all in the cause of delivering the railway Britain needs.

DEVELOPING A LONG TERM RESEARCH STRATEGY

The railway is an industry where long term forward planning is essential. Short-term, incremental work only gets the industry so far; by investing in longer term research we can deliver a much improved railway in the future.

All Network Rail's research and development and innovation activities address at least one of the major challenges facing the industry, known as the 'four Cs':

- CAPACITY: increasing the capacity of the railway;
- CUSTOMERS: delivering a service to meet the rising expectations of passengers;
- CARBON: improving rail's environmental performance;
- COST: improving the overall cost effectiveness of the railway.

The railway is already much improved on where it was, but keeping up with growing demand for travel and delivering value for money needs us to keep pushing ahead. Rail is carrying record numbers of passengers and freight on a network that is safer and more reliable than ever.

Passenger demand has grown by 40% and freight by 60% over the last decade. Of 1.3 billion annual passenger journeys, 1 billion are by commuters and business travellers, almost all on the key networks vital for the economy and into or between the urban centres in which many of the most productive parts of the economy are located. The rail freight industry supports economic output of £5.9 billion, six times its direct turnover. Commuter demand is expected to increase by at least 22% by 2014 and passenger growth of 39-54% is expected in major northern cities over the next decade. Rail demand is projected to grow by 30% over the next decade and up to 140% over 30 years.

Research helps Network Rail take costs out of the industry by delivering efficiency savings. In the last 5 year regulatory period (2004-9), Network Rail reduced costs by 27%. In the next 5 years up to 2014 we are required to build on this by meeting a 22% efficiency target, which amounts to a saving of £4 billion. Network Rail is committed to driving costs down further, in line with the current Value for Money inquiry by Sir Roy McNulty. Research and

technology will be a key part of this.

RESEARCH PARTNERSHIPS WITH UNIVERSITIES

Network Rail's commitment to research has led us to develop strong links with British universities. This includes funding Professorial chairs at three universities, funding PhD students and leading bids for funding from the Research Councils and the EU. In fact, Britain now receives more EU research funding for rail than any other country, in no small part due to the strength of collaboration between Network Rail and British universities.

Network Rail has established three strategic research chairs at the Universities of Nottingham, Sheffield and Imperial College London, recognising the advantages of longer term relationships and allowing the universities to build a centre of excellence in railway engineering. Each University has a specific theme of specialisation although they may propose a research project on any subject where they have a capability.

From the start of its research programme, Network Rail has collaborated with the University of Birmingham to develop remote monitoring systems for railway track-side assets, such as point machines, level crossing barriers and track circuits. Failure of track circuits and point machines are two of the largest causes of train delay. In partnership with Japan's Central Railways and Deutsche Bahn, Birmingham is also further developing expertise in advanced algorithms for detecting incipient failure as part of Network Rail's Intelligent Infrastructure project.

One of the early themes of our research programme was Rolling Contact Fatigue (RCF), essentially wear and tear caused by vehicles going over rails. This led to a contract with the Rail Technology Unit at Manchester Metropolitan University to produce software capable of replicating the design and track quality of any track route. When used with a detailed computer simulation of train design, it will predict suitability of a train for a specified route. This is used to evaluate all new train designs and determine where vehicles may need to be modified. We are currently funding testing of an innovative suspension spring which is able to provide 'soft' and 'hard' characteristics to both reduce forces on the track and give passengers a comfortable ride at speed.

We have also used our RCF research to develop analysis tools to predict where and when rail failures will occur, reduce their severity and extend track asset lives. Reduced rail degradation means a safer, more reliable and lower cost railway.

We have also supported PhD projects, with some very interesting outputs. One recent thesis on the effects of climate change on the rail network was done at Birmingham. It has informed a lot of our adaptation plans, as well as developing new relationships on this subject with a range of universities. We are currently supporting one of Network Rail's staff in his PhD work on sustainable station building, in the Department for the Built Environment at Nottingham University.

Perhaps more important than directly providing funding, Network Rail is able to use its unique position and expertise to work with universities to leverage large amounts of research funding for rail. The UK is now the largest recipient of EU funding for rail research, in addition to funding from the Engineering and Physical Sciences Research Council.

Future projects include work to increase the resistance of track to loads from vehicles which would reduce maintenance needs, and automating maintenance processes, with significant cost and safety benefits. These two projects have received over €9 million EU funding. We are also hoping to take forward 'On-time', which will explore real-time rescheduling of trains when delays occur. This will start in late 2011 if funding is approved by the European Commission.

TRAINING THE NEXT GENERATION OF ENGINEERS

In addition to our high-level research, Network Rail is one of the country's biggest investors in vocational training and development. This is because we have a continuing need for young rail technicians and engineers to help deliver the schemes and develop the technological advances needed to deliver a high-performing railway safely and efficiently to meet strongly growing demand from passengers and freight.

Our further and higher education programmes range from apprenticeships through to post-graduate qualifications to train the technicians, incorporated and chartered engineers that Network Rail and the broader industry will need in future.

Network Rail's award winning advanced apprenticeship scheme is one of the largest in the country. It is based at a residential facility at HMS Sultan in Gosport, Europe's largest engineering training facility, and combines high quality technical training with personal development. The apprentices specialise in one of track; signalling and telecoms; or electrification and plant.

Network Rail has trained 1,250 skilled maintenance engineering technicians since it launched in 2005. Our scheme will train a further 1,200 apprentices in the next five years and this year's intake of 201 apprentices have just begun their three year programme.

Over the past three years Network Rail has also recruited 469 graduates, 28% in an engineering discipline. Our graduate engineering development programme, with an intake of around 50 per annum, is accredited by leading engineering institutions, IMechE, IET, and ICE.

Network Rail has developed a Foundation Degree and BEng degree in rail engineering in partnership with Sheffield Hallam University and launched an MSc in project management in partnership with University College London and the University of Warwick.

Network Rail also assists universities in running seminars and international conferences on railway engineering. Some also have laboratory facilities specifically for railway engineering. These activities increase student awareness of the challenges and opportunities offered by rail engineering.

Network Rail's research, innovation and education programmes are vital to driving up the safety, performance, efficiency and economic contribution of the railway in this country and abroad. For the wider economy and further/higher education sectors, these schemes are crucial in equipping a new generation of young people with STEM skills and providing and leveraging much needed research funding and expertise for some of Britain's leading universities.

LIGHTS! CHEMISTRY! ACTION!

The Royal Society of Chemistry launched the United Nations International Year of Chemistry 2011 [IYC 2011] at the House of Commons on Monday 24 January with the help of the Rt Hon David Willetts MP, Minister for Universities and Science.

IYC 2011 is a worldwide celebration of the considerable achievements of chemistry and its contributions to the wellbeing of humankind.

But it wasn't the usual kind of reception or the usual kind of launch. It was something completely different.

The Commons Terrace Marquee was packed to the hilt and there was a palpable sense of occasion and anticipation – because everyone knew that two little pieces of Parliamentary history were about to be made.

For the first time ever, a series of live chemistry experiments were performed on the Terrace of the House of Commons in a pioneering display in Parliament of the wonders of chemistry.

For the first time ever, a live webcast was made from the Terrace of the House of Commons enabling people throughout the UK and around the world to see the launch in Parliament, the speeches and the experiments via the RSC website.

The launch was co-sponsored on an All-Party basis by Mark Lancaster TD MP, Dr Julian Huppert MP and Andrew Miller MP, Chair of the Commons Select Committee on Science and Technology. They also jointly sponsored EDM 1324 on the Commons Order Paper.

IYC 2011

IYC 2011 aims to increase the public's appreciation of chemistry in meeting world needs, to engage young people in chemistry and to generate enthusiasm for chemistry's creative future.

Chemistry – the science of matter, its properties and reactions – lies at the heart of the most promising multi-disciplinary research. Whether it is in nanotechnology, catalysis or tissue engineering, chemistry is involved in new exciting discoveries with the greatest potential to benefit our society. The need for these discoveries has never been greater.

Throughout the year a wide range of interactive, entertaining and educational activities for all ages will take place, allowing children and adults alike to explore the critical role of chemistry in our lives. For example, on 22 June teachers and pupils from constituencies all across the UK will be taking part in a global chemistry experiment into the properties and quality of water. It will be the largest chemistry experiment ever conducted.

PARLIAMENTARY LAUNCH

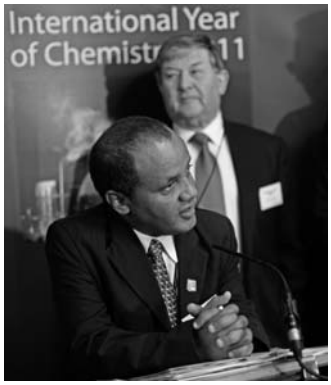
Andrew Miller chaired the proceedings and introduced the President of the Royal Society of Chemistry, Professor David Phillips OBE CChem FRSC, who

referred to the centenaries of the Nobel Prize in Chemistry to Marie Curie for her discovery and work on Radium and the discovery of Polonium, and of Ernest Rutherford's revolutionary theory of the atom.

Professor Phillips explained that the ground-breaking discoveries made by Curie, Rutherford and many of the other great minds at the turn of the last century had sparked huge advances in human development: in terms of life expectancy and quality of life, personal mobility, the ability to feed humanity, and, more recently, in the number of ways to communicate. But what many people didn't realise was how the pace of change is accelerating. He drew attention to the fact that the discoveries of the past enabled us to find ways of producing more while consuming ever increasing amounts of materials and energy. The challenge now was to build on this knowledge and to produce more of the things we need while consuming less of our scarce natural resources. This required a whole new way of doing things and a whole new way of thinking.

It would also require a new generation of scientists and engineers to make this change possible. Inspiring them with a lifelong interest in science was a top priority and hence IYC 2011 will explore how people can work together to demonstrate the vital role of chemistry.

There was also a contribution from Ethiopia given by Professor Temechegn Engida, President of the Federation of African Societies of Chemistry, a body which was instrumental in securing the UN resolution which declared that 2011 would be the International Year of Chemistry.



In his address the Minister paid tribute to the role and importance of chemistry which he described as "so fundamental to everything that enables us to lead civilised lives" and made such a vital contribution to the UK economy. He then declared himself ready to help launch IYC by transforming himself, along with his Parliamentary colleagues, into high-powered laboratory assistants.

THE CHEMISTRY EXPERIMENTS

The experiments were all conducted by Professor Hal Sosabowski and his team from the University of Brighton. All the experiments had been exhaustively approved and authorised well in advance by the House authorities under the helpful guidance of the Serjeant-at-Arms who was present at the event to see them conducted.

David Willetts inaugurated the first experiment which involved *Chemical Luminescence* designed to illustrate a reaction that gives out light rather than heat (which some people occasionally argue is the reverse of Parliamentary debate!). The effect, which was instant and spectacular, was created by pouring a liquid from one test tube into another.

The second experiment was a *Pulsing Reaction* – for which Andrew Miller was the laboratory assistant – and featured a large test tube whose liquid content magically changed from clear to coloured and back again repeatedly.

The third experiment was the so-called *Floating Boat* where a lightweight tinfoil craft – launched by Dr Julian Huppert – floated magically in thin air on the top of an apparently empty fish tank.

All three MPs then participated in the next experiment which featured the *manufacture of clouds* with the use of solid carbon dioxide in hot water. The film camera caught the drama of this experiment.

The final experiment was performed outside on the Terrace solely by Professor Sosabowski (to the dramatic accompaniment of the music used in *2001: A Space Odyssey*) while the crowd inside pressed their faces to the glass doors. Called *The Barking Dog* it featured a series of perfectly timed controlled explosions in a number of different tubes – and it brought the official opening formalities to a spectacular end.

IYC 2011 was well and truly launched.

To watch the edited webcast highlights (speeches and experiments) please log on to www.rsc.org and follow the directions.

Professor Hal Sosabowski is flanked by RSC President David Phillips, Andrew Miller and the Science Minister

SEMTA SUPPORTS SCIENCE SKILLS

Philip Whiteman
Chief Executive, Semta

With an annual turnover of over £32 billion, the science industry is hugely important to the UK economy but its future growth may be limited by skills gaps.

DEMONSTRATING THE NEEDS OF SCIENCE EMPLOYERS

As we look to the UK's economic recovery, much emphasis has been placed on the importance of training investment and the value of transferable skills that are needed to secure the future of UK companies. According to the UK Science Industries (Bioscience) Report published by Sector Skills Council, Semta, the UK's 191,000 science employees produce an average of £76,500 Gross Value Added (GVA) – a figure vastly higher than the UK average of just £35,500 per employee. The data reiterates the important contribution the sector is making – and can make in the future – in rebalancing the UK economy.

The report reveals that science employers need to recruit 50,000 people between now and 2016. That is the estimated number required to cater for the sector's projected growth and to replace those retiring. The largest demand will be for people qualified to National Qualification Framework Level 4 and for managers.

Semta's research indicates a 14 per cent increase in employment over the last 12 months, with 48 per cent of employers recruiting during that period. The report also reveals that 31 per cent of graduates, postgraduates and doctorates taken over the last 12 months were recruited from outside the UK.

According to the Semta report, the introduction of new products and services, along with new technologies, are key drivers. Over the next few years they will call for new working practices which will increase the need for highly skilled employees. In addition, new legislative or regulatory requirements will require good management and leadership skills and flexibility within the workforce.

THE IMPACT OF THE POLITICAL AGENDA

Bearing in mind Semta's insight data, the new government strategy for skills and skills investment is vitally important to the sector and the 6,500 science employers we represent. We welcome many elements of the plans. In particular, the review announced funds for 75,000 adult apprenticeship places per year, reiterating measures outlined in the last Comprehensive Spending Review. This is good news for the science sector, where new technical skills are crucial for growth and for filling skills gaps caused by retirements.

Ultimately, more places will assist in the provision of the additional skilled people that will be needed in the future to ensure the sector remains strong and continues to grow and compete on the global trade stage.

Other changes in the skills landscape, such as the rising cost of university courses, will serve to increase the key role of apprenticeships in ensuring businesses have the skills they need to succeed. This is particularly important given the high proportion of professionals (25 per cent) and managerial roles (23 per cent) working in the sector.

APPRENTICESHIPS IN ACTION

Our role is to stimulate businesses to invest in skills that make them more competitive. So part of our success comes from developing solutions that employers value because they give a real bottom line return.

Apprenticeships not only develop higher level skills, they also provide a healthy return on investment so Semta is helping drive growth in apprenticeship numbers by developing frameworks that meet the needs of employers. These frameworks set out all the elements individual apprenticeships should contain under the Government's new Specifications for Apprenticeship Standards for England and Wales (SASE/W), ensuring the quality and integrity of qualifications is upheld.

With employers and science sector stakeholders, Semta developed a Life Sciences Modern Apprenticeship in Scotland. Designed with career progression in mind, the Life Sciences Modern Apprenticeship Framework allows candidates to progress from Technician to Assistant Scientist through higher levels of working responsibility and educational achievement, up to a Science degree.

Introduced in Scotland last year, employers have already spoken out in praise of the new apprenticeship and the support they received from Semta. HR Director at BioReliance, Louise Rice commented:

"BioReliance are excited about the exceptional efforts and contribution made by Semta. We've seen significant progress and increased confidence addressing the life science educational gaps between academia, government and the commercial industry. This drive and support is so important for life science businesses and will allow us to continue to address skill gaps and the importance of science across the country."

The Life Sciences Modern Apprenticeship has the full support and endorsement of the Scottish Government. To date over 70 candidates have been registered and 26 organisations have employed apprentices, ranging from small to global companies and NHS to universities.

The success of the Life Sciences Modern Apprenticeship in Scotland has already led to the launch of an apprenticeship framework for Laboratory Technicians in England in partnership with Cogent, the Sector Skills Council for chemicals, nuclear, oil and gas, petroleum and polymers. In addition, Semta is working on a broader Science Apprenticeship to be launched in England this year.

Carolyn Mason, Semta UK Policy Implementation Manager, said: *"Semta is taking the lead in driving common working between stakeholders and partners to ensure that science employers get the most effective and efficient support. Our apprenticeship frameworks are a great example and cover the specific skills employers are asking for as well as building transferable competence."*

SIMPLIFYING THE SKILLS LANDSCAPE

To simplify the skills landscape for its employers, Semta is leading a science cluster of Sector Skills Councils. What this means is that key organisations are brought together to plan and review activity across sectors using science, technology, engineering and mathematics skills. The science cluster is advised by a high powered STEM skills forum which includes representatives from industry, academia and government who agree and prioritise action proposals.

The Science Cluster has four key goals and areas of focus for activity:

1. Research/Labour Market Intelligence (LMI),
2. 14-19 STEM Education,
3. Higher Education,
4. Workforce Development.

In essence, the Science Cluster of Sector Skills Councils is active in representing the employer voice to those responsible for educational policy. Recent activities include working with awarding bodies to review draft GCSEs in Science, to ensure they are rigorous and more oriented to eventual future employment. Individual Sector Skills Councils are also encouraging a more practical, innovative style of teaching for the delivery of qualifications in their sectors.

A key function of the cluster is sharing good practice, and Semta is collecting data on members' current activities. This includes exploring ways in which Sector Skills Councils can work with STEMNET to recruit STEM ambassadors. Here, Semta is targeting newly-qualified apprentices and their employers by sending out STEMNET leaflets with apprenticeship certificates through leading awarding bodies such as EAL. Within the Science Cluster, Semta is driving work to ensure that Higher Education providers have accurate intelligence on employer demand and to increase the number of work placements, particularly among small and medium sized employers.

Understanding the sector's need for higher level skills Semta and Cogent are partnering on a Working Higher Project which is developing a Foundation Degree for Bioscience, leading to further academic and career progression opportunities.

HOW SEMTA CAN HELP YOU

Semta is supporting businesses and the Government, working with the National Apprenticeships Service and the Skills Funding Agency, to put businesses in its sectors at the forefront of a rebalanced economy.

Businesses working with Semta's National Skills Academy for Manufacturing have seen, on average, a 6:1 ratio of return on their skills investment. The National Skills Academy offers a wider range of quality approved programmes specifically designed to deliver real benefits to individuals and their companies. There are programmes and qualifications in Business Improvement Techniques (B-IT), Leadership and Management, Employability, Health and Safety and Technical skills. To support individuals there is an e-learning centre with over 1,000 courses ranging from How to Make Presentations, through to Environmental Legislation and Policy, to Six Stigma. The cost of e-learning modules starts at £5 - £10.

Huntingdon Life Sciences achieved immediate cost savings of £250,000 after implementing B-IT training with the National Skills Academy for Manufacturing. Over 150 employees targeted process improvements as part of their NVQ programme. They delivered bottom-line benefits through the rationalisation of laboratories, better organisation of storage, reduction of floor space and reduced inventory.

Changing standard operating procedures from paper to electronic format alone saved at least £50,000; the cost of archiving was reduced by 85%; rework was reduced, and 20% was taken out of QA auditing costs.

Jane Pearse, Director of Special Projects, said: *"I've never seen such empowerment as I've seen with B-IT. Staff are telling senior managers about the success of their projects, as they are now able to measure success and demonstrate savings. The sense of ownership has been superb. Lean is now firmly part of our culture."*

Semta works with individual employers to identify and support their individual skills needs. There are four simple steps:

1. Make an appointment with one of our sector experts
2. With Semta's advice and guidance, create a plan which:
   a. Addresses the skills needs of the individual business
   b. Identifies sources of training to meet these needs
   c. Helps them access any available funding to support the training
3. Implement the plan
4. Evaluate the success of the training and consider further skills needs.

To find out how employee skills training can boost your business, contact Semta Customer Services on 0845 643 9001, email customerservices@semta.org.uk or visit www.semta.org.uk

How *In Vitro* Diagnostics can realise cost savings and improve patient outcomes for the NHS

Doris-Ann Williams
Director General, British In Vitro Diagnostics Association

BIVDA

The Department of Health estimate that 4% of the NHS budget is spent on the provision of pathology services which contribute about 70% of the information used in making clinical decisions. This already represents a great value for money proposition but it is clear that there are opportunities for achieving even more than this.

In Vitro Diagnostics, or IVDs, are the tests performed on clinical samples to provide information for diagnosing and screening for disease. The tests can also be used to monitor therapy or rule out putative diagnoses and have an increasing role to play alongside drugs. There are a growing number of diagnostic dependent drugs which should only be prescribed for patients where a parallel test has shown the drug will be effective for that patient based on the genetic make-up of the individual or the disease they are suffering from. It is likely that many more drugs will routinely be used with IVDs in this way in the future, particularly for cancer. There also will be IVDs which show if an individual is responding to a specific therapy.

Of immediate concern is the ability of IVDs to play their role in cost savings for the NHS over the next few years. Pathology services have been in the headlights of the QIPP initiative of the Department of Health since its inception in September 2009. QIPP is the acronym for Quality, Innovation, Prevention and Procurement, an ongoing project to identify budgetary savings while maintaining health outcomes and patient safety. In the final report of the review of pathology services by Lord Carter of Coles (from 2005-2008) it was identified that there could be significant savings made by the re-design of pathology services. There has been a tremendous amount of work done in England in the last eighteen months to do just this, led by the National Clinical Director for Pathology Services, Dr Ian Barnes. This has seen improved utilisation of networked laboratories and a range of other innovations including the joint venture between Guys and St Thomas's NHS Trust and Serco to provide a more commercialised service under the name of GSTS Pathology. This is a model which is starting to appear across the country in other hospitals and there are also other private providers with an interest in doing similar activities.

However that is the work being done to streamline and improve efficiency of the service. Of the total expenditure on pathology, just under a quarter of the money is actually used to purchase the reagents and equipment to perform the testing. So industry has recognised that it also has a role to play in making cost efficiencies and this is something which BIVDA and its member companies have viewed as a real opportunity for our sector. We have long been concerned that the laboratory is usually viewed as an overhead by hospital management and that the tests provided are mere commodities. This is far from the truth and IVD companies in the UK have been very eager to participate in the QIPP initiative by providing examples on tests which can save money and improve patient outcomes. For medical technologies this is largely being achieved through the iTAPP programme. iTAPP is

the Innovative Technology Adoption Procurement Programme and is being run by the Procurement, Investment and Commercial Division of the Department of Health (PICD) and now under QIPP. It is an activity reviewing submissions from industry for technologies with potential for costs, systems and patients benefits, were they to be more widely adopted. iTAPP is working also with NHS Technology Adoption Centre on developing adoption strategies. There are currently 100 different medical device and IVD technologies being examined with a top tier which alone could represent savings in the hundreds of millions of pounds annually.

However adoption of new IVD technology is very complex due to how the money moves around the NHS. For example, Payment by Results incentivises hospitals to perform invasive tests or procedures which could be replaced by a more minimally invasive test using blood or another biological sample. Sometimes these aren't pleasant but, as an example, providing a faecal sample must be less upsetting to individuals than having to go through a colonoscopy unnecessarily. There is also an increase in patient safety by using less invasive technology. So there is an urgent need for hospital finance managers to re-engineer their systems so that testing is provided to allow greater saving in other areas.

Increasingly testing is being done outside of the laboratory using technology developed by IVD manufacturers to be smaller, often portable, straightforward to use but still utilising the science within the equipment that is used in a laboratory setting. It is now relatively common for much testing to be done in wards, operating theatres, critical care units etc within a hospital. The best scenario for this is where the testing and related equipment is centrally managed by the pathology staff so that they can ensure the correct maintenance, staff training and quality assurance is used. It also offers better financial management as the same equipment can then be provided across the hospital site rather than each department making their own procurement decisions in an area where they will have less expertise than their scientific colleagues.

Another area for improvement is in the utilisation of testing in the community setting to prevent referral to hospital in many cases. This is already making significant savings in some areas of England – for example in the East of England where many GPs use a point of care test for D-dimer to rule out a diagnosis of deep vein thrombosis in people presenting with clinical signs of this condition. This saves the cost of an admission when the condition is not present and speeds up treatment for the people who may have DVT when they reach hospital. Another example is in the management of people with chronic obstructive pulmonary disease (COPD) who are often admitted to hospital at night when there is often no real clinical reason to do so. Portable blood gas meters can now allow a fingerprick of blood to be tested in the patient's home by a community nurse or paramedic and if the gas levels are normal then the patient can be reassured and settled without being taken into hospital. As confidence in the use of these technologies grows and with adoption being supported appropriately then patient outcomes and care can be increased while saving money on hospital admission and interventional procedures.

For more information please contact
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ANNUAL LUNCHEON OF THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE

The Annual Lunch of the Parliamentary and Scientific Committee was held on Wednesday, 27th October 2010 in the Cholmondeley Room and Terrace, House of Lords.

The President, The Rt Hon Lord Jenkin of Roding, opened proceedings with a warm welcome to all present.

"At a time when there are close on 400 All-Party Groups in Parliament, I always like to remind people that we were the first such Group.

Founded in 1939 amid the perils of the threat of war, this unique institution came into being as a crucial necessity to guide Parliament and the Government on the role of science and technology.

In its early years, after the war, it was responsible for securing a number of innovative changes in the relations between science, Government and Parliament. For instance, it was this Committee which started the process that eventually led to the formation of POST. It also was very influential in the establishment of the Science and Technology Select Committees in both Houses of Parliament – Committees which have a vital role in holding Governments to account, and helping to ensure that Ministers are kept aware of trends and discoveries in S and T.

However valuable all this has been and is, we have to recognise that, as a consequence, the P & Sci no longer occupies the central role it once had – particularly in holding Ministers to account.

Yet, successive Officers and Councils have successfully ensured that we continue to have a really worthwhile role. We are a unique focus and think-tank for science and technology. We are an important bridge between, on the one hand, scientists, engineers and technologists in industry, academia, the professions, and on the other, Members of both Houses. We can be a platform for those able to put forward new ideas which need consideration in Parliament; for those who have new scientific advances to report, and for those seeking to influence the research policies of

Departments. These are matters of importance to Governments of all persuasions.

It is significant that our Chairman, Andrew Miller MP, was elected to this post shortly before he was elected by the House of Commons to be the Chair of the Select Committee on Science and Technology. His dual role, though no doubt time-consuming, is very valuable in both jobs.

Enough about us! My main duty today is to welcome David Willetts MP, Minister of State for Universities and Science, as our guest speaker.

After leaving university, he began his career in the Treasury, progressed to further senior posts near the centre of Government; and entered Parliament in 1992 as the MP for Havant. His great abilities – the media do not call him 'two-brains' for nothing! – led to early front bench appointments – he did time as a whip, then a Minister in the Cabinet Office, then Paymaster General, all in his first term in the House. When David Cameron became Leader of the Opposition, David Willetts was appointed shadow spokesman on Education and Skills, later being promoted to spokesman, shadowing that curious but short-lived Department of Innovation, Universities and Skills.

Following the 2010 election, David was made Minister of State for Universities and Science. In that capacity he attends Cabinet. It is widely recognised in Whitehall, and increasingly outside, that it was David's influence and arguments in the CSR which won such a good settlement for Science. He is currently involved, together with his Secretary of State, Vince Cable, in working out how the recommendations of the Browne Committee can be carried forward into policy decisions on the future financing of the Universities. He is right at the centre of the issues that are of great interest to this Committee, and we very much look forward to hearing what he has to say to us. Over to you, David!"

DAVID WILLETTS MP

David Willetts thanked Lord Jenkin for the introduction. "It's a great pleasure to be here to celebrate what has been a great year for British science. When one thinks of all those Nobel Prize winners, it is an extraordinary recognition of the strength of our science base. It is also a year where we mark a new vigour in the relationships between the scientific community and both Houses of Parliament.

The Parliamentary and Scientific Committee is hugely important. I only realised when I read Andrew Miller's excellent piece in the most recent edition of Science in Parliament that the group was founded in 1939. Lord Jenkin touched on this in his introduction. One can only assume that there was recognition, with war looming, that investing in, and understanding, science and technology was going to be crucial. As we all know, the role of British scientists in the war was crucial. The extraordinary productivity and creativity of that period is something that still amazes us.

Well, we now have a different type of challenge, it's an economic challenge, and it's one where we have to recognise that our competitors are themselves investing. As Martin Rees pointed out so persuasively in the weeks and months running up to the science settlement, we had to take into account what was happening in other countries. I'm very pleased that with the new kind of challenges that we face, in the CSR settlement, the Coalition Government did indeed recognise the enormous importance of science and research.

And so it is not so much a great pleasure as a great relief that we got the settlement we did. Just to take you through the figures, we have a commitment to a ring-fenced budget each year of £4.6bn. So it's a secure, ring-fenced budget for the next four years. We still have to decide on the exact breakdown of the figures.

Although we have yet to decide on the breakdown of the figures, as a rough indication I can tell you in the current year we give Research Councils £2.75bn, HEFCE £1.6bn for QR funding for universities, the Academies £0.1bn and the Higher Education Innovation Fund £0.15bn, which adds up to £4.6bn. That gives you a rough sense of the scale of the flows of funds that we're talking about.

It is ring-fenced, it is secure but, of course, the protected cash settlement that we now have presents us all with a challenge – a challenge to deliver efficiency savings. If we can offset much of the effects of inflation at 9 or 10% over the next four years, by delivering the kind of efficiency savings that Bill Wakeham has identified in his very useful report, for example, then we really will be able to ensure we have a stable and secure science base.

So the funding is important. But other things are important as well. And I just wanted to touch on two others. One thing that matters is being able to convert that science spending into economic activity and economic benefit.

That does not mean that individual scientists carrying out their research have to be expected to behave as if they're businessmen. They are not, they

have a different set of skills, and they have a different set of interests. We should not expect scientists carrying out their research to be thinking of some commercial application or other every day. That is bad for science, and in the long run it's bad for the economy as well.

But we do need people with broader skill sets who then think about how the ideas emerging from our very productive science and research base themselves have a practical industrial application. Last week we announced the CSR settlement for science. This week we've been able to announce funding for Technology and Innovation Centres, as proposed by both Herman Hauser in his report for the previous Government and also by James Dyson in his report for my Party. We hope that the £200m or so that we have identified to fund those will also help tackle one of the great challenges we've always faced in Britain; ensuring that we can move through those technology readiness levels from the scientific research to genuine commercial applications.

That is a crucial challenge. I invite the different experts that I see here today to start thinking and advising us on the sectors where we need these Technology and Innovation Centres and how we define their role. Come forward with ideas. The next few months are going to be crucial as we develop our plans and I very much welcome any input we may have from the Parliamentary and Scientific Committee, or from the Science and Technology Select Committees, as we develop our specific proposals.

So as well as science, there is a technology and commercial agenda. My third point is the importance of ensuring that those of us in the House of Commons and House of Lords have proper access to scientific advice and information.

We cannot be accused of slavish devotion to empirical evidence in day to day politics. Just occasionally the argument runs free, and perhaps runs rather ahead of the evidence base that one might require. Fortunately, our speeches do not have to appear in peer reviewed journals. Indeed, I even remember the arguments when there was the suggestion that basic standards set by the Advertising Standards Authority should apply to political speeches. Even that we had a bit of a problem with.

So I have to accept that in politics we don't always match the high standards of rigour and evidence that the scientific community expects. However, it is very important that we have the opportunity to draw on scientific evidence. The Parliamentary and Scientific Committee, the Parliamentary Office of Science and Technology and the Select Committees all ensure that we do that.

Finally, there have been some rather pessimistic comments that we are losing parliamentarians with scientific knowledge and understanding. I want to take you through this, because we have to look at the picture in the round. Of course there are very distinguished parliamentarians, with a close interest in science, who have sadly stood down. I saw Ian Taylor here for example, who made a fantastic contribution over the years in the House of Commons and who is no longer a colleague.

But at the same time we have new members of parliament joining us with an interest in science. I see opposite me George Freeman, who really knows about this and it's great that George is here today. Although it went very much against the grain, we actually commissioned a small bit of empirical research on this. I can report to this group that before May, based on the calculations we made, there were 65 Members of Parliament who had a degree level qualification in science or engineering. Since the election in May there are still approximately 65 Members of Parliament with a degree in science or engineering.

So we have at least maintained what I can only call a protected base. We have secured, once again, stability. We may wish to have an increase but at least we have stability. We have frozen it at that nominal level of 65. I hope you appreciate what an achievement that is! Of course if we can build on that base it would be excellent, but at least we have that as a secure base from which we can start. Thank you very much indeed.

Following a brief discussion, the Chairman, Andrew Miller MP, then proposed a vote of thanks to David Willetts for this demonstration of his unfailing confidence in and strong encouragement and support for Science, Technology, Engineering and Mathematics and all those who contribute towards this aim as key components in the recovery of the UK from the depths of the economic downturn.

ENGINEERING IN REGENERATIVE MEDICINE

Professor Molly M Stevens
Department of Materials, Department of Bioengineering & Institute for Biomedical Engineering, Imperial College London

There are few things more fascinating, and more difficult to recreate, than the natural processes involved in the growth and development of animal and human life. From the embryo, cells grow and divide, transforming into a myriad of different cells types defined by molecular and cellular signals and events (differentiation).

The goal of tissue engineering (TE) is to replicate some of these complex processes to replace and regenerate lost tissue. Decades of research now seem set to pay off in the treatment of a multitude of debilitating and deadly conditions such as myocardial infarction, spinal injury, osteoarthritis, osteoporosis, diabetes, liver cirrhosis and retinopathy.

The general strategy is to seed cells within a scaffold, a structural device that defines the geometry of the replacement tissue and provides environmental cues that promote tissue regeneration. TE skin equivalents have been in clinical use since 1997 and other TE devices currently in clinical trials or in use include those for cartilage, bone, blood vessel and pancreas. TE bladders and sections of the trachea have been successfully employed in humans.

Even without intervention from scientists, human tissue has a staggering capacity to self-regenerate. For example, a human liver can regrow to its previous size when as much as half of it has been removed. Bone, skin and several other tissues are also able to self-regenerate to fill injuries up to a critical size, often aided by stem cells present naturally in the body. These stem cells can be stimulated in the presence of the correct conditions to grow into multiple different cell types. Thus complex tissue can be produced by using and enhancing the body's own systems.

As well as requiring information from each other, cells derive information from their environments, including the material that surrounds them within tissues, namely the extra cellular matrix (ECM). A TE material scaffold must take on this instructive role to maintain cell viability and control cell behaviour. Mechanisms for such instruction can be both chemical and physical, and include the degree of physical support, geometry, and directional flexibility, as well as numerous chemical signals that lead to cascades of intra- and extracellular events.

THE VALUE IN TAKING A MULTIDISCIPLINARY APPROACH

Research in regenerative medicine within the Stevens group at Imperial College London includes the directed differentiation of stem cells, the design of novel bioactive scaffolds and new approaches towards tissue regeneration. We have developed novel approaches to tissue engineering that are likely to prove very powerful in the engineering of large quantities of human mature bone for transplantations in which the donor is also the recipient, as well as other vital organs such as liver and pancreas. Such targets have proven elusive with other approaches. To achieve these diverse aims we employ collaboration with numerous partners and have a multidisciplinary team consisting of members with backgrounds across:

- Biomedical Engineering
- Bioengineering
- Materials Engineering
- Chemical Engineering
- Electrical Engineering
- Mechanical Engineering
- Surgery
- Chemistry
- Cell biology
- Physics

With the combined knowledge from all of these diverse fields, successful development of tissue engineering is greatly facilitated.

REGROWING BONES

Bone tissue is of particular interest due to its highly complex architecture that contains many blood vessels and covers several length scales (macro to nano), important structural function, regulation role of calcium and phosphate levels within the body, and its high regenerative capacity. The majority of bone fractures heal themselves without the need for medical intervention, however in

some cases such as removal of tumours, this self-regeneration must be supplemented with grafted cells from elsewhere in the body. Harvesting of such autologous bone tissue is limited by supply and by negative effects on the donor site, which make TE of bone highly desirable.

Bone repair and replacement is also an important consideration in an ageing population. The number of age-related bone replacements such as primary knee arthroplasties is increasing rapidly; already 16% of the US population is over 65 years of age and this looks set to rise. Overall, globally, there are around 1 million bone defects annually that require grafting to repair.

Bone has specific requirements that differ from those of other bodily tissues, which must be considered in the engineering of bone tissue. Ideally, the template or scaffold for bone TE should be bioactive, contributing actively towards cell differentiation, encouraging directional bone growth and afterwards being reabsorbed or replaced by the body. Materials for such scaffolds used commonly include bioactive glasses, bioceramics, or polymers in the form of nanofibres or composite materials; they must be porous, functional, and, of course, biocompatible. Biological components from the ECM such as proteins that "switch on" certain cellular signals are often incorporated into the scaffolds.

SIMPLE MATERIALS CAN SOMETIMES REGENERATE EVEN COMPLEX TISSUES

Our developed concept that allowed the engineering of large volumes of bone in a predictable manner relied on the creation of an artificial space or "bioreactor" in the body between a bone and the periosteum (a membrane that surrounds all the major bones). A cavity is first created between the bone and periosteum by the injection of a salt solution. This cavity is then filled with a bioactive gel containing calcium to trigger the production of fresh layers of bone in the *in vivo* bioreactor. New bone tissue grows from stem cells in the periosteum into the bioactive gel and rapidly fills the bioreactor space. The new bone can then be easily harvested and transplanted elsewhere in the body without major trauma to the harvest site unlike with traditional bone harvesting from body sites such as the iliac crest. This reduces long-term morbidity and pain for the patient. Cartilage can also be produced using a similar concept using a different biomaterials gel formulation.

STRONTIUM – THE VITAL INGREDIENT

Bioceramics form a particularly strong bond with living tissue by formation of a hard bone-like layer on the surface, and they have been used to repair hard tissue in a variety of craniofacial, maxillofacial and periodontal applications. We have recently shown that if the bioceramic used contains strontium then it has the potential to combine the known bone regenerative properties of such glasses with the positive effects on the metabolism (anabolic) and slowing of tissue-breakdown (catabolic effects) demonstrated by strontium cations.

It is thought that this result is caused by a synergistic effect of strontium on the action of the bioceramics, which release calcium, silicon, and other vital bone-growing minerals to encourage bone growth. When implanted into a bone defect, the released strontium stimulates osteoblasts (bone cells) to make new bone and prevents it from being resorbed by osteoclast cells. The new bone is significantly stronger and of higher quality than if strontium is not incorporated into the material.

FROM BENCH TO BEDSIDE

Repregen™ Ltd, formerly BioCeramic Therapeutics Ltd until March 2010, is a spin-out company from Imperial Innovations plc co-founded in 2006 with Professor Stevens and headquartered within the Imperial College Incubator. RepRegen Ltd is a medical device company that uses patent-pending repair and regeneration technology platforms designed to mend and regrow hard tissue such as bone and soft tissue such as cartilage.

An ageing population and an increase of high risk sports have led to a surge of bone-related diseases and bone fractures. As a result, the use of bone graft substitutes has dramatically increased in the last decade. There are currently no synthetic products on the market with performance that is comparable to biologics such as Bone Morphogenetic Proteins and the gold standard autograft.

RepRegen Ltd's platform of strontium bone graft substitutes for hard tissue regeneration offers improved performance over conventional bone graft materials. The first product, StronBone™, recently received EU regulatory approval for orthopaedic, spinal and dental bone grafting indications. The company has a series of strontium bioceramic products in the pipeline which will build on this first product including a putty and porous bone graft.

RepRegen have shown that strontium is highly beneficial to bone cells and enhanced mineralisation and have also demonstrated this *in vivo* with rapid formation of high quality, mechanically competent bone. In fact significantly higher quality bone is formed with the incorporation of strontium into the biomaterial.

There are over 50 synthetic products on the market with little to distinguish them from each other. RepRegen's products offer a number of firsts which will clearly distinguish them in the market. If the NHS were to adopt these products, this would result in worldwide exposure and also result in the significant cost savings outlined above. RepRegen's StronBone™ is significantly cheaper to manufacture than biologics such as Bone Morphogenetic Proteins. Adoption of StronBone in the NHS would aim to result in faster patient recovery, fewer complications and implant failures due to infections, reducing costs to the NHS and burden on society and the economy in general.

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For more information go to www3.imperial.ac.uk/people/m.stevens and www.repregen.com

mHEALTH – MOBILE PHONES FOR HEALTHCARE

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INTRODUCTION

Developments in the last decade have led to mobile communications technologies becoming a new tool for the delivery of healthcare. It is only 25 years since the UK cellular telephony service, as it was called then, was launched. As recently as 10 years ago, the link between mobile phones and health was seen in an entirely negative light. Exposure to electromagnetic radiation close to the brain, through the use of a mobile phone, was perceived as giving rise to an increased risk of developing a brain tumour, and all mobile phones had to be switched off inside hospitals because of "possible interference with medical equipment".

What changed between 2000 and 2010? A number of studies, for example the report from Professor Sir William Stewart in 2000 as well as two reports from the World Health Organisation and a paper in the *British Medical Journal* in January 2006 (SJ Hepworth, MJ Schoemaker, KR Muir et al *Mobile phone use and risk of glioma in adults: case-control study)* showed that there were minimal health risks associated with mobile phone use, although children under the age of 16 are still advised to limit the time they spend on calls.

The introduction of GPRS (General Packet Radio Service), sometimes known as 2.5G, in 2002 made it possible to have two-way real-time transfer of data to and from a remote computer server. Today, mobile telephony, which includes voice, text messaging (SMS) and data services, has become the most widespread communication infrastructure in the world, with 80% of the world's population living within range of a cellular network. The mobile phone is both a data entry device with a keyboard and a data review device with a colour screen. Mobile phones have now become tools to facilitate the delivery of healthcare services, based on the secure exchange of medical data, and leading to a new term, "mHealth", the use of mobile communications technologies in health solutions.

LONG-TERM CONDITIONS

A 2010 report from McKinsey *(mHealth: A new vision for healthcare)* warns that, if current trends continue, spending on healthcare will consume an unsustainable proportion of the wealth of developed nations, up to 25% of gross domestic product (GDP), with the management of long-term conditions accounting for 80% of the growth in costs. Long-term conditions (also called chronic diseases) are defined by the World Health Organisation as health problems that require ongoing management over a period of years or decades. Innovative methods are required to address this challenge, and mHealth is highlighted in the report as having the potential to achieve significant reductions in the cost burden of long-term conditions.

In the UK there are 17.5 million people with a long-term condition. Some 12 million of these suffer from the most common conditions, namely diabetes, hypertension, asthma or chronic obstructive pulmonary disease – COPD. In the United States, long-term conditions affect 130 million people, generating healthcare costs of approximately $1.4 trillion per annum overall. Around 80% of GP consultations relate to long-term conditions and patients with these conditions or their complications use over 60% of hospital days. Type 2 diabetes is the fastest growing disease in the developed world as a result of poor diet and obesity, and the World Health Organisation has predicted that long-term conditions will be the leading cause of disability by 2020.

Improved self-management, coupled with regular education and support, is seen as the best means of slowing the inexorable rise of healthcare spending on long-term conditions, through a reduction in the number of unplanned hospital admissions, emergency visits to the GP surgery or days off work.

HOW ENGINEERING IS HELPING

The challenge today is to create sustainable, large-scale programmes that can support self-management of long-term conditions without being a drain on healthcare resources. Patients with a mild or moderate form of a long-term condition expect to lead a normal life and do not want to change their routine or be confined to one location for self-monitoring. The mobile phone can be used not only to transmit self-monitoring data and patient diaries to a remote server but also to provide real-time feedback, which increases patient compliance. Transmission of the encrypted data from the phone to the server using GPRS or 3G is a secure process. Algorithms running on the server can then prioritise patients for "telehealth nurses" to review and call on their mobile phone, whenever appropriate, without the costs of frequent visits to the patient's home.

Telehealth services (or "remote health monitoring") are focused mainly on two types of populations, with different economic cases. One type targets patients with COPD or chronic heart failure, for example, those who have a high risk of experiencing an expensive care episode, such as an unplanned hospital admission. The second type is more concerned with the long-term benefits of self-management for conditions such as diabetes. Here the target population is more likely to be younger, more active and early adopters of new technology.

The concept of mHealth can benefit both groups, although it has so far been mostly deployed among the second group. One of the main barriers to the adoption of mHealth by the first group has been the small and difficult-to-use keyboards of today's mobile phones, but this is being eroded by the introduction of the new generation of smart phones with large icons on touch-sensitive screens. It is essential that mHealth solutions are designed for the requirements of their target population, which can vary widely: an application to help teenagers manage their diabetes will be very different from one used by elderly patients to monitor their blood pressure following their discharge from hospital after a stroke. Both of these have been successfully developed at the University of Oxford and adopted by hundreds of patients (see http://www.ibme.ox.ac.uk/bsp and www.obsmedical.com/products/telehealth/).

OTHER APPLICATIONS OF MHEALTH

Other mHealth services are also being developed in markets outside the management of long-term conditions. For example, the automatic sending of text messages to remind patients of appointments is widespread within the NHS. Similarly, text-message reminders can help promote adherence to medication regimens, by prompting individuals to take their medication and encouraging them to complete their treatments. The Pill Phone, a mobile medication reminder from a US company, tells patients when they should take their medicine. Medication Tracker, MedsLog and Pillbox are among the most popular medication trackers in the iPhone store. Text messaging has also been used to improve success rates in smoking cessation programmes.

Recently mHealth has begun to have an impact in the developing world, albeit mostly through pilot projects at this stage. Three quarters of mobile phone users are in developing countries. Making sure that there is the right amount of malaria drugs at the hospital or the health centre where they are dispensed is a hard logistical problem in sub-Saharan countries, which mobile phone technology is helping to solve. Mobile phone applications have also been developed to empower community health workers, allowing them to record medical information in patients' homes and uploading it to a basic electronic health record.

FUTURE WORK

Before any new drug or medical device can be introduced into the market-place, evidence is required of its safety and efficacy. Because mHealth is a technology based on self-monitoring, there are no safety implications as it is generally accepted that the use of a mobile phone carries no health risks. There are now several thousand healthcare applications for the iPhone.

But the *sustained* use of mobile phones for healthcare will depend on evidence gathered in clinical studies demonstrating improved patient outcomes, for example an increase in the long-term control of blood glucose levels in people with diabetes or fewer exacerbations in people with respiratory conditions such as asthma or COPD.

The new generation of smart phones and tablets (iPads) based around either the iPhone Operating System (OS) or its open-source alternative, the Android OS, has the potential to provide a *generic* mHealth platform, usable across the long-term condition spectrum. With the computing power available on these new devices, mHealth will deliver software applications which can be optimised for the individual and integrated into care pathways so as to maximise the productivity of healthcare workers.

HOW ENGINEERING PROVIDES BETTER HEALTHCARE

MEDICAL ENGINEERING SOLUTIONS FOR "FIFTY ACTIVE YEARS AFTER FIFTY"

How can we be more active and live more healthily for the second half of our lives?

John Fisher and Eileen Ingham
Institute of Medical and Biological Engineering
University of Leeds

Advances in modern medicine have led to increased life expectancy and we all expect to live longer. A fifty year old today may well live for another fifty years and may well walk up to another 100 million steps in the second half of their lifetime. Our musculoskeletal system starts to age and degenerate at around the age of fifty. As we age, we need to keep active in order to avoid other co-morbidities, remain healthy and continue to contribute to society and the economy. The ageing population, the so called "silver tsunami" is now one of the major societal challenges.

For example, it is estimated that the number of joint replacements implanted worldwide will increase fivefold to 5 million by 2030. These joint replacements will have to last longer and meet higher patient expectations and demand. Medical engineering can provide solutions for repair, restoration and replacement of tissues in the musculoskeletal and cardiovascular systems to help keep the ageing population healthy and provide "fifty active years after fifty". This paper summarises past medical engineering achievements, recent advances in longer lasting joint replacements and research into the future potential of regenerative biological scaffolds. The examples cited demonstrate the importance of integrating research, innovation and commercialisation, and partnership working between universities, industry and healthcare providers.

Total artificial hip joint replacements were invented in the UK in 1960 and have been manufactured here for over 50 years. The traditional designs, made from metal on polyethylene, provide pain relief and mobility for the elderly population, over 65 years. Our research has shown that when used in younger more active patients, the conventional design results in long term failure due to adverse reactions to the increased load of polyethylene wear products. This has defined the need for lower wearing and longer lasting joint replacements.

We have also researched and developed replacement heart valves. Chemically treated bioprosthetic heart valves which were researched, designed and developed in the University, were licensed to a local startup company and have been manufactured in the UK for over twenty years. These traditional medical devices have provided effective technology solutions for the elderly, but do not address the needs of the current ageing population.

Over the last twenty years, one area of our research has focused on reducing wear and improving the longevity of joint replacements. We have researched novel hard on hard bearings, and our unique ceramic-on-metal hip joint has demonstrated extremely low wear and extended life times. It has been licensed to a global company and is now sold worldwide for use in young active and high demand patients. In the knee we have redefined the scientific laws of the wear of polyethylene, and this has led to the understanding of lower wearing design solutions, which are now marketed worldwide. One example, the partial knee replacement, which allows early intervention and preserves natural tissue, has been shown to have tenfold less wear than conventional knee designs. During this period we have developed the largest simulation facility in the world for artificial joints, which allows us to study new materials and pre-clinically evaluate new technology solutions and designs, thus improving performance, reliability and safety of devices that are implanted in the body.

. . . we have developed the largest simulation facility in the world for artificial joints . .

Our current and future research is focused on regenerative biological scaffolds. These are scaffolds of biological origin, which uniquely replicate the structure and function of the tissue from which they are derived. When implanted in the patient they regenerate with the patients own cells. We believe that by replicating tissue specific architecture, structure and function, that the cells are subjected to the appropriate tissue specific environment, signals and strains, which will drive them to differentiate down the correct tissue specific lineages.

Research on biological scaffolds is being translated through University spin out company Tissue Regenix Group, recently listed on AIM and also through NHS Blood & Transplant Tissue Services. Current clinical products include the dCELL® vascular patch for blood vessel repair, a pulmonary valve replacement scaffold currently in clinical studies, and a dermal product for skin repair. Biological scaffolds for meniscus repair are currently under commercial development by Tissue Regenix Group. Unique biological scaffolds for ligament and bladder repair have been patented. Research work is ongoing for blood vessels, cartilage and bone and other soft and hard tissue composite grafts. This family of regenerative biological scaffolds represents a paradigm shift in medical technologies and tissue replacement, directly addressing the needs of the ageing population.

. . . Our current and future research is focused on regenerative biological scaffolds. . .

The Institute of Medical and Biological Engineering and its partners in the WELMEC Centre of Excellence in Medical Engineering, the IKCRTD Innovation and Knowledge Centre in Regenerative Therapies and Devices, regeNer8 Centre for Translational Regenerative Medicine integrate multidisciplinary research, innovation, translation and product development, with 200 research staff, 50 industry partners and 50 clinical collaborators addressing the challenges of "50 active years after 50". With our academic, clinical and industry partners we are developing a novel approach to establishing a research led technology and innovation centre in medical technologies.

Research and innovation is supported by EPSRC, the Wellcome Trust, Technology Strategy Board, BBSRC, EU, NIHR, NIH, MRC, DOH, NHSBT, CHSF, FCRF, Arthritis UK and over 30 industry partners.

THE CODE FOR SUSTAINABLE HOMES

St John's Vicarage, Wembley for the London Diocesan Fund

Karen Smith
London Diocesan Fund

The London Diocesan Fund, in partnership with ASRA Greater London Housing Association, have commissioned a new vicarage in the parish of Wembley, St John as part of a mixed use development including social housing and a church hall. This vicarage is one of the first in the country designed to comply with Level 6 of the Code for Sustainable Homes (the Code) and demonstrates the Fund's commitment to sustainability and the environment. This paper explores key issues relating to the Code and the experiences of this project.

What is a Code 6 dwelling?

The Code is an environmental assessment method developed for the Department for Communities and Local Government in 2007 for new-build dwellings. It is now mandatory to assess all new dwellings in England under this scheme. The Code rates the sustainability of the dwelling by awarding credits across a number of categories including energy usage, pollution and waste, and health and wellbeing. It addresses both construction and 'in-use' aspects of the dwelling; Code 1 being the lowest level and Code 6, the highest, achieving a sustainable zero carbon home.

What makes this a Code 6 dwelling compared to a standard new-build dwelling?

The Code 6 detailed vicarage specification by Wilson Stephen Associates, the Fund's project managers, required the energy rating of the dwelling to have more than a 100% improvement above the Building Regulations notional building as defined in Approved Document Part L and the SAP calculation methodology. The required CO_2 emissions are zero, necessitating renewable technologies designed to offset all the emissions produced from the heating, hot water systems and occupant's appliances.

The vicarage includes controlled water usage, rainwater harvesting, vertical-bore ground source heat pumps, whole-house ventilation with heat recovery and photovoltaic arrays. Grey-water harvesting was not necessary. The success of the design very much depends on the attention to detail from the main contractor, Galliford Try Partnership, and rigorous monitoring of the construction processes is ongoing in conjunction with BSRIA Limited, the Fund's appointed Code consultant. High standards of insulation and air-tightness are key to minimising heat loss.

The Church Commissioners' publication, *Parsonages: A Design Guide,* details the recommendations for vicarage design and performance but differs slightly in emphasis to the Code. However, there is sufficient flexibility within the interpretation of both requirements to procure an acceptable design solution.

What are the planning considerations?

The Code 6 dwelling created planning benefits. The retention of the existing ecological infrastructure along with enhanced landscaping provisions and sustainable on-site energy generation was well received. Such proposals along with compliance to Lifetime Homes standards are likely to find favour with the published policies of most planning authorities. However, early consultation with planning authorities is essential as the physical characteristics of the technologies required to achieve Code 6 affect a wide range of parameters including roof design, aspect, impact of local environment and day-lighting.

What site considerations are applicable for a Code 6 dwelling?

A Code 6 dwelling is likely to be more readily achievable on a brown-field site with low or little existing ecological value and minimal solar shading. An assessment of the intended technologies on the surrounding environment is also important requiring particular attention to ground conditions and water permeability.

This vicarage site proved particularly challenging in relation to building aspect and solar shading but notwithstanding these conditions, a solution has been developed through the employer's agent, Cyril Silver & Partners LLP, and architects, Calford Seaden LLP.

Could anyone build it?

A Code 6 dwelling can be constructed by any competent contractor; however extensive technical knowledge and experienced design and construction management are essential. The process typically involves extensive administration including construction material source certification, design assessments, CO_2 monitoring, SAP production and analysis and waste recycling. The Galliford Try Partnership's in-house project team enables them to deliver the required holistic construction approach.

Do Code 6 properties have to be new-build?

The Code is designed for new-build dwellings only. Refurbished properties use the

BRE EcoHomes 2006 scheme, although a Domestic Refurbishment Assessment scheme is currently being trialled.

What is the percentage of additional costs to build a Code 6 over a standard dwelling?

A straightforward new vicarage would normally equate to Code 3 level. The financial uplift to achieve the vicarage Code 6 is 22%. Clearly, each project will differ depending on site constraints, ground conditions and renewable technologies installed.

What would the carbon footprint be of a Code 6 dwelling?

A Code 6 dwelling is zero carbon operationally with the predicted occupancy energy load being displaced through renewable technologies. Carbon footprints, however, will vary but the vicarage dwelling emission rate is anticipated to be - 5.25 Kg $CO_2/m^2/yr$.

How much energy does a Code 6 dwelling save?

A Code 6 vicarage should produce significant energy savings compared to a standard dwelling. However, most electricity-generating renewable technologies cannot operate at peak generation throughout the year. This vicarage energy target is 5072 kWh/yr compared to 14193kWh/yr for a Part L 2010 dwelling or 164193 kWh/yr for a Part L 2006 dwelling.

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TESTING TIMES - NEW IDEAS

Dr Steve Thompson, Science and Innovation Promoter, British High Commission, New Zealand

Policy directions in many countries are moving to link science closely with innovation and commercial exploitation. New Zealand and Britain are no exceptions and both countries are strengthening their incentives for adding commercial value from science. There is a natural fit between New Zealand's practical creativity and the UK's own innovation system, which can combine to access capital and penetrate world markets.

The UK added encouragement to UK-NZ links with the creation in 2007 of a Science and Innovation Promoter (SIP) position at the High Commission in Wellington. The SIP's aim is to develop practical and commercialisable research collaborations between the UK and New Zealand.

The first year of operation was characterised by start-up and two missions to NZ: Greenhouse Gases and Ag/Bio. Subsequent missions have concentrated on the Ag/Bio/Food area, Clean Energy and Technology, Textiles, Sensors and Extremophiles (organisms which live in extreme conditions). Results over the three years to date have reaped over 50 "Significant Assists", and 7 concrete collaborations instigated by, plus a further 5 collaborations assisted by, the SIP.

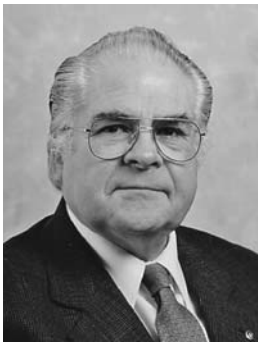
Times are tough in both countries right now, and redoubled efforts are needed to build new collaborations. Close liaison with UKTI's New Zealand team ensures that these missions are jointly advertised to cover the spectrum from R&D through to investment, and trade, with UKTI being responsible for trade and investment. The SIP is able to bid for BIS funding to assist missions, while UKTI must charge for many of its services. It has thus been important to define the area(s) of common interest and the point at which the research role hands over to UKTI, and a set of liaison principles has been evolved over time:

1. The SIP's remit starts at the research end of the spectrum in order not to invade UKTI space, but the focus is on commercially-orientated research - ie collaborations which stand a good chance of developing exploitable IP. This may involve research organisations with a commercial orientation and/or the research arms of companies.
2. The SIP can bid for BIS funding to assist visits, as long as the visitors a) can demonstrate their interest at the research end of the spectrum, b) are seriously interested in collaboration, and c) couldn't come without assistance.
3. The SIP keeps UKTI Auckland informed as ideas for missions are developed. As the interests of mission participants become clear, UKTI Auckland identifies those participants who might benefit from, and be chargeable for, its services. If an investment angle emerges from an R&D visit, this is passed to UKTI to follow through.

Concrete collaborations are the name of the game, but behind the scorecard, much work goes into nurturing promising linkages in both the UK and New Zealand. Seminars and workshops give New Zealanders an up-to-date picture of UK capabilities, but UK organisations are often unsure of NZ capabilities and are unwilling to visit unless some brokering has taken place beforehand. A new initiative this year will be to twin UK S&I organisations with their counterparts in New Zealand, so that a natural stream of information flows between the two countries.

And on top of that, there's the rugby world cup towards the end of 2011. Now that's a good reason to visit!

BUILDING BRIDGES – LAYING DOWN SOME FOUNDATIONS



Dr Michael W Elves
Chairman
Newton's Apple Foundation

Developments in Science, Engineering and Technology have much to offer Society yet many of the difficulties of transferring scientific evidence into strategies, policies and regulations still remain.

Newton's Apple Foundation was founded in 2006 with the objective of acting as a bridge between the science and engineering communities and policy makers in Government and Parliament *(Science in Parliament* (2008) vol 65 page 4). We believe that such bridges are even more important today than they were in 2006. Developments in Science, Engineering and Technology have much to offer society yet many of the difficulties of transferring scientific evidence into strategies, policies and regulations still remain. We saw it as a particular challenge to encourage younger scientists and engineers to engage with policy issues which affect the way they work, or to which their own research could make a contribution; and to understand the governmental and parliamentary structures and processes involved.

We therefore established a group of relevant experts charged with the task of looking at how we could meet this challenge. They devised the "Newton's Heirs Introduction to Science Policy Programme." This programme, launched in Westminster in October 2008, delivers workshops and was informed by our experience of running science policy events for the annual NESTA Crucible Lab projects, the British Association Communication Conference and the Women in Science – Policy and Networking Conference. It provides a forum in which scientists and engineers at the beginning of their careers can meet those involved in the processes of developing and implementing policies that are, or should be, underpinned by scientific evidence. We have run a series of these workshops over the last two years and have been encouraged by how the scientific community has responded to them.

Most workshops were held in London, often in the Palace of Westminster, but also in venues provided by Learned Societies and Trade Associations. It is not surprising therefore that the great majority of the participants came from institutions and organisations in London and the Home Counties. However we also had delegates from as far afield as the West Country, the Midlands, Scotland and Wales. In addition to the London-based events two workshops sponsored by the University of East Anglia were held in Norwich and a further two workshops were run as part of the NESTA Crucible Lab programme. In all over 380 people have attended one of these workshops the great majority (70%) being young researchers – PhD students and Post-doctoral fellows – but they also attracted a significant number of people from outside academia, including Research Council HQs and Learned Society staff and from industry.

Each workshop provides participants with a brief introduction to the way that Government and Parliament are structured, and how the policy and legislative processes are operated. Participants hear talks from a panel of experts in the various fields of policy formulation including an MP, someone with experience of a Government Department (usually a civil servant) and a representative of a Learned Society, with sometimes a speaker from industry with experience of science policy issues. In addition each is provided with copies of our three booklets *"Science Policy Explained and Explored"* and *"How Policy is made – a Short Guide"* and *"A Directory of useful Science Policy Websites."* The latter was created in response to requests from participants in the first workshop and includes web addresses for Government Departments, Parliamentary Select Committees, the major Learned Societies and other relevant bodies. An important part of the workshop is the discussion period which provides an opportunity for questions to be raised and issues discussed with the panel members. The discussion period is so popular that it often continues informally

with individual speakers after the meeting has ended.

The workshops highlight channels through which scientists and engineers may engage with policy formulation processes by providing their views, expert opinions and evidence when scientific issues are raised, or matters affecting the way science is conducted are involved;

- By responding to Government Consultations, Green Papers and Inquiries;
- By providing evidence to relevant Select Committee Inquiries;
- By supporting Policy Groups within their Learned Societies and becoming involved with the production of 'position papers'; and
- By acting as mentors to constituency MPs helping them understand the scientific method, the processes involved in research and the interpretation of scientific data.

Participant feedback provides us with information about the impact the workshops have on their understanding of policy formulation and implementation processes. Participants are asked to place their understanding of science policy and the processes into one of four levels before and after the event:

1. No understanding
2. Some understanding
3. Good understanding
4. In-depth understanding

The majority of participants (over 90%) came to the workshops claiming no, or only some, knowledge of science policy and the policy processes. At the end of the event the majority felt that their understanding had increased by at least one level (72%) and in some cases (17%) by two levels – or even three levels! A more detailed report on the workshops may be found on our website (www.newtons-apple.org.uk)

We have discovered that there is a real and growing interest amongst the younger generation of scientists in policy matters and a thirst for knowledge about the processes, and how they may become involved. All of our events have been greatly oversubscribed within a few days of being advertised. It is of particular interest that we have found an increasing number of questions at these events which centre around careers in the policy arena. A small number of participants have even gone on to take up temporary jobs as interns, fellows, etc in organisations that provide them with some hands-on experience. The workshops are therefore meeting a real need in the scientific community and are laying down some foundations in the building of the bridge between scientists and policy makers. We are therefore greatly encouraged as we move forward with our third programme of workshops in 2010/11 and as we start to develop further programmes to provide some more in-depth experience for young scientists and encourage a deeper engagement in the field of science policy. We are always open to ideas as to how this may be done as Newton's Apple is committed to consolidating the progress we have made and to forming yet stronger foundations.

Dr Michael Elves was a Former Director of Scientific and Educational Affairs, Glaxo Wellcome and a specialist adviser to the House of Commons Select Committee on Science and Technology 1997-2005

Business Secretary announces joint UK/China Investment in Solar Energy and Fuel Cells

Business Secretary Vince Cable announced a joint investment project between the UK and China on solar energy and fuel cells.

The Research Councils UK Energy Programme will invest £2.45 million and will work together with the Chinese Academy of Sciences to provide equivalent resources to fund the research.

Vince Cable's speech outlined the UK's ambitions for building on its science and innovation relationship with China and his ambition for an open international framework to promote innovation.

Extracts from the speech include the following:

"The UK envisages an ambitious programme of research engagement with China over the next five years. This recognises the priorities and strengths of the two countries, the capacity to deliver excellent research and the potential for co-investment from China (and from other UK sources) to support the delivery. As in science, we think that excellence and openness are vital for success in international innovation."

Dr Cable also announced that British company MRCT has signed agreements with Chinese companies to connect innovative research in the UK with development capabilities in China. This includes jointly developing a new drug for cancer.

Dr Cable highlighted the UK plans to promote technology-based innovation as a key driver of growth, as set out in the UK's Blueprint for Technology, launched by the Prime Minister on 4 November.

1. The UK Blueprint for Technology was published on 4 November. See http://www.bis.gov.uk/news/topstories/2010/Nov/blueprint-for-technology

2. The new collaboration in Solar Energy and Fuel Cells has been agreed between Research Councils UK Energy Programme and the Chinese Academy of Sciences. The UK will provide £2.45m, with matched resources from the Chinese Academy of Sciences. This new research initiative will fund five research projects which will address challenges in solar energy and fuel cells and contribute to tackling energy security and climate change. The successful UK recipients are Ifor Samuel, University of St Andrews, Wen-Feng Lin, Queen's University Belfast, Bryce Richards, Heriot-Watt University, Anthony Kucernak, Imperial College and Richard Catlow University College London. The Research Councils UK Energy Programme's total portfolio of collaborative energy research with China now stands at approximately £20m.

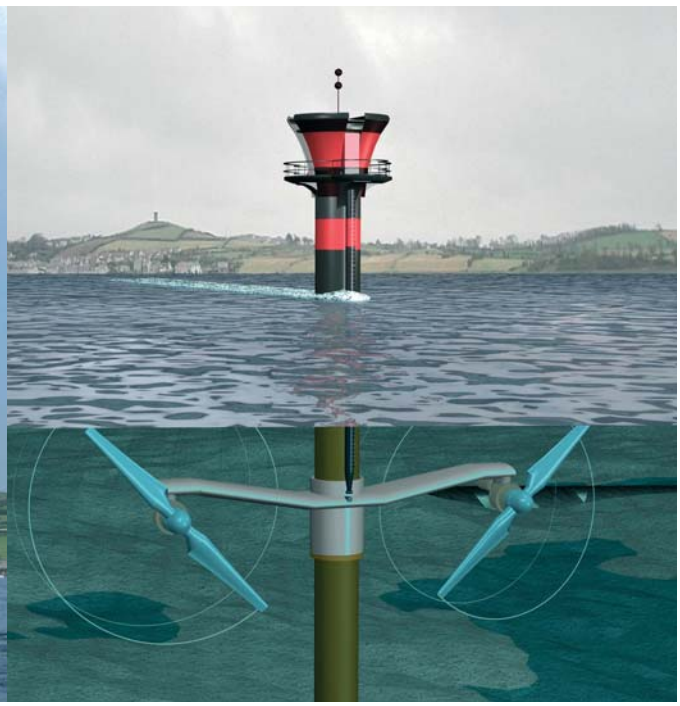
MARINE RENEWABLE ENERGY

Dr Ralph Rayner
Sector Director, Energy and Environment, BMT Group Limited
Member of the Executive Council of the SMI Association of Marine Scientific Industries

Realising the promise of abundant marine renewable energy has had a long gestation. For decades, there have been attempts to capture the power of ocean winds, waves, tides, currents and temperature differences as a source of renewable energy. Until recently, few of the promising technologies for doing so had reached commercial viability or significant delivery of their potential contribution to energy supplies. Granted, there are a few notable exceptions, such as the La Rance tidal barrage, which has been successfully delivering about 600 million KWh of electrical power from the rise and fall of the tides every year since 1966. More generally, until the end of the twentieth century, the majority of activity in marine renewable energy was experimental, conducted with limited budgets, and with little government support or encouragement.

The acceptance that large scale use of fossil fuels is leading to dangerous levels of climate change and a growing recognition of the finite nature of hydrocarbon reserves, as well as energy security concerns, has led to a resurgence of interest in renewable energy. Nations around the planet are progressively committing to ambitious targets for renewable power generation.

In Europe, the 2009 Renewable Energy Directive sets a binding requirement that 20% of energy across the EU is to be from renewable sources by 2020. For the UK, this EU Directive translates into a legally-binding target of 15% of energy from renewables. This ambitious target will require a seven-fold increase in UK renewable energy from 2008 levels. Under its lead scenario the Department of Energy and Climate Change suggests we could see more than 30% of UK electricity being generated from renewable sources,



compared with 5.5% today. Much of this is expected to come from wind power, on and offshore, with biomass, hydro, wave and tidal also performing an important role.

The announcement of successful negotiations for leases to develop UK offshore wind farms with a potential capacity of up to 25 GW takes offshore wind energy onto a path to meeting this target. Other nations are also expanding commitments to offshore wind energy and more plan to do so. 2010 marks a turning point for offshore wind energy and sets a massive challenge for delivery of increased UK capacity over a single decade.

Although less mature, other marine renewable energy sources are emerging from experiment and prototype to become commercially viable technologies. The installation of the world's largest commercial tidal current turbine in the narrow entrance to Strangford Lough in 2008 marked the start of serious exploitation of tidal stream energy in the UK. More schemes are to follow soon, including the installation of a novel tidal stream generating system in Ramsay Sound.

Wave power is another potentially huge renewable energy source. Many different systems have been developed to exploit wave energy but none have yet demonstrated viability at a truly commercial scale. A number of prototype and pre-commercial systems are under test and clear winners are likely to emerge in the coming few years.

Over the coming decade, investment in marine renewable energy will be substantial. Offshore wind is already creating some of the biggest infrastructure projects in the world with a potential investment of over £100 billion.

This rapidly growing market creates exciting opportunities for members of the Society of Maritime Industries with their wealth of knowledge and experience in marine engineering, science and technology.

Engineering skills are needed to design and build highly reliable and robust structures and machinery capable of operating in the demanding and sometimes very hostile marine environment. Scientific knowledge is needed to identify optimum locations, determine design criteria, minimise impact on the environment and plan installation operations and through life maintenance. Novel technologies are needed to optimise power outputs and efficiently transmit electricity to shore for connection to the grid. Specialised vessels are needed for construction and maintenance.

Realising the potential of marine renewable energy draws on knowledge, skills and experience that Society of Maritime Industries' members have in abundance. Our collective understanding of the unique engineering, scientific and technical challenges of operating in the maritime environment gives us a major part to play in building a low carbon economy and a sustainable basis for meeting the world's energy demands.

AUTISM: A DIFFERENCE OR DISORDER? IMPLICATIONS FOR ACCESS TO SERVICES

Dr Ellie Dommett
Department of Life Sciences,
The Open University

The APPG on Scientific Research in Learning and Education was re-launched in October to continue exploring issues at the interface between scientific research and education. The most recent meeting, chaired by Baronesses Warnock and Greenfield, focused on whether Autism is best described as a disorder or a difference. Autism is characterised by social and communication problems along with restrictive or repetitive behaviour and interests. It affects about 1% of the population and can be divided into high- and low-functioning Autism, which are marked by impaired language development and differentiated by IQ; and Asperger's Syndrome in which language development and IQ may be normal but social and communications problems persist.

The meeting heard from Professor Simon Baron-Cohen (Cambridge University) and Professor Patricia Howlin (Institute of Psychiatry, London). Howlin opened by stating that to call Autism a difference or disorder is more than a debate over semantics and is, in fact, critical in enabling access to support services. Although acknowledging that the debate is not black and white and that, in reality, Autism may be both these things, Howlin presented persuasive arguments for seeing Autism as a disorder including that such an approach is likely to lead to improvements in therapy. She stated that even children with High Functioning Autism, can find adulthood very hard thus warranting the disorder label, for what appear the more mild cases. She stated that, as adults, less than 10% of such individuals live independently, less than 1% has a high quality of life and around 25% develop psychiatric problems. She also suggested that there are dangers of labeling Autism as a difference, including the risk of teasing, rejection and bullying. Howlin acknowledged that in an ideal world we should be more tolerant of difference, but the reality of the situation, especially in the current economic climate where services are stretched, is that a difference will not be treated with empathy. Given that an individual with Autism may appear healthy and highly educated, society and those in frontline health services will lack sympathy for them. Howlin concluded by stating that whilst the term disorder may be unpalatable to some, it is likely to be of help to many by providing them with appropriate, and much needed, support.

Baron-Cohen began by stating that Autism and Asperger's Syndrome are unambiguously medical conditions and that 'condition' or 'disability' may be more appropriate terms than 'disorder'. He reasoned that disorder implied something was broken and had a known cause, whilst both 'condition' and 'disability' give access to support if needed, without implying something requiring fixing. Nevertheless, he noted that low-functioning Autism may co-exist with disabling characteristics, in addition to social and communication problems, such as epilepsy, gastrointestinal problems and anxiety. He went on to argue that those with high-functioning Autism and Asperger's Syndrome, whilst suffering from disabling social and communication problems, will show key differences to the general population, which may be advantageous. These include excellent attention to detail and ability to gain a deep understanding of a particular topic, such that they could be seen as specialists rather than generalists. Baron-Cohen went on to suggest that the current focus on weaknesses associated with Autism rather than strengths, together with the idea that there is a single, normal route to adulthood may be counter-productive. Perhaps more provocatively he suggested that everyone falls on a continuum for autistic traits, with those with a diagnosis typically, but not always, having a higher autistic spectrum quotient. He even proposed that it is not the score that determines diagnosis but rather the environment, with some people finding themselves in a more supportive environment not needing help or diagnosis, whilst others greatly need the diagnosis to access support services. Baron-Cohen closed by suggesting that both a disability and difference approach remain useful.

In conclusion, both speakers agreed that the situation was not clear-cut and that whilst Autism does produce differences in functioning, this label alone however could preclude access to services. Both speakers also supported more research with girls and adults with Autism, which have received less funding to date. They also suggested that, given the prevalence of Autism, schools should expect to have children with Autism in each year group and must show flexibility in supporting the heterogeneous group with both disabilities and differences. In sum, the debate raised many valuable questions and addressed key considerations in how nomenclature can impact on societal views and access to support services.

HOW FAR SHOULD WE GO TO MEET THE DEMAND FOR HUMAN BODILY MATERIAL?

Catherine Joynson
Communications Manager, Nuffield Council on Bioethics

Following a public consultation which asked how ethical it was to encourage people to donate their body parts, The Guardian newspaper proclaimed that the Nuffield Council on Bioethics "never shrinks from the unthinkable".

It is true that the Council's inquiry on the donation of human material touches on some extremely sensitive issues. It is also true that the Council sees its role to confront these issues openly and rigorously. Hence, it chose to discuss the shortage of human bodily material in medicine and research at its annual 'Bioethics in Parliament' seminar, this year hosted by Professor Lord Harries of Pentregarth and attended by MPs, peers and key organisations in the field.

TAKING A BROAD VIEW

The Council's inquiry is considering and comparing all kinds of bodily donation, including donation during life of blood, organs, tissue, sperm, eggs and embryos, and donation after death of tissue and body parts, as well as whole bodies for medical training.

There have been several inquiries focusing on specific types of donation in recent years, such as the Organ Donation Taskforce, which have led to improvements in NHS transplant services and high-profile public awareness campaigns. Yet despite encouraging trends, there is a continuing need to be met. Eight thousand people are waiting for an organ transplant and 1700 more egg and sperm donors are wanted.

The reasons why this is a controversial problem are clear. Body parts can only come from people, and people often feel very strongly about donating a part of their body or a relative's body. Increasing the 'supply' can therefore mean increasing pressure on potential donors.

Professor Dame Marilyn Strathern, chair of the inquiry, outlined that this led the Council to two key ethical questions: is it always right to try to meet demand, and how far can we go in encouraging people to donate? By looking at all kinds of donation, the Council is considering these questions from the perspective of the potential donor and the complex range of options that each person faces in life.

IS IT ALWAYS RIGHT TO MEET DEMAND?

The question of whether we should be trying to meet demand at all may depend on what the donation is for. Bodily material is needed for medical treatment that could enhance, prolong, save or even create a life, and for research which may lead to new scientific understanding and treatments. Some uses of bodily material may result in commercial gain, such as in the case of fertility clinics or research. It could be argued that it is more important to meet some types of demand than others.

HOW FAR CAN WE GO IN ENCOURAGING PEOPLE TO DONATE?

Raising awareness

We can all donate bodily material, but the majority of us fail to take action. Raising awareness of the need could help, suggested presenter and broadcaster Tessa Dunlop (above). In 2010, Tessa made a film for BBC1's The One Show about her father's decision to donate his body to a local medical school after a diagnosis of terminal cancer. 'The carcase is an unattractive thing, you won't want mine hanging around,' he informed Tessa. Her father's decision to 'carry on working' after his death provided her family with great comfort.

Following the broadcast there was a significant rise in enquiries about body donation to medical schools. Yet she found that some members of the medical profession were reluctant to be involved in the programme. Improving communication between doctors and families about donation could help increase awareness of the need and understanding of what is involved, said Dr Vivienne Nathanson from the British Medical Association.

Incentives

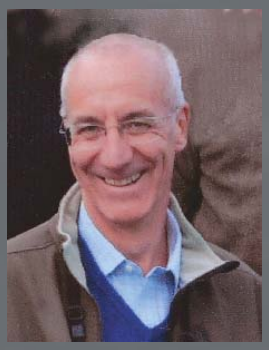
When the Council published a public consultation in 2010, the media coverage focused heavily on the question of whether providing further incentives would encourage more people to donate. Many donors regard altruism as the highest incentive, and it can also be an effective way of ensuring high quality donations. But it may be that others are encouraged by financial or other types of rewards. Payment is not allowed for most types of donation in the UK at the moment, although women can get reduced-cost IVF treatment in return for egg donation. Increased financial incentives could take the form of more generous reimbursement of expenses, a donation to the donor's charity of choice, or payment towards funeral expenses for donation after death.

Consent

Gaining consent from the donor is a key principle in the donation and use of bodily material, but the regulations on consent vary. Participants at the seminar were keen for the Council to review whether current consent rules are fit for purpose, particularly in the area of consent to use human tissue for research. The Council is in the process of doing this, and will publish its conclusions on the whole range of ethical issues raised by demand for human bodily material in autumn 2011.

Find out more:
www.nuffieldbioethics.org/human-bodies

AS THE CLIMATE CHANGES, WHAT'S THE EFFECT OF THIS UNUSUALLY COLD WINTER WEATHER ON OUR WILDLIFE?



Dr Andy Clements
Director, British Trust for Ornithology

Birds are important barometers of change – they are colourful, vocal and highly visible components of British wildlife which respond, through the timing and success of breeding attempts, their migration patterns and their survival rates, to changes in the conditions they encounter. The British Trust for Ornithology (BTO) draws on people's inherent interest in birds to underpin our scientific research into the populations and ecology of birds. With climate change high on political agendas world-wide, the long term study of bird populations puts Britain firmly at the leading edge of climate research.

This has been an extraordinary winter for birds, with extreme weather-related movements of many species. Already there are indications that some species are faring badly – reports of dead Barn Owls to our Ringing Office are twice what they would be in an average winter, as these birds find it difficult to feed when snow cover hides small mammal prey – whilst anyone interested in birds in even the most urban environment will, with luck, have noticed Waxwings, those rather exotic looking crested berry-eaters, that have arrived from Scandinavia in unusually large numbers this year.

The BTO's work, partnering the observations of 40,000 volunteer bird recorders with rigorous survey design, and intelligent, modern data analysis and interpretation by our professional scientists, means we can contribute solid evidence-based science to Government and society in a remarkably cost-effective manner. It was the *BTO Atlas of Breeding Birds in Britain and Ireland* during the 1980s that demonstrated marked declines in farmland birds, first noticed in earlier BTO surveys during the 1970s. This led to the design of the BTO/RSPB/JNCC Breeding Bird Survey that collects data to inform the Farmland Bird Index. By extending the measure to encompass other types of land-cover the BBS survey provides a broader measure of environmental health using the Wild Bird Indicator (Fig 1).

BTO scientists not only work with volunteers to monitor bird trends, as reflected in the Farmland Bird Index, we also undertake research to understand the causes of change. Working alongside a range of NGO, academic and government partners, we were at the heart of the planning process to devise wildlife-friendly prescriptions to use in the Entry Level and Higher Level Environmental Stewardship schemes. We are now completing the circle by helping to monitor the effectiveness of the Entry Level Scheme. A recent paper in the BTO journal, *Bird Study*, shows that field boundaries managed under ELS provide benefits for the red-listed Yellowhammer. The long-term, extensive datasets for

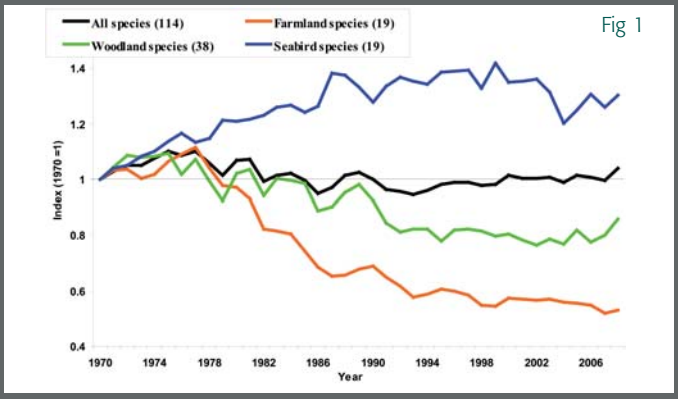


Fig 1

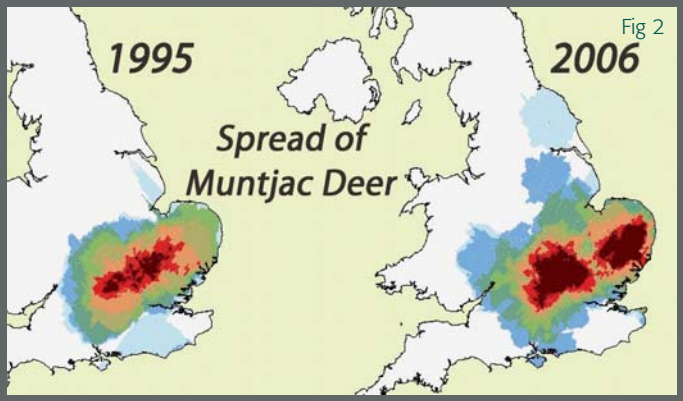


Fig 2

which we are the guardians are invaluable, recording the evidence of change and providing a resource that helps us to address key questions through more intensive research.

We've further capitalised on the enthusiasm of our ever-increasing community of citizen scientists by providing opportunities to record other taxa too. The Breeding Bird Survey collects data on mammals as part of the Tracking Mammals Partnership so, for example, we can present results showing how deer populations are growing and expanding their range (Fig 2). Linked, intensive research demonstrates the effects large numbers of deer are having on woodland structure and how this, in turn, affects Nightingales. We know that this is a species that has declined dramatically and we now know that, where they occur as breeding birds, they selectively prefer habitats where there is thick understorey in which to hold territory and to nest – habitats without deer.

As a 'birds-first' organisation, the whole life cycle approach to understanding what is happening to our bird populations is important. Escaping cold winters, like the one we are currently experiencing, is the strategy adopted by our long-distance migrant birds, of which Nightingale is a classic example. So, if we want answers about their migration and wintering areas, then we have to follow them – and new technology allows us to do this. Working with colleagues in Switzerland, we showed that a single data-logged Nightingale travelled as far as Guinea-Bissau during the autumn and winter of 2009/10, before returning to its breeding woodlands in the fenland of Cambridgeshire (Fig 3). Our

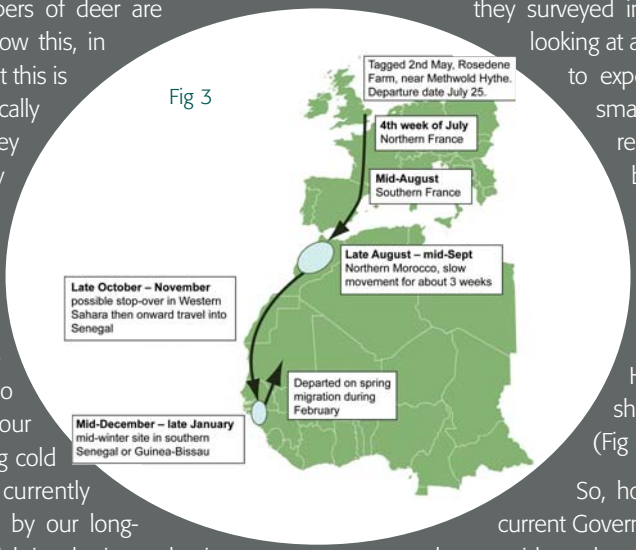


Fig 3

Fig 4

Out of Africa project is run in collaboration with RSPB and local partners in West Africa to build on information like this, and undertakes extensive survey and ringing work to find where migrant species spend the winter and what pressures (for example by quality of life development for the rural poor) are placed on the habitats and food resources they require.

But let's return to this cold winter. We will only gain a sound view of the fate of our resident birds after many thousands of volunteers have undertaken their summer counts, returning to the same sites they surveyed in 2010, or through ringing studies looking at adult survival. Our experience tells us to expect declines in the populations of small birds, herons and Kingfishers that require open unfrozen waters, and birds of prey. It may be that some of the dramatic spreads and colonisations of southern species seen in recent years, and no doubt assisted by climate change, may stall. The BTO long running Heronries census data from 1929 shows well the effects of hard winters (Fig 4).

So, how does our contribution sit within current Government priorities? An impartial, policy-relevant evidence base is undoubtedly an asset. BTO has a strong partnership with the Joint Nature Conservation Committee (JNCC), the Government agency which is itself an impartial evidence provider on biodiversity, supporting BTO core surveys that contribute to the Government's environmental surveillance requirement. BTO raises some £5m annually from contracts, donations and membership to fund our research and survey work. But that is not the whole story. With a volunteer workforce of 40,000, contributing the equivalent of £36m of survey work annually, and frameworks that reliably scale-up local effort to the national scale (our 'super-volunteer' Regional Representatives that encourage and support the troops), the BTO model looks like the Big Society in action. Our volunteers think that too, and one of the commonest reasons they give for making an effort, is to see their own individual records become part of a significant body of scientific work. As their records come in this year, you will be able to track the growing knowledge about how our birds have fared this winter – check out our science at www.bto.org.

GLOBAL WATER SECURITY: AN INTRODUCTION

Roger A Falconer FREng
Halcrow Professor of Water Management
Cardiff School of Engineering, Cardiff University

In April 2010 the Royal Academy of Engineering published a report entitled Global Water Security – An Engineering Perspective. This report was produced by the Institution of Civil Engineers, the Royal Academy of Engineering and the Chartered Institution of Water and Environmental Management, through a Steering Group of 12 specialists working in the field. The Steering Group took evidence (in hearing and written) from a wide range of UK and international experts covering all aspects of water security.

The main drivers for the report were concerns from numerous sources from within government, the professions and learned societies etc, about the increasing challenges arising relating to water security (ie security of supply) and the implications for Britain, both within the UK and internationally. Some of these challenges, threats and opportunities are introduced below.

There are 1.2 billion people living on this earth today with no access to safe drinking water and 2 million people die annually of diarrhoea – still one of the biggest causes of infant mortality on earth today and I tell my first year students that it is engineers that hold the key to reducing significantly this sad statistic, rather than the medical profession. Engineering offers rewarding career opportunities second to none to those young people aspiring to want to save lives or improve the quality of life of our fellow citizens living on this earth today.

There are 2.4 billion people who do not have basic water sanitation and 1 million die annually of hepatitis A. Women in developing countries have to walk typically 3.7 miles to carry water for the family; again engineers could make a huge contribution to the quality of life for these women. Floods often cause significant loss of life and destroy homes, with this year's Pakistan floods leading to 21 million people being homeless. However, the disease associated with the after effects of such floods can often bring far more loss of life to communities and countries than the floods themselves. It is estimated that at any one time more than half the hospital beds worldwide are occupied by people with water related diseases (BMJ, 2004).

. . . half the hospital beds worldwide are occupied by people with water related diseases. . .

So the challenges of water security are immense and Britain does, and can continue to do, so much to help the rest of the world in addressing some of the massive challenges of water security.

Along with these challenges there are two further issues that are exacerbating the current threats to water security. Firstly, there is climate change, where average global temperatures are expected to rise by at least 2°C by the end of this century. If the temperature increases between 2 and 5°C there will be major water resources problems globally, also resulting in significant sea water level rise and causing catastrophic coastal flooding in many parts of the world, such as Bangladesh. Secondly, we are encountering 'the Perfect Storm' in the form of global population growth expected to rise by 2030 from 6 to 8 billion. Associated with this population growth we can expect the demand for food, energy and water to increase by 50%, 50% and 30% respectively. The water, food and energy nexus is crucial to our existence, with water being at the heart of everything; it is

. . . countries become richer they will change their diets, as typified for example by the big increase in meat consumption in China. . .

crucial for our energy supply, food, health, industry, trade etc. If we look at the water stress globally (defined as millions of litres of water available per person per year) from 1960 to 2010, we find that even in the southeast of England water supply is currently particularly stressed. If we predict forward to the 2050s and beyond we see that even the whole of the UK will be facing problems towards the end of this century.

Problems in water supply will relate not only to the 50% increase in human population over the next 30 years; urbanisation is occurring all over the world, which will tend to exacerbate this effect. In countries such as China, for example, people are moving into the major cities while in the UK people are moving more and more to the southeast of England, which is not sustainable.

Food production is also rising, along with industrial production, and new energy sources will be required to support this industrial production and feed the population growth. As countries become richer they will change their diets, as typified for example by the big increase in meat consumption in China. If we now look at the consequences of changing diets and food consumption etc in the context of embedded or virtual water, the global implications are considerable. To produce 1kg of wheat requires 1,300 litres of water, whereas in contrast to produce 1 kg of beef requires 15,000 litres of water, ie over 10 times as much water.

Looking at other commodities, it takes 140 litres of embedded water, nearly a bath full (150 litres), to produce one cup of coffee, and that water is used in another country – such as Brazil – when the coffee is drunk in Britain. One pair of cotton jeans requires 73 baths full of embedded water, which are attributable mainly to the cotton production, and that water is likely to be used in countries such as Egypt, where there are already serious water shortages. The embedded water footprint of the 25 European Union countries bears most heavily on countries such as India and Pakistan, which are the primary sources of cotton supply to the EU. The drying up of the Aral Sea is one example which can be partly attributed to cotton production, though this is not the only cause of the drying up of this water body. The point to appreciate, however, is that the demand for embedded water products in one country can have very serious impacts elsewhere in the world, such as Egypt, for example.

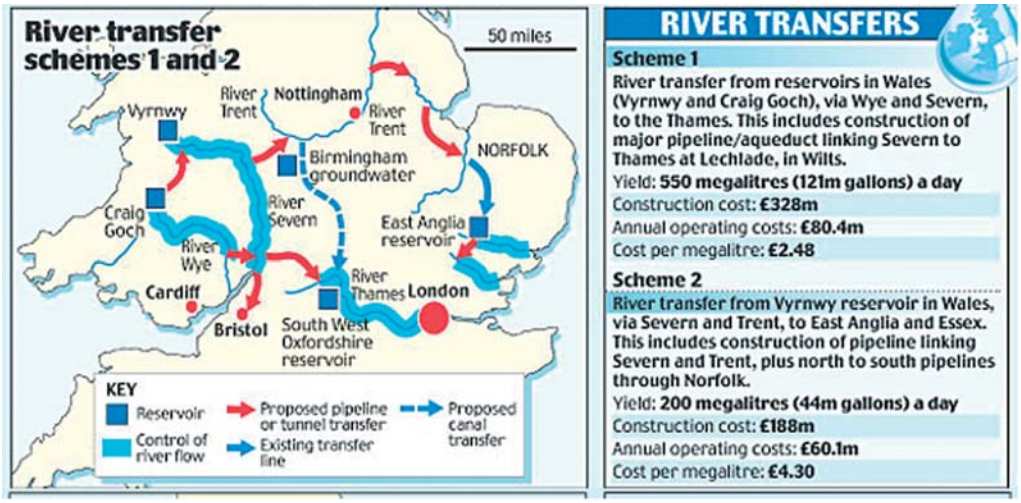
Desalination is one possible solution in large coastal cities, but this process is still relatively expensive and imposes a large carbon footprint, through large energy demands. Research studies being undertaken within our Hydro-environmental Research Centre at Cardiff University have found that salinity levels along the Arabian coast of the Persian Gulf are increasing slowly, potentially due to the rapid growth in desalination plants and this must have long term impacts for the hydro-ecology of this highly stressed water body.

Conservation and water re-use is often a short term solution to a longer term problem. Storage involves water transfer and better integrated water management, with a much more holistic approach to river basin management being required than used hitherto. To increase global water security, improved water quality in river basins and coastal waters is required, along with a reduction in global water pollution. It also goes without saying that global population growth needs controlling. Integrated water management requires a Cloud to Coast (C2C) approach that treats the water cycle as an integrated system, bringing together the professionals who currently specialise in modelling various components of the system, including: hydraulic engineers, hydrologists, biologists etc and with the distribution from the cloud to the coast, through the catchment, groundwater, sewers, rivers, estuaries, needing to be treated as one. Our research centre at Cardiff is currently developing such an integrated approach with consultants Halcrow.

In addressing some of these challenges global actions are needed; in particular, we need the water footprint and the concept of embedded or virtual water to be better understood and more widely promoted. Better technologies and further research is needed for more efficient agriculture. New sustainable sources of water are needed from desalination, recycling and water harvesting. Inter-governmental bodies, such as the WTO, must elevate issues of water security further up their agenda. The public must become more engaged in the challenges we all face with regard to water security; this is a global problem which affects every nation.

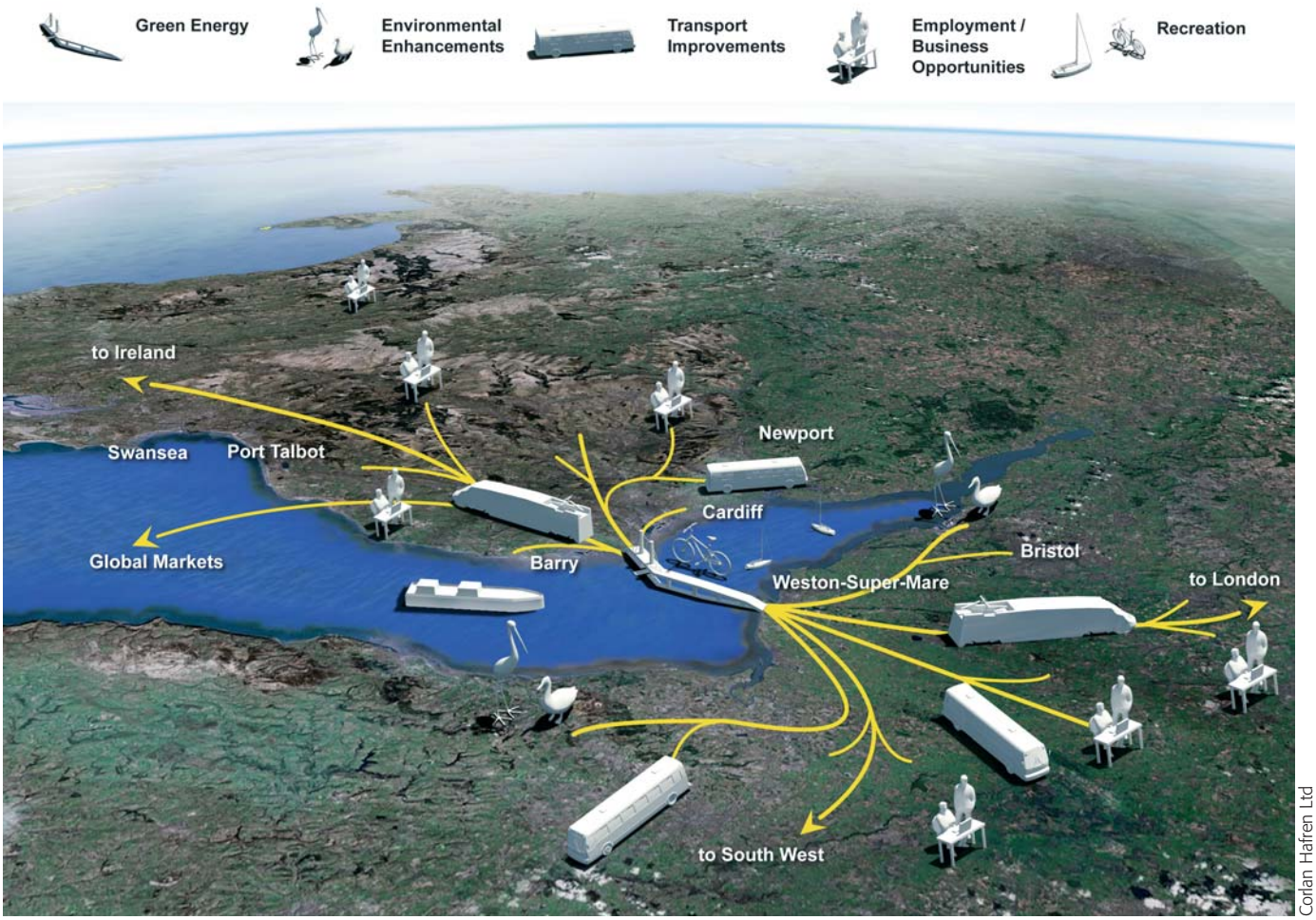
There are also key water security Challenges and Opportunities for the UK. For example, population growth is not just a challenge for developing countries; it is also

we can expect the demand for food, energy and water to increase by 50%, 50% and 30% respectively.



an issue that concerns the UK. The population is predicted to grow by nearly 16% over the next 22 years, from 61.8m in 2009 to 71.6m by 2033. This implies a yearly average growth rate of 718,000 per annum and will probably continue to increase at a comparable rate thereafter unless action is taken.

Water stress in the UK is not distributed evenly, with the southeast of England, including London, subjected to serious levels of water stress, while low water stress is located in both the north and southwest of England, but not including Cornwall, which has moderate water stress levels comparable with East Anglia and the East and West Midlands. River transfers offer a solution to water shortages in the South East of England by raising dams in Wales and transferring water via networks of rivers and canals as shown in the illustration provided. Alternatively, the proposed Severn Barrage must be considered as more than a renewable energy project; this project offers the opportunity to create a large water body 1.5 times the size of Lake Garda, with much reduced tidal currents than now, reduced turbidity, and much clearer water; thus creating a huge resource for recreational opportunities etc. This large water body would then provide a great catalyst to encourage more of the UK's population and industry and commerce to re-locate from the South East to the South West of England, making Bristol a larger city, and encouraging some of the population to move from a high (SE) to a low (SW) water stressed region of the UK. One thing is for certain; the current level of population migration to the South East of England is not sustainable – at least in terms of water security!



Corlan Hafren Ltd

Meeting of the Parliamentary and Scientific Committee on Tuesday 19th October 2010

GLOBAL WATER SECURITY
Is it achievable?
What are the consequences of failure?

Michael Norton MBE CEng
Managing Director, Water and Power, Halcrow Group Ltd

In his Reith Lectures this year Professor Sir Martin Rees, Astronomer Royal, said "This is a crucial century. The Earth has existed for 45 million centuries. But this is the first when one species, ours, can determine for good or ill – the future of the entire biosphere."

Though Earth is 4/5ths covered with a thin layer of salty water, human life depends on freshwater, as does Earth's incredible biodiversity, a crucial component of human well-being. That freshwater comes courtesy of Earth's greatest engine, the water cycle, but now, in Earth's 45th million century, a global crisis of freshwater scarcity is on our doorstep; a crisis that is accelerating through our unbridled development, burgeoning demand for food and energy, and the effects of climate change.

Only 0.01% of the total global water volume of 1.4 billion cubic kilometres is freshwater, and only 105 thousand cubic kilometres is easily accessible.

This limited volume, which is not uniformly distributed in time or space provides a wide range of functions:

- to sustain human life (consumption and sanitation)
- with nutrients and sunlight for food production
- to support energy production
- to sustain industry
- to maintain our ecosystems, biodiversity environment and landscape

Increasing attention is now being paid to the **Water-food-energy nexus**, a nexus overlain by competition for finance, the impact of international trade flows and climate change impacts.

Even though 13% of water abstractions in Europe are for drinking, the largest withdrawals are for irrigated agriculture; for food production. There is limited scope to increase global area under irrigation – therefore we need higher yielding crops or improved irrigation to meet future food demands. Alternatively we need to seek to grow more food in those parts of the world with sufficient land and rainfall. In any case we need to produce food in a way that protects the natural resources it depends on – soil, nutrients and water – and on which we rely for other services – drinking water, climate regulation, flood protection, filtering of pollution.

One fifth of the world's population, 1.2 billion, live in areas of physical water scarcity (not enough water to meet all demands). About 1.6 billion live in basins affected by economic scarcity (lack of investment in water or lack of human capacity to satisfy the demand for water). Lack of adequate water and

. . . Population growth means that the earth will have to sustain 2 billion more people in the next 20 years. . .

sanitation causes 5-10 million deaths annually; 80% of all sickness and disease is attributable to inadequate water and sanitation. The MDGs of hunger alleviation, poverty alleviation, sanitation, water supply and environmental sustainability are all linked to water-related issues.

Conflicts over water have taken place and seem set to increase. "The fighting in Darfur, Sudan resulted from water shortage and subsequent fighting between farmers and herders" (Ban Ki-moon 2008). Water may be key to solving Middle eastern conflict.

Recent work by a group of researchers led by Professor Vorosmarty from New York and published in September 2010 has shown that richer nations have been able to improve their water security through investment in more storage and supply infrastructure. Rich nations tolerate high levels of water stress and reduce their negative impacts through infrastructure development.

Lack of water infrastructure in Ethiopia plus its climate and hydrological vulnerability take a 38% toll on GDP. While Cambodia, Indonesia, the Philippines and Viet Nam lose an estimated $9 billion a year because of poor sanitation (2005 prices), or 2% of their combined GDP.

Climate change will affect the amount of rain and when it falls, the demand for water, water quality, and land use. Population growth means that the earth will have to sustain 2 billion more people in the next 20 years. The number of people affected by water scarcity may increase from 1.7 billion to 5 billion by 2025 irrespective of climate change; 60% of the world's people.

Here in UK we will see warmer and drier summers, wetter winters, more extreme rainfall events and a rise in sea levels. Our eastern counties will see summer evaporation exceed rainfall and that is going to change our landscape. If we experience an average temperature rise of 4 degrees, it is quite possible that our cities will experience 10 degrees rise and that will have significant water and energy implications. We will have up to 20 million extra people in England and Wales by 2050's, and over 3 million more homes mostly in the southeast, where water resource zones are already classified as water stressed.

In my personal view adaptation to the impacts of climate change in the UK will only be achieved through a national programme of water storage; from water harvesting, green roofs and infiltration devices, to major projects of Aquifer Storage and Recharge and impounding reservoirs in our wet regions. The cost will be tens of billions of pounds but put that alongside the major investments in energy £200 billion over the next ten years, or HS2 £35 billion or even Crossrail at £20 billion. It is a cost we must face.

If we look at the water cycle, we see that for every 100 rain drops, only 36 reach the ocean. The competing uses for green and blue water on its journey for "Cloud to Coast" need us to understand better these competing uses and the impacts of exporting virtual water in goods and food. We need more simple and yet more flexible simulation models to allow us to optimise the use of water for society.

Virtual water can be expressed as water footprint; by person, nation, industry or product. Applied to nations, the concept permits assessment of external and internal footprints,

. . . Lack of adequate water and sanitation causes 5-10 million deaths annually . . .

often linked closely to trade. UK national footprint is 102Gm^3/year of which 38% is internal (water in the UK), and 62% external (water in other countries).The UK average footprint per person is 4.5m^3 per day; thirty times the 150 litres supplied by our water company. The remainder is the virtual water embedded in the food we eat, the beverages we drink, the clothes we wear, the cars we drive and so on. The UK is the sixth largest net importer of water in the world.

Work on virtual water flows between the world's regions reveals some interesting insights. Some water scarce areas of the world are net exporters, such as Australia. Why? Because they wish to trade on the global market their products such as wine and fruit. This means that international trade has the potential to save water globally if a water intensive commodity is traded from an area where it is produced with high productivity to an area with lower productivity. However, there is a continuing lack of correlation between countries hydrologically best suited to grow food and those that actually do. This has led to a view that virtual water might have a sub-optimizing characteristic in that its availability slows down adoption of water policy reform.

But where does the water used in production come from? Though there has been an emphasis on blue water through irrigation, there is now more focus on the potential of improving water security through rain fed crop production. Green water already comprises the majority of virtual water but virtual water trade can do more to reduce irrigation water demand. Unlike blue water, green water cannot be reallocated to other uses. Green water also has relatively few environmental externalities whereas blue water use is linked to water depletion, salinisation, water logging and soil degradation. Green water trade is constrained by: international trade agreements and subsidies (in the USA and Europe, these are leading to increased blue water use); land availability; technology eg agricultural efficiencies.

By importing from USA, Egypt saves 930m^3/ton of water, but its trade with the USA results in a net global water loss of 777m^3/ton, because more water is used in USA to grow wheat. However, based on blue water only, this trading saves 251m^3/ton.

Water scarcity is being recognised as an increasingly critical issue for sustainability of life on our planet. Six high profile reports and papers have been published in the last 18 months:

- Global Water Security, prepared for John Beddington by an alliance of RAEng, ICE and CIWEM.
- Water in a Changing World, the third report of UN Water.
- Charting our Water Future, by World Bank, McKinsey and the 2030 WRG.

- Water: Our Thirsty World, in National Geographic.
- Innovative Water Partnerships, by the World Economic Forum.
- For Want of a Drink, a special feature in the Economist.
- September issue of Nature with the work of Vorosmarty and others on the links between water security, loss of biodiversity and GDP.

Economic theory tells us that it is easier to encourage funding if true economic value of water is realised. Without it, we get price-cost differential and long-term sustainability becomes unlikely. However, to what extent is water a human right and if so whose responsibility is it to deliver it and who should meet the costs? True water pricing and trading is rare, but Australia and Chile have introduced it in their water scarce regions.

On average in the UK we pay around £3 for each cubic metre of water we buy from our water company; and that serves our drinking, washing, cooking, garden, car washing, and sewerage needs for a whole week! It is interesting to compare what we get for that £3, with other everyday things such as a sandwich, a coffee or a pint of beer.

I believe that until we value water appropriately, we will not be able to face some of the challenges that I am describing today. The value of water in our ecosystems is taken for granted, and includes:

- **Provisioning services** include controlling water quantity and quality for consumptive use.
- **Regulatory services** include buffering of flood flows and climate regulation
- **Cultural services** include recreation and tourism
- **Support services** include nutrient cycling and ecosystem resilience to, for example, climate change

The report Charting our Water Future uses so-called "cost curves" to prioritise water sector interventions to close the supply-demand gap. The curve for India turns around traditional thinking by showing that a suite of measures starting with those that improve the efficiency of water in agriculture would make more sense, leaving major supply measures until later. In China, the work shows that a focus on improving industrial efficiency may mean that closing the gap could be achieved at a cost benefit.

The Innovative Water Partnerships work of the WEF suggests that communities, industry and government can work successfully together to find win-win solutions. For example treated municipal wastewater can be a resource for industry and agriculture, as are the biosolids which the treatment process produces. Traditionally, the private sector was never present at water policy discussions. However, things are changing and water risks are faced by many businesses and those that are realising this first are taking steps to secure their water. SAB Miller improved water efficiency through re-designing of breweries and investment in equipment with efficient consumptions of water and energy.

. . . the demand for embedded water products in one country can have very serious impacts elsewhere . . .

Governments can provide a **facilitating** role, ensuring **engagement of all stakeholders and promoting a shared resource** which makes misuse less likely. Through **demonstrating** which measures have the greatest impact, this can spur investment from the private sector.

UK government aims to ensure UK food security through strong UK agriculture, and international trade links that support developing economies. However, high reliance on international trade for our food security means high reliance on water management in the nations which are supplying the food.

The concepts of blue and green water, virtual water and water footprint, and of water scarcity are not yet taught effectively within the education curriculum – anywhere. There is a pressing need to promote the idea of water as a shared and valued resource in our schools.

So, is global water security achievable? And if so, how would we know that we had achieved it? What would it look like? Here are five "tests" which I propose:

- Affordable drinking water for all, to promote public health
- Sustainable sources of water for industry and its supply chain, to promote economic health
- Integrated management of water in all its forms and for all its users
- And linked to this, policy and trade reforms which encourage sustainable water resources development and which discourage conflicts
- Mobilisation of the substantial volumes of public and private funds, via transparent and fair regulatory regimes which correctly value water

The consequences of failure are very grim. We will see:

- more people without safe drinking water and sanitation.
- food security endangered in nations which are water scarce.
- more pollution in developing nations.
- more conflict over water which crosses boundaries.

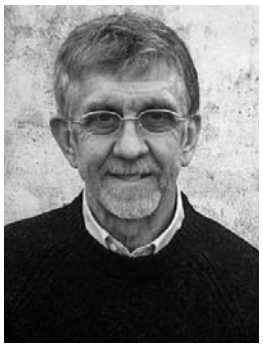
The potential for water scarcity or lack of water security to destabilise the world is high.

I will conclude by saying that we need to widen and deepen the debate around the fundamental role played by water in all human activity on our planet; social, cultural and economic. We know there are many innovative ways to close the supply demand gap, it isn't that difficult in theory, but this requires multiple stakeholder engagement and this is where government can do much to facilitate and catalyse innovative water partnerships which have long term benefits and which overcome corporate, political, and financial timescales

There is enough water, probably enough to sustain 10 billion people on Earth. We just need to use it wisely especially our precious green water. That means growing food where there is reliable green water.

Finally, water professionals like me need to take this message outside of their cosy group – the "water box". Today, I am doing just that!

SYNTHETIC BIOLOGY PUBLIC DIALOGUE



Dr Brian Johnson
Chair, BBSRC/EPSRC
Synthetic Biology Public
Dialogue

People have always been curious about how living things work. For centuries humans have studied micro-organisms, plants and animals (including of course ourselves) to try to find out how they are constructed and how they work. In the past 50 years this scientific endeavour has been extended to the molecular level, with spectacular advances in our knowledge of how genes work, how they are translated into cellular components, and how they control the whole organism. More recently researchers have been able to store genetic information on computer databases that can be accessed by the global scientific community. At the same time molecular biologists have learnt how to synthesise the basic genetic components of cells, RNA and DNA, with great accuracy; we can now assemble long lengths of these molecules, which are of course the blueprint for life, and we can do this increasingly rapidly and cheaply.

About 20 years ago, groups of biologists, chemists, engineers and computer scientists realised that it was now possible to radically *redesign* biological components such as DNA, proteins and molecular modules that assemble and run cells. The culture of synthetic biology was born, and multidisciplinary teams set out to make the aspirations real.

Pioneering researchers in the last decade have demonstrated that working viruses can be assembled using gene sequence templates stored on computers, and a team led by Craig Venter in America this year demonstrated that bacterial chromosomes can be synthesised from scratch and successfully transplanted into cells. Synthetic biology has reached a new and important developmental stage, because in the near future we will be able to design and assemble micro-organisms to carry out a multitude of tasks currently done using rather crude and energy-intensive industrial processes. On a longer timescale it should be possible to design and build higher organisms and other biologically-based systems to produce fuel, industrial raw materials, engineering components, drugs and perhaps food more sustainably. Several eminent scientists have described synthetic biology as the "second industrial revolution". Undoubtedly there is great potential in this new scientific culture.

Like all new science and technology, beside potential benefits, societal and ethical issues will emerge from the use of synthetic biology. The Research Councils, especially BBSRC and EPSRC, who fund most synthetic biology research in the UK, together with the learned societies (especially the RAEng and Royal Society), realised several years ago that this was potentially a controversial scientific area. We could only guess at what these issues might be, so in 2007 BBSRC's Bioscience in Society Panel commissioned social scientists Andy Balmer and Paul Martin at the University of Nottingham to give us a view of the societal and ethical issues that might arise from synthetic biology. Their excellent and widely-read report[1] confirmed that there would be significant issues arising from synthetic biology and recommended that we engage with the public at an early stage in the development of synthetic biology, before commercial products appeared, and that public engagement should involve scientific researchers, social scientists, NGOs and ethicists.

Partly as a response to that report, the societal and ethical issues panels of BBSRC and EPSRC combined forces to initiate the public dialogue that started in 2009 and has produced the report published this year[2]. TNS/BMRB were commissioned as the main contractor and Laura Grant Associates as evaluators, with Sciencewise providing valuable advice and funding. We set out to capture a wide range of public views, including people's aspirations for synthetic biology, and their concerns. Most of all we wanted this dialogue to be the first phase in an ongoing conversation between the research community and members of the public, employing innovative techniques such as video ethnography, where researchers record their daily lives to show public

participants the world of science and scientists.

TNS/BMRB interviewed 41 stakeholders with a professional interest in synthetic biology, and then ran a series of three workshops at four locations involving 160 public participants and a number of researchers, including synthetic biologists and social scientists. Public participants were drawn from a wide range of backgrounds, ethnicity, faiths and abilities, making the group a representative sample of society. The whole process was overseen by a lively and diverse oversight group, including sociologists, NGOs and scientists, who were charged with acting as 'critical friends' to the contractors.

When first introduced to synthetic biology public participants mentioned that the ability to design and assemble novel biologically-based systems gave synthetic biology a "uniqueness" that both fascinated and excited them, not only because they could see the potential in this scientific area but they also felt that the science was "unimaginable", far removed from science with which they were familiar.

Participants were, as we expected, excited by potential outputs from synthetic biology, but were also deeply interested in the process of science. Scientists' motivations and aspirations were the subjects of much deliberation and debate, generating a series of questions that participants felt should be addressed by the scientific community. Amongst these were "Why are you doing this research?", "What do you hope to achieve?" and "What sort of technology is produced when you are respectful of nature?" People also felt there was a disconnect between individuals' own science, seen by researchers as incremental or routine, and the field overall, viewed by the public as transformative. One of the key issues to emerge was the need for scientists to consider the wider implications of their work more effectively and to show the public that they had done so.

The dialogue reveals that both professional stakeholders and public participants found the technology fascinating and were excited by its potential, for example, to help us tackle some of the big challenges society faces, such as global warming, serious diseases, energy problems and food security. The prospect of being able to make progress towards these goals was a significant factor in public acceptability of the research. But coupled with this recognition of potential was a strong sense of trepidation and concern, for instance around the suitability of current regulations to cope with this new field, and for wider impacts of the technology. Concerns included the pace of development in the field, the idea that the science may be progressing too quickly when long term impacts were unknown. Other significant concerns focused on where synthetic biology was going, and what it might look like in the future, together with potential for uncontrolled release of synthetic organisms into the environment. The need for effective international regulation and control was one of the most important issues flagged up by participants, but a significant number also felt that overregulation could slow down important research especially in the medical field. There needed to be greater capacity for regulators to be able to anticipate scientific developments. Given the novelty of synthetic pathway or micro-organism there was doubt whether current regulatory systems were adequate.

People were concerned that scientists should afford dignity, responsibility and respect when intervening in the natural world. Perhaps surprisingly, there was general agreement that creating life was acceptable when balanced with the benefits that synthetic biology could bring. However, people found problematic the idea of treating nature as parts to be assembled. Nature was seen as too complex with genetic and environmental interactions too dynamic and stochastic to predict in a precise way. Despite voicing these concerns, participants did not divide into 'pro' and 'anti' groups. Typically, excitement and trepidation resided within each individual.

Public participants felt that the Research Councils, as major public funders of synthetic biology research, should take the lead in making sure the discussions, concerns and hopes that the report highlights have real influence on Research Council policies and those of others; for instance regulators and the private sector. One of the key issues to emerge was what was meant by funding 'good science'. Currently, this process is focused on technical excellence, but participants wanted to see a broader definition of good science, perhaps in a normative or social sense. They also wanted scope to feed public aspirations and concerns into research funding strategy. To enable this it should be incumbent on the Research Councils to make the science publicly accessible. For certain grant applications, people felt that a more iterative process is needed not only involving scientists, but also the public, social scientists, ethicists and others to feed in views, with ideas shaped through debate.

This dialogue breaks new ground in public engagement, not only in terms of how it is planned and conducted but also because it is taking place at a very early stage in the science. This presents some real challenges, not least because at the start most public participants were completely unaware of synthetic biology, and as yet there are no tangible products. It is perhaps a measure of the success of this stage in the dialogue that many participants are now keenly interested in synthetic biology and have said that they want to continue their dialogue with researchers.

I hope we can enable them to do this, because as chair of the steering group, I would like to see the dialogue continue within institutions and through public debate; in other words become embedded in the business of science and technology. To my mind it is only right and proper that members of the public are able to make their views directly available to scientists and not just via the media, for those views to be taken into account, and for researchers to be able to engage easily and openly with the society within which they operate.

Finally, I would like to thank the steering and oversight groups for their hard work and professional stakeholders for their input. I also especially want to thank our public participants, some of whom are here today, for the time and effort they put into the workshop discussions.

1. Synthetic Biology: Social and Ethical Challenges. Balmer, A. & Martin, P., University of Nottingham. 2008. Available at: http://www.bbsrc.ac.uk/web/FILES/Reviews/0806_synthetic_biology.pdf

2. Synthetic Biology Dialogue. BBSRC/EPSRC 2010. Report available at: http://www.bbsrc.ac.uk/web/FILES/Reviews/1006-synthetic-biology-dialogue.pdf

SYNTHETIC BIOLOGY PUBLIC DIALOGUE

Tim Gander

Professor Douglas Kell
Chief Executive,
Biotechnology and Biological Sciences Research Council,
The University of Manchester

BBSRC and EPSRC recognised several years ago that synthetic biology was an emerging area of science that had great potential both to generate exciting beneficial outputs and to raise social and ethical concerns. In 2009 we commissioned a dialogue to begin to explore the diversity of views around this novel area of science so that our future policy and dialogue activities could be better informed. Workshops with members of the public took place in early 2010 and a report was published later in the year highlighting a number of recommendations for the Research Councils and others to consider when thinking about synthetic biology. Here, I will take the opportunity to explain some of the actions the Research Councils have committed to in our response to those recommendations. A number of the actions will be carried out jointly between BBSRC and EPSRC but, recognising that the communities of scientists that we fund are different from one another, we will also be working on some actions separately.

Firstly, it is important to convey that we view this dialogue as the foundation for an ongoing conversation about synthetic biology. As the field develops and matures and as applications begin to reach the marketplace and consumers, it is vitally important that we stay engaged with those who have a stake in synthetic biology – that includes the public but also special interest groups such as NGOs, industrialists, environmental groups and others.

There are many ways of having these conversations and multiple routes for them to influence not just the Research Councils, but others such as scientists and policy makers. To facilitate ongoing discussion we will be producing a reader friendly digest of the report to help get its messages to a wider audience. In BBSRC we draw on the expertise of our Bioscience for Society Strategy Panel (BSS), with its diverse membership that includes social scientists, bioethicists and consumer groups. It was this panel who first highlighted the potential for synthetic biology to raise social and ethical issues to the Research Councils and in doing so sparked this whole exercise. BSS helps us to include perspectives in our policy making from beyond those of the close-knit scientific community and they will continue to keep a close eye on this area as the science develops.

Clearly, though, the report and dialogue call for much more than a watching brief, and our response sets out our commitment to do much more. It is not necessary to repeat what is laid out in the response letter, but it may be helpful to outline the thinking behind the actions and illustrate it by pulling out one or two examples.

The report highlights that there are some issues that are particularly acute in synthetic biology: the juxtaposition of 'synthetic' and 'biology'; of 'artificial' and 'natural': and, the potential for synthetic biology to have industrial scale impacts and so to be both very exciting and yet also very 'scary', are two that stick in my mind. This means that we do need to be particularly vigilant and attentive to synthetic biology as a scientific area. It is why we have committed to working hard, with our synthetic biology research community, to ensuring that we are open and engaged. I know that our Networks in Synthetic Biology are already doing a great deal to talk about their research and to bring in outside perspectives to their work. But we can do more which is why, with funding from Sciencewise, we will be holding a workshop with the synthetic biology community not only to discuss the report and its messages but also to share best practice in public engagement and to begin to build a tool kit that will help researchers talk about their

research and explore the issues around it.

The headline message from the report is, "conditional support of synthetic biology". It's striking that for all four applications discussed in the workshops each time at least half of people thought research should be encouraged.

But it would be a grave mistake to interpret this simplistic top line message as meaning that we need do nothing. The report really brings out the plurality of voices and views that were expressed during the dialogue. It was striking to me how people's views were nuanced, for instance the same people would recognise the potential for synthetic biology to tackle global challenges whilst at the same time expressing anxiety about regulatory and societal issues. Clearly discussion and debate about synthetic biology is not either black or white, nor should it be depicted or treated as such. Each new advance and novel application of synthetic biology will prompt a conversation to explore the grey areas and to try to decide whether the potential risks are or are not outweighed by the potential benefits.

The report has real value to us because as well as helping us understand people's attitude to synthetic biology it also tells us about issues that stretch right across our work and indeed that of government and industry. For instance, there are messages about how innovation happens that are not just relevant to synthetic biology but can be applied to any area of research that we fund. In fact, BBSRC's Bioscience for Industry Strategy Panel has recently been discussing just these issues and has helped us put together a Knowledge Exchange and Commercialisation policy that aims to shift the focus of knowledge exchange towards recognising social goods as well as commercial potential research and its outputs. This work has the support of our Research Council colleagues.

The dialogue and report has also prompted us within BBSRC to review how we monitor the ethics of all our grant applications and to think about how we can encourage researchers right across the piece to consider the motivations for their work and to look at it in the wider social context.

Of course, the report touches on areas that are beyond the Research Councils' sphere of influence. Far from ignoring these issues we are actively working to ensure that the report has influence beyond our walls, we know it is important that the messages from this report reach all those who have a stake in them.

Finally, I would like to thank all those who've taken part so far in this discussion, either as advisors or participants and by inviting those of you haven't yet been involved to join in the ongoing discussion around this potentially life changing technology.

The recommendations that have arisen from the dialogue and the response that BBSRC and EPSRC have made to those recommendations are available through our website (www.bbsrc.ac.uk/syntheticbiologydialogue).

SYNTHETIC BIOLOGY DIALOGUE AND WHAT IS THE PUBLIC PERSPECTIVE?

SYNTHETIC BIOLOGY PUBLIC DIALOGUE

Professor David Delpy
Chief Executive, Engineering and Physical Sciences Research Council

Synthetic biology provides us with a unique opportunity to engage the public early on in the future direction of an emerging and potentially revolutionary area of research.

The synthetic biology public dialogue, commissioned by EPSRC, BBSRC and Sciencewise, has been an extremely valuable and positive experience for the Research Councils. We hope this is the first step in building a platform for ongoing communication with the public about important scientific advances – getting issues out in the open and engaging a wider audience in the debate.

Two of the main themes emerging from the dialogue responses, which I will explore further here, were regulation and an approach to responsible science and innovation.

REGULATION

The issue of regulation for synthetic biology is a problematic one as framing regulation when hypothesizing about future technology is fraught with difficulties. However, strong concerns were expressed by all participants in the dialogue about the need for effective regulation and adaptive governance, with regulators seeking to anticipate and

respond to scientific developments. Doubts were also expressed about the ability of the current regulatory systems to cope if a breakthrough led to an increase in synthetic biology applications.

If these issues are not satisfactorily addressed then there could well be a public reaction against synthetic biology, limiting our ability to realise the potentially huge benefits of the technology.

Much of our existing regulation uses conventional risk assessment to assess the safety of, for example, a genetically modified (GM) organism by comparing it with that of a predecessor. If synthetic biology were to create totally new entities without provenance or predecessors this approach would not necessarily work. To complicate things further, research is still in its infancy and the hypothetical applications cross over the boundaries of different Government Departments, potential regulators, and international bodies.

This is an area where the Research Councils have limited influence, but I have alerted Sir John Beddington in his role as the Government's Chief Scientific Adviser. We have discussed this and corresponded and I know he is giving this his active consideration.

I do believe that the Research Councils and our research communities can and should seek to identify at an early stage the potential wider impacts of emerging technologies (on society, health and the environment) and in so doing inform regulatory decisions. The researchers we fund should form the first link in an anticipatory and adaptive governance partnership.

RESPONSIBLE SCIENCE AND INNOVATION

A key message from the dialogue is that the public have an interest not just in the outcomes of research, but in the process and conduct of the research itself. The public rightly expect to be able to trust funders to ensure that scientists think about the potential impacts of their research and act responsibly, and that government puts in place appropriate and timely regulatory processes.

These are generic issues that are not limited to synthetic biology, but apply across the whole spectrum of research and innovation.

Research Councils have a responsibility to scrutinize the potential impacts and risks of emerging technologies, and encourage the researchers we fund to do likewise. This is an area that EPSRC's advisory body, the Societal Issues Panel [1], is considering closely. Such processes must not be about necessarily stopping areas of research in response to potential risk and uncertainty; we need to identify how to proceed responsibly. The challenge will be to define an approach that promotes creativity and innovation in research underpinned by a commitment to its responsible development.

DEVELOPING A FRAMEWORK FOR THE FUTURE

Through a pilot project in partnership with the Economic and Social Research Council (ESRC) we have been exploring ways to encourage and embed such 'upstream' reflection. As part of the pilot EPSRC included a specific section on responsible innovation for the first time within a major funding call.

For more detail on the pilot project see *Rising to the Challenge of Responsible Innovation* by Professor Richard Owen on page 5 of this publication.

In conjunction with ESRC we are looking at how we might build on this pilot and develop an outline Responsible Science and Innovation Framework as a basis for a wider discussion and to explore how we might develop a unified, consistent approach across Research Councils and other partners. Although any potential framework would be made available to all research areas, it would not be expected to be used in all cases. We must take care not to be heavy handed and force an approach on areas where it might not be appropriate. This is about creating the opportunity for reflection within the whole life cycle of research and innovation, encouraging researchers to think imaginatively about the potential applications and impacts of their science, and helping to inform policy and regulation discussions.

CONCLUSION

We have embarked on the first step in establishing a route to responsible innovation, but there is much left to do. If successful we believe this will lead to a positive culture change for research and innovation funders and those who are funded by them. It will be an important start to translating the concepts of adaptive and anticipatory technological governance into practice at an early stage in the innovation process.

I would like to thank all those who contributed to the dialogue, especially the members of the public and the scientists who found time to participate. Special thanks should go to BMRB who conducted the exercise and also to Sciencewise whose resources and wealth of expertise contributed so much to the process.

1 EPSRC's Societal Issues Panel is chaired by Professor Lord Robert Winston. The current membership comprises: Professor Jim Al-Khalili (University of Surrey and EPSRC Senior Media Fellow), Anita Charlesworth (Nuffield Trust and Chief Scientific Advisor to the Department of Culture Media and Sport), Professor Richard Jones (University of Sheffield), Professor Phil Macnaghten (Durham University), Professor Judith Petts (University of Southampton), Tim Radford (Freelance Journalist), Professor Tom Rodden (University of Nottingham), Professor Kathy Sykes (University of Bristol) and Professor Paul Younger (University of Newcastle).

WHY WE NEED A GREATER DIVERSITY OF EXPERTS FOR EFFECTIVE PUBLIC DIALOGUE

Suzannah Lansdell
Dialogue and Engagement Specialist
Sciencewise-ERC

One of the key outcomes from the 'Use of Experts' workstream report was for the role of experts to be more carefully considered in the planning and delivery of public dialogues. This article looks at one aspect of that report – to advocate bringing in a greater number and diversity of experts in public dialogue and why that is becoming even more pertinent.

In the public dialogues Sciencewise-ERC has funded and advised on, a sample of members of the public is asked to deliberate on an issue, exploring their hopes, fears and aspirations so that policy can be better informed by those views.

Therefore, we give people quite a challenge – from knowing little, if anything, on a subject to, over the course of two or three days, being immersed in subjects such as synthetic biology, geoengineering, stem cells and animals containing human material, and then discussing the challenges, issues, benefits and pitfalls. Participants are taken through a range of information and often in a spread of different formats – information sheets, videos, presentations and their own research – to bring them up to speed with the core aspects and narratives on the subject. Participants also hear the views of different 'experts' as another way of enabling them to see through and round the different aspects of an issue.

And therein is the challenge that requires explicit consideration – who are the 'experts' and how do we faithfully and credibly cover the diversity of perspectives that may exist on an issue?

WHY A DIVERSITY OF EXPERTS?

I suggest there are two key drivers for this diversity. Firstly, to enable participants to deliberate as effectively as they can on the issue at hand and, secondly, (and often not given enough emphasis) to provide an opportunity for the experts to be participants themselves in those processes as a way of directly hearing the issues from the public and thus informing their own thinking and research trajectories.

FOR PUBLIC PARTICIPANTS – SEEING THE WHOLE

If we are expecting people to make choices or express views on a subject, then we should provide perspectives that enable participants to get as holistic a view as possible on the issue to help the process of deliberation.

Without faithfully providing as full a picture as possible of the issues, the process becomes in danger of being challenged for bias.

"Debates about science should involve different opinions/viewpoints and a plurality of expertise and recognition of other types of knowledge that take into account minority opinions" [1]

Obviously, each dialogue is specifically planned and factors such as purpose of the dialogue, and the issue being discussed are key to defining who the experts may be. Inevitably, time factors will also play a part somewhere along the line restricting how much can be achieved – which is why it is so important to think carefully about who is chosen to provide 'expert input'.

Evaluations of dialogues show that a variety of viewpoints is always valued by participants – and, indeed, if the variety of input is not there, then participants often quickly pick up on its omission.

"It was also particularly valuable to have a variety of viewpoints among the speakers. This helped ensure that participants did not feel manipulated towards a particular conclusion, and also helped them feel there was no 'right' answer which, in turn, made them feel more comfortable about expressing their own views." (HFEA Hybrid & Chimera Embryos dialogue) [2]

As far as possible, it is really valuable to give participants the opportunity to say which experts and/or viewpoints they would want to hear.

FOR EXPERTS – REFLECTING PUBLIC HOPES, FEARS AND ASPIRATIONS

There is another reason for wanting to include a diversity of experts in public dialogue – to provide greater opportunity for the experts themselves. Public dialogue is, importantly (or should be), about experts being able to discuss the issues with public participants – to hear first hand the issues and concerns. Giving experts an opportunity to hear what the public thinks and feels about an issue is important, and crucial in the case of research, if we are to truly embed societal thinking into future research trajectories.

"I gained a lot from listening to the views of a very diverse range of members of the public who, by and large, were very supportive of us, but had a few areas where they weren't certain. I think it has allowed me to sort of set my barometer at a more appropriate point." (Professor Chris Mason, University College London, an expert speaker and member of the Oversight Group in the Stem Cell Dialogue) [3]

Not only does diversity enable richer public dialogues, it also enables greater reflection of public thinking into future science and technological developments.

EXPERT – WHAT EXPERT?

So, who exactly is an expert? This, of course, will vary from subject to subject and process to process. In Sciencewise dialogues, expert input has broadly fallen into the following categories:

- **Experts (scientific/technical/legal)** provide technical and scientific-based inputs from the whole range of science – from social science and philosophy through to physical and life sciences
- **Stakeholders** largely provide views and evidence based on a particular standpoint and often represent lobbying or special interest groups, eg the Renewable Energy Association, Greenpeace
- **Experiential** publics are members of the public who have a specific knowledge, can contribute by sharing their personal insights and stories into an issue, eg parents of children with a chronic medical condition, who have gained considerable knowledge of that particular condition over time, but who also have direct experience as users of a medical service

BROADENING THE NOTION OF WHO IS AN EXPERT

The notion of who might be perceived as an expert is under constant debate.

"…when it comes to the future of an emerging technology, no one (or everyone) is an expert." http://www.nature.com/news/2010/100804/full/466688a.html NatureNews: World View: Not by experts alone – David Sarewitz

As the Big Society starts to play out, it is possible that, with an emphasis away from centralised 'power' to more local delivery, there will come a greater recognition of the role and experiences of those individuals and organisations delivering solutions. The extension of this means a widening of whom we might perceive as experts in the future – particularly to those with increasing direct and practical, rather than academic, experience.

Couple this with the continued rise of the professional amateur, resourced and profiled by ever wider internet powered information sharing, and it is likely that the choice of which 'experts' and perspectives are pertinent, challenging and appropriate in public dialogue is sure to broaden.

So, while advocating a much stronger presence and number of scientists and academic experts to participate in public dialogue, it is also necessary to consider involving a much wider set of perspectives on an issue to equip public participants with the range of viewpoints on the subject at hand.

In conclusion, the tips to bear in mind for every dialogue is to think carefully about which, and in what way, experts are involved in public dialogue:

- Are the range of perspectives faithfully covered to give participants a holistic view of the issues?
- Who is best suited to give those perspectives – academics, NGOs, those with experiences or stories to share – do we need to look beyond the 'usual suspects'?
- How can experts themselves be participants in the process and become more able to understand fully the thoughts of public participants so that, in turn, this can help develop thinking, research and developments that are fit for purpose and in line with a society that ultimately gives the 'licence to operate' for many new technologies.

1 Participatory Science and Scientific Participation: The role of Civil Society Organisation in decisionmaking about novel developments in biotechnology. http://www.participationinscience.eu/psx2/final/PSX2_final%20report.pdf

2 Warburton, Diane – Shared Practice (2007) - Evaluation of the HFEA public consultation on hybrid and chimera embryos http://www.sharedpractice.org.uk/Downloads/HFEA%20Report.pdf

3 Mohr, Alison (2009) An independent evaluation of the BBSRC and MRC Stem Cell Dialogue Project 2008. University of Nottingham, Institute for Science and Society, P47, Final draft May 2009.

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RESEARCHERS VISUALISE HERPES VIRUS' TACTICAL MANOEUVRE

For the first time, researchers have developed a 3D picture of a herpes virus protein interacting with a key part of the human cellular machinery, enhancing our understanding of how it hijacks human cells to spread infection and opening up new possibilities for stepping in to prevent or treat infection. This discovery uncovers one of the many tactical manoeuvres employed by the virus.

The Biotechnology and Biological Sciences Research Council (BBSRC)-funded team, led by The University of Manchester, have used NMR – a technique related to the one used in MRI body scanners and capable of visualising molecules at the smallest scales – to produce images of a herpes virus protein interacting with a mouse cellular protein. These images were then used to develop a 3D model of this herpes virus protein interacting with human protein. The research was published this evening in PLoS Pathogens on 6 January.

Lead researcher Dr Alexander Golovanov from Manchester's Interdisciplinary Biocentre and Faculty of Life Sciences said, "There are quite a few types of herpes viruses that cause problems as mild as cold sores through to some quite serious illnesses, such as shingles or even cancer. Viruses cannot survive or replicate on their own – they need the resources and apparatus within a human cell to do so. To prevent or treat diseases caused by viruses we need to know as much as possible about how they do this so that we can spot weak points or take out key tactical manoeuvres."

The 3D model shows how the viral protein piggybacks onto the molecular machinery components inside human cells, promoting virus replication and spread of infection through the body.

"When you look at the image, it's like a backpack on an elephant: the small compact fragment of viral protein fits nicely on the back of the human protein," said Dr Golovanov.

By studying the images along with biochemical experiments using the human version of the cellular protein, the team has uncovered the mechanism by which the viral and cellular proteins work together to guide the viral genetic material out of the cell's nucleus. Once there, the genetic material can be utilised to make proteins that are used as building blocks for new viruses. The researchers have also confirmed that this relationship between the two proteins exists for related herpes viruses that infect monkeys.

Dr Golovanov continued, "Our discovery gives us a whole step more detail on how herpes viruses use the human cell to survive and replicate. This opens up the possibilities for asking new questions about how to prevent or treat the diseases they cause."

Professor Janet Allen, BBSRC Director of Research, said "This new research gives us an important piece of the jigsaw for how a particular viral infection works on a molecular level, which is great news. Understanding the relationship between a human, animal or plant – the host – and the organisms that cause disease – pathogens – is a fundamental step toward successful strategies to minimise the impact of infection. To study host-pathogen relationships we have to look in detail at the smallest scale of molecules – as this study does – and also right through to the largest scale of how diseases work in whole systems – a crop disease in the context of a whole area of agricultural land, for example. BBSRC's broad portfolio of research into host-pathogen relationships facilitates this well."

550 MILLION YEARS AGO RISE IN OXYGEN DROVE EVOLUTION OF ANIMAL LIFE

Researchers funded by the Biotechnology and Biological Sciences Research Council (BBSRC) at the University of Oxford have uncovered a clue that may help to explain why the earliest evidence of complex multicellular animal life appears around 550 million years ago, when atmospheric oxygen levels on the planet rose sharply from 3% to their modern day level of 21%.

The team, led by Professor Chris Schofield, has found that humans share a method of sensing oxygen with the world's simplest known living animal – *Trichoplax adhaerens* – suggesting the method has been around since the first animals emerged around 550 million years ago.

This discovery, published on 17 December in the January 2011 edition of EMBO Reports, throws light on how humans sense oxygen and how oxygen levels drove the very earliest stages of animal evolution.

Professor Schofield said "It's absolutely necessary for any multicellular organism to have a sufficient supply of oxygen to almost every cell and so the atmospheric rise in oxygen made it possible for multicellular organisms to exist.

"But there was still a very different physiological challenge for these organisms than for the more evolutionarily ancient single-celled organisms such as bacteria. Being multicelluar means oxygen has to get to cells not on the surface of the organism. We think this is what drove the ancestors of *Trichoplax adhaerens* to develop a system to sense a lack of oxygen in any cell and then do something about it."

The oxygen sensing process enables animals to survive better at low oxygen levels, or 'hypoxia'. In humans this system responds to hypoxia, such as is caused by high altitudes or physical exertion, and is very important for the prevention of stroke and heart attacks as well as some types of cancer.

Trichoplax adhaerens is a tiny seawater organism that lacks any organs and has only five types of cells, giving it the appearance of an amoeba. By analysing how *Trichoplax* reacts to a lack of oxygen, Oxford researcher Dr Christoph Loenarz found that it uses the same mechanism as humans – in fact, when the key enzyme from Trichoplax was put it in a human cell, it worked just as well as the human enzyme usually would.

They also looked at the genomes of several other species and found that this mechanism is present in multi-cellular animals, but not in the single-celled organisms that were the precursors of animals, suggesting that the mechanism evolved at the same time as the earliest multicellular animals.

Defects in the most important human oxygen sensing enzyme can cause polycythemia – an increase in red blood cells. The work could also open up new approaches to develop therapies for this disorder.

Professor Douglas Kell, Chief Executive, BBSRC said "Understanding how animals – and ultimately humans – evolved is essential to our ability to pick apart the workings of our cells. Knowledge of normal biological processes underpins new developments that can improve quality of life for everyone. The more skilful we become in studying the evolution of some of our most essential cell biology, the better our chances of ensuring long term health and well being to match the increase in average lifespan in the UK and beyond."

HOUSE OF COMMONS SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

The Science and Technology Committee is established under Standing Order No 152, and charged with the scrutiny of the expenditure, administration and policy of the Government Office for Science, a semi-autonomous organisation based within the Department for Business, Innovation and Skills.

The current members of the Science and Technology Committee are:
Gavin Barwell (Conservative, Croydon Central), Gregg McClymont (Labour, Cumbernauld, Kilsyth and Kirkintilloch East), Stephen Metcalfe (Conservative, South Basildon and East Thurrock), Andrew Miller (Labour, Ellesmere Port and Neston), David Morris (Conservative, Morecambe and Lunesdale), Stephen Mosley (Conservative, City of Chester), Pamela Nash (Labour, Airdrie and Shotts), Jonathan Reynolds (Labour/Co-operative, Stalybridge and Hyde), Alok Sharma (Conservative, Reading West), Graham Stringer (Labour, Blackley and Broughton) and Roger Williams (Liberal Democrat, Brecon and Radnorshire).

Andrew Miller was elected by the House of Commons to be the Chair of the Committee on 9 June 2010. The remaining Members were formally appointed to the Committee on 12 July 2010.

CURRENT INQUIRIES

Scientific advice and evidence in emergencies

The Committee announced on 27 July 2010 that it would examine the Government's use of scientific advice and evidence in emergency situations. The inquiry examined four case studies indicated below in italics. The Committee held five oral evidence sessions.

On Wednesday 20 October the Committee took evidence on *Swine Flu* from Professor Sheila Bird, Vice-President (2006-09), Royal Statistical Society, Professor Neil Ferguson OBE, Director, MRC Centre for Outbreak Analysis and Modelling, Justin McCracken, Chief Executive, Health Protection Agency, and Dr Peter Holden, British Medical Association; Professor Sir Gordon Duff, Chair of the Scientific Pandemic Influenza Advisory Committee, Sir Liam Donaldson, Former Chief Medical Officer, Professor David Harper CBE, Chief Scientist, Department of Health.

On Wednesday 3 November the Committee took evidence on *volcanic ash* from Ray Elgy, Head of Licensing & Training Standards, Civil Aviation Authority, Dr Guy Gratton, Royal Aeronautical Society, Dr Sue Loughlin, Head of Volcanology, British Geological Survey, and Captain Tim Steeds, Director of Safety & Security, British Airways; Professor Brian Collins, Chief Scientific Adviser, Department for Transport, Dr Miles Parker, Deputy Chief Scientific Adviser, Department for Environment, Food and Rural Affairs, and Professor Julia Slingo, Chief Scientific Advisor, Met Office.

On Wednesday 10 November the Committee took evidence on *space weather* from Professor Paul Cannon FREng, Royal Academy of Engineering, Professor Mike Hapgood, Royal Astronomical Society, and Chris Train, Network Operations Director, National Grid; Professor Brian Collins, Chief Scientific Adviser, Department for Business, Innovation and Skills (BIS), Phil Evans, Director of Government Business, Met Office, Paul Hollinshead, Director of Science and Innovation Group, and Phil Lawton, Downstream Gas and Electricity Resilience Manager, Department of Energy and Climate Change.

On Wednesday 17 November the Committee took evidence on *cyber security* from Professor Ross Anderson, Professor of Security Engineering, University of Cambridge, Robert Hayes, Senior Fellow, The Microsoft Institute for Advanced Technology in Governments, Malcolm Hutty, Head of Public Affairs, London Internet Exchange (LINX), and Professor Peter Sommer, Visiting Professor, London School of Economics; Dr Steve Marsh, Deputy Director, Office of Cyber Security and Information Assurance, Cabinet Office, Professor Bernard Silverman, Chief Scientific Adviser, Home Office, and Professor Mark Welland, Chief Scientific Adviser, Ministry of Defence.

On Wednesday 1 December the Committee took evidence from Professor Sir John Beddington, Government Chief Scientific Adviser; Rt Hon Lord Adonis, former Secretary of State for Transport, and Rt Hon Andy Burnham MP, former Secretary of State for Health; Rt Hon Baroness Neville-Jones, Minister of State for Security, and Rt Hon David Willetts MP, Minister of State for Universities and Science.

The written evidence received in the inquiry is on the Committee's website. The Report is currently being prepared.

Technology Innovation Centres

On 20 October 2010 the Committee announced an inquiry into Technology Innovation Centres. The Committee announced that it would examine the German Fraunhofer Institutes as a model for Technology Innovation Centres in this country and its validity in improving commercialisation of research in the UK. The Committee invited written submissions on the following issues by 2 December 2010:

1. What is the Fraunhofer model and would it be applicable to the UK?
2. Are there existing Fraunhofer-type research centres within the UK, and if so, are they effective?
3. What other models are there for research centres oriented toward applications and results?
4. Whose role should it be to coordinate research in a UK-wide network of innovation centres?

5. What effect would the introduction of Fraunhofer-type institutes have on the work of Public Sector Research Establishments and other existing research centres that undertake Government sponsored research?

The Committee held three oral evidence sessions.

On Wednesday 15 December the Committee took evidence from Dr David Bembo, Member of Council, Association for University Research and Industry Links, Dr Tim Bradshaw, Head of Enterprise & Innovation, Confederation of British Industry, Professor Ric Parker, Director of Research & Technology, Rolls-Royce Group, and Patrick Reeve, Chair of the BVCA Venture Capital Public Policy Committee, British Private Equity and Venture Capital Association.

On Monday 20 December the Committee took evidence from Pam Alexander, Chief Executive, South East England Development Agency (SEEDA), Richard Brook OBE, President, Association of Independent Research and Technology Organisations, Nigel Perry, Chief Executive, Centre for Process Innovation Ltd, and Professor Keith Ridgway OBE, Research Director, Advanced Manufacturing Research Centre.

On Wednesday 12 January 2011 the Committee took evidence from Iain Gray, Chief Executive, Technology Strategy Board; Rt Hon David Willetts MP, Minister of State for Universities and Science.

The written evidence received in the inquiry is on the Committee's website. The Report is currently being prepared.

Strategically important metals

On 11 November the Committee announced an inquiry into strategically important metals. The Committee invited written submissions on the following issues by 17 December 2010:

1. Is there a global shortfall in the supply and availability of strategically important metals essential to the production of advanced technology in the UK?
2. How vulnerable is the UK to a potential decline or restriction in the supply of strategically important metals? What should the Government be doing to safeguard against this and to ensure supplies are produced ethically?
3. How desirable, easy and cost-effective is it to recover and recycle metals from discarded products? How can this be encouraged? Where recycling currently takes place, what arrangements need to be in place to ensure it is done cost-effectively, safely and ethically?
4. Are there substitutes for those metals that are in decline in technological products manufactured in the UK? How can these substitutes be more widely applied?
5. What opportunities are there to work internationally on the challenge of recovering, recycling and substituting strategically important metals?

The written evidence received in the inquiry is on the Committee's website. The Committee plans to take oral evidence in early 2011.

UK Centre for Medical Research and Innovation

On 18 November the Committee announced an inquiry into the UK Centre for Medical Research and Innovation (UKCMRI). The Committee invited written submissions on the following issues by 12 January 2011:

1. Review the progress on the UKCMRI since 2008 and assess the plans for the coming years.
2. What do the four partners hope to achieve from the project and what new technologies and innovations are being considered?
3. Is the financing of the UKCMRI robust and justified, with particular reference to the public support for the project and the knock-on effect on budgets for other research?
4. What are the risk assessment arrangements to ensure the safety of the site?
5. What are the arrangements for the closure of the existing National Institute for Medical Research at Mill Hill?

The written evidence received in the inquiry is on the Committee's website. The Committee plan to take oral evidence in early 2011.

ORAL EVIDENCE

The transcripts of the evidence sessions described above and below are available on the Science and Technology Committee's website [www.parliament.uk/science].

Spending Review 2010

On 24 November the Committee took evidence on the *Spending Review 2010* from Rt Hon David Willetts MP, Minister for Universities and Science, and Professor Adrian Smith, Director General, Science and Research, Department for Business, Innovation and Skills. The Committee held a further evidence session on 19 January 2011 when it took evidence from Chief Executives of the UK Research Councils on their budget allocations and how they will meet the Government's priorities for science.

The Reviews into the Climatic Research Unit's E-mails

On 31 March 2010 the former Science and Technology Committee published a report on the disclosure of climate data from the Climatic Research Unit (CRU) at the University of East Anglia (UEA) (HC (2009-10) 387-I). The Committee took evidence on *The Reviews into the Climatic Research Unit's E-mails* from Lord Oxburgh, who headed the *International Panel set up by the University of East Anglia to examine the research of the Climatic Research Unit* on 8 September 2010 and from Sir Muir Russell, who headed the *Independent Climate Change E-mails Review,* Professor Edward Acton, Vice-Chancellor, and Professor Trevor Davies, Pro Vice Chancellor for Research, University of East Anglia, on 27 October 2010.

Government Office for Science Annual Review 2010

On 27 October the Committee took evidence on the *Government Office for Science Annual Review 2010* from Professor Sir John Beddington, Government Chief Scientific Adviser and Head, Government Office for Science.

GOVERNMENT RESPONSES

Government Response to the Science and Technology Committee report 'The Regulation of Geoengineering'

On 28 September 2010 the Government published its Response to the former Committee's Report on 'The Regulation of Geoengineering' as a Command Paper (Cm 7936).

Government Response to the House of Commons Science & Technology Select Committee Report: "The disclosure of

climate data from the Climatic Research Unit at the University of East Anglia"

On 28 September 2010 the Government published its Response to the former Committee's Report on 'The disclosure of climate data from the Climatic Research Unit at the University of East Anglia' as a Command Paper (Cm 7934).

As of January 2011 the Government response to one of its predecessor Committee's Reports of Session 2009-10, is still outstanding: *Bioengineering*, Seventh Report (HC 220), published 25 March 2010.

FURTHER INFORMATION

Further information about the work of the Science and Technology Committee or its current inquiries can be obtained from the Clerk of the Committee, Glenn McKee, the Second Clerk, Ed Beale, or from the Senior Committee Assistant, Andy Boyd, on 020 7219 8367/2792/2793 respectively; or by writing to: The Clerk of the Committee, Science and Technology Committee, House of Commons, 7 Millbank, London SW1P 3JA. Enquiries can also be e-mailed to scitechcom@parliament.uk. Anyone wishing to be included on the Committee's mailing list should contact the staff of the Committee. Anyone wishing to submit evidence to the Committee is strongly recommended to obtain a copy of the guidance note first. Guidance on the submission of evidence can be found at http://www.parliament.uk/commons/selcom/witguide.htm. The Committee has a website, www.parliament.uk/science, where all recent publications, terms of reference for all inquiries and press notices are available.

PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY (POST)

RECENT POST PUBLICATIONS

Indoor Air Quality

November 2010 *POSTnote 366*

It is well established that outdoor air pollution is harmful to human health. However, less attention has been paid to the potential health effects of indoor air pollution. This POSTnote describes sources of indoor air pollution, the evidence for adverse effects on human health and outlines possible policy responses.

Biofortification

November 2010 *POSTnote 367*

Breeding crops to enhance their nutritional composition, known as biofortification, is one potential strategy for addressing certain forms of undernutrition. This approach may be useful where there is a dependence on calorie-rich but nutrient-poor staple foods. This briefing describes developments in biofortification, examines its potential impact, and the implications for policy makers in the UK and abroad.

Rare Earth Metals

January 2011 *POSTnote 368*

Rapid global industrialisation and population growth are placing increasing pressure on availability of raw materials. A group of elements known as the Rare Earth Metals has become a highly sought-after resource for high-technology and low carbon industries. Currently, global demand is increasing, and there are concerns over future availability. This briefing examines the debate on future supplies, and discusses the UK and international response.

Biodiversity Offsetting

January 2011 *POSTnote 369*

Given growing recognition of the importance of biodiversity, all sectors are looking for ways to mitigate the environmental costs of human activity. Biodiversity offsetting refers to market-based schemes designed to compensate for losses of biodiversity due to human development. The intention is to maintain or enhance an equivalent amount of biodiversity at an alternate location. This briefing summarises biodiversity offsetting and examines opportunities and risks of offsets within a UK context.

Environmental Limits

January 2011 *POSTnote 370*

An environmental limit is usually interpreted as the point or range of conditions beyond which there is a significant risk of abrupt, irreversible, or difficult to reverse, changes to the benefits derived from natural resource systems with impacts on human well-being. Natural resources such as land, water, soil, plants and animals should be used and managed within boundaries that allow the resource to renew itself. Otherwise well-being, for present and future generations, will be impacted. This briefing summarises a longer POST report on environmental limits, which sets out the challenges to achieving this aim, while

considering the complex trade-offs between social, economic and environmental objectives.

MEMBERS OF THE POST BOARD FOR 2010-15

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For the Department of Information Services: Mr Christopher Barclay; Mr John Pullinger

CURRENT WORK

Biological Sciences – Deception Detection Technologies, Interpretation of the Mental Capacity Act, Review of Stem Cell Research.

Environment and Energy – Future Electricity Transmission, Climate Change Adaptation in sub-Saharan Africa, Update to Carbon Footprint of Electricity Generation (POSTnote 268), Unconventional Gas, Energy Security, Future Landscapes, Evidence Based Conservation.

Physical sciences and IT – Solar Technologies, Technologies for Clean Water, Opening up Public Sector Data.

CONFERENCES AND SEMINARS

Health of Military Personnel

On 2nd November POST hosted a seminar in collaboration with the British Psychological Society on the health of military personnel. Recent conflicts in Afghanistan and Iraq have highlighted the short and long-term impacts on the physical health and mental well-being of personnel who have served in these theatres of war. Research in psychology and psychiatry is providing new perspectives on which support strategies are most effective for military personnel. James Arbuthnot MP, Chair of the House of Commons Defence Select Committee, chaired the seminar.

Political and Market Factors Affecting Developments in Energy Technology and Climate Change

On 14th December POST hosted a Westminster Energy Forum seminar to examine the political and market factors affecting developments in energy technology and climate change. Speakers included Oliver Graham of the Boston Consulting Group, Fiona Harvey, Environment Correspondent of the Financial Times, Adrian Haworth from GE Energy, Prof Sir Brian Hoskins, Director of the Grantham Institute for Climate Change, Huw Irranca-Davies MP, Opposition spokesperson on Energy and David Kennedy, Chief Executive of the Committee on Climate Change.

Rare Earth Metals and Beyond

On 12th January POST hosted a seminar on global mineral resource availability, with a particular focus on "rare earth" metal supply issues relevant to the UK and EU. Rapid global industrialisation and population growth are placing increasing pressure on global mineral resources. For example, currently "rare earth" metals, used widely in high-tech products and low carbon energy technologies, are experiencing both increasing global demand, and supply issues. This has caused as much as ten-fold price increases over the last six months, giving rise to debate over longer term security of supply. Lord Oxburgh chaired the seminar which included presentations from Judith Chegwidden, Managing Director of Roskill Information Services Ltd, Dr Jonathan Di John, School of Oriental and African Studies, Andrew Gunn, British Geological Survey, and Nick Morley, Oakdene Hollins.

Staff, Fellows and Interns at POST

Staff

A new Physics and IT Adviser, Dr Mary Matthews, started at POST in November, following the secondment of Dr Martin Griffiths to the Royal Statistical Society.
A new Biology and Health Adviser, Dr Ana Padilla, started at POST in January to cover for Dr Sarah Bunn who is on maternity leave.

Conventional Fellows

Beth Dyson, Manchester University, Natural Environment Research Council
Joanne Edgar, Bristol University, Institute of Food Science and Technology
Eleanor Kean, Cardiff University, British Ecological Society
Benjamin O'Driscoll, University of Reading, Royal Society of Chemistry
Dr Gareth Owen, Kings College London, Wellcome Trust Bioethics Fellowship

Special Post-doctoral Fellow

Dr Mara Almeida, Medical Research Council Functional Genomics Unit, University of Oxford, on a special Portuguese government six-month scholarship to study the functioning of parliamentary science offices.

Hansard Society Intern

Lindsay Amico, Northeastern University, Boston, USA

INTERNATIONAL ACTIVITIES

Lectures and Presentations

On 25th/26th November the Director was invited to give a keynote presentation in Brussels at a pan-European conference on "Undergrounding of Extra High Voltage (EHV) Power Lines". The driver for continental interest is that in various European countries, in particular Germany and Austria, intense local opposition is occurring to planned new lines intended to bring renewable energy from the Baltic and North Sea to southern demand centres. Some technological advances are occurring in underground cable systems but these are unlikely to reduce their cost below being an order of magnitude greater than for overhead lines.

On 27th/28th November Dr Nath was invited to give a talk about POST's work with the Parliament of Uganda at a UNESCO

sponsored conference on "Regional cooperation in science and technology: opportunity and challenges in the context of globalisation in New Delhi."

POST African Parliaments Programme

Preparations for parliamentary and presidential elections are under way in Uganda so the programme is focusing on plans for activities in the new parliament, which will include a third round of MP-scientist pairing and the setting up of a "remote mentoring" scheme for Ugandan parliamentary staff working on scientific issues. Discussions are also being held with the Parliament of Uganda and the Ugandan National Academy of Sciences about how to sustain capacity building activities in science and technology when the POST programme comes to an end in mid 2012.

HOUSE OF COMMONS LIBRARY SCIENCE AND ENVIRONMENT SECTION

Research Papers produced for Members of Parliament are summarised opposite. Papers can be accessed at http://www.parliament.uk/business/publications/research/research-papers/

The Section produces a series of frequently updated notes on a wide range of topics. Opposite are summaries of some recently updated notes.
The notes can be accessed online at http://www.parliament.uk/topics/Topical-Issues.htm

For further information contact Christopher Barclay Head of Section Tel: 020 7219 3624 email: barclaycr@parliament.uk

Daylight Saving Bill

Research Paper 10/78

Over the past decade there have been several attempts to shift clocks forward for one hour throughout the year, so that more daylight would be experienced in the evenings rather than the mornings. There could be a range of benefits from such a change including: fewer people killed on the roads; improved health and wellbeing; an economic stimulus; and reduced greenhouse gas emissions.

A number of commentators are not convinced by the supporting evidence and claims, or believe that more information is required before a decision can be supported. There are particular concerns in Scotland about the implications of the darker mornings that a change would cause.

The Daylight Saving Bill 2010-11 is a Private Member's Bill sponsored by Rebecca Harris MP. It would require the Government to conduct a cross-departmental analysis of the potential costs and benefits of advancing time by one hour for all, or part of, the year. If this analysis found that a clock change would benefit the UK, the Bill requires that the Government initiate a trial clock change to determine the full implications.

Localism Bill: Planning and Housing

Research Paper 11/03

Part 5 of the Bill will abolish regional planning, introduce a neighbourhood planning regime and abolish the Infrastructure Planning Commission.

Part 6 of the Bill will make significant changes to the way in which social housing is provided and will also repeal the legislation governing the provision of Home Information Packs (HIPs). This Part includes provisions that will enable the long awaited reform of council housing finance.

Part 7 of the Bill will make changes to housing and regeneration functions in London. It will abolish the London Development Agency and introduce a regime for Mayoral Development Corporations. Changes to Greater London Authority governance will allow the delegation of functions by Ministers to the Mayor.

Cancun Climate Conference SN/SC/5772

The high expectations for the Copenhagen Climate Conference (COP15) held in December 2009 were not met and agreement on the successor to the Kyoto Protocol was not reached. Instead a non-binding Copenhagen Accord was put together by some of the major emitting countries behind closed doors and agreed to at the last minute. After Copenhagen progress was slow with little movement from the various parties.

Expectations were not high for any progress during the next conference in Cancun (COP16). The outcome after two weeks of negotiations was modest, but the meeting was considered a success on the basis that the negotiations did not collapse as they did in Copenhagen. Although there was little progress in negotiating a successor to the Kyoto Protocol progress was made on several issues including technology transfer, funding and forestry. In addition, there was agreement (mediated by India) that both developed and developing countries would commit to reduce emissions; and that both would be subject to some form of monitoring and verification. The Agreement was supported by all member countries, with the exception of Bolivia.

The Green Deal SN/SC/5763

One of the main components in the Energy Bill 2010-11 is the framework for a "Green Deal." The aim is to encourage home energy efficiency improvements, to be paid for by consequent savings from energy bills. It will apply in England,

Wales and Scotland and is a two-strand policy.

The first strand is a pay-as-you save scheme whereby qualifying Green Deal customers would get the money upfront to make the energy efficiency improvements in the form of a loan.

The second strand is to replace the current obligations on energy suppliers, to reduce carbon dioxide emissions from homes, with the new energy company obligation (ECO). The ECO would underpin the Green Deal. It would focus the obligation on those properties and households which could not make energy savings without extra financial support, such as those with hard-to-treat homes and the fuel poor.

The Green Deal is expected to be available to customers in the latter half of 2012. This note examines the Green Deal proposals in more detail.

Heating oil SN/SC/5806

Evidence suggests that the price of home heating fuel has increased substantially during winter 2010-11. The heating oil industry has blamed the rise in prices on a combination of higher crude oil costs and on cold, snowy weather in the UK making deliveries more expensive. Campaign groups have accused these companies of profiteering and using the cold weather as an excuse to raise prices unnecessarily.

The home heating oil market is not regulated by Ofgem, but can be investigated by the Office of Fair Trading (OFT) if there is evidence to suggest that competition laws have been infringed. Following representations from the Government, the OFT has now agreed to examine the supply of energy to consumers who are not connected to the main gas grid. The study will launch formally in March 2011.

The Government has also said that it is keeping a careful watch on the situation. The Government also has a number of policies and schemes to try to help the situation in the future. These include the Green Deal, social price support and the renewable heat incentive. This note sets out all these issues in more detail.

Flood defence SN/SC/5755

Between May and June 2007 extreme rainfall led to widespread flooding in England and Wales. It was arguably the largest peacetime emergency since World War II, causing 13 deaths and £3.2 billion in damage. Average flood damage costs are currently in the region of £1 billion per year, but these costs could rise to £27 billion by 2080.

Maintaining existing levels of flood defence would require spending on asset maintenance and construction to increase to over £1 billion per year by 2035. Given current budget constraints, national flood defence spending will reduce slightly from current levels over the next four years. Local sources of funding will probably play a bigger role in coming years.

The Forestry Commission and the sale of public forests in England SN/SC/5734

This note sets out information on the sale of the Public Forest Estate (PFE) in England, which is managed by the Forestry Commission. The PFE currently provides multiple economic, social and environmental public benefits, although it costs some £15 million per year to operate. Governments have been able to sell parts of the PFE since 1981. In the eighties thousands of hectares were sold. There was a change in policy following the 1997 general election when the sale of such land was restricted.

The Coalition has signalled its intention to sell a significant proportion of the PFE. Powers to enable the sale are contained in the Public Bodies Bill 2010-11. A public consultation was launched on 27 January. Some are concerned that the sale of the PFE may lead to the loss of public benefits and environmental damage. Others believe that the land could be managed better by other land owners such as charities and industry, in a way that preserves these benefits.

Animal cloning SN/SC/5798

Since 1997, when the first mammal was cloned from an adult cell at the Roslin Institute in Edinburgh, a number of commentators have raised concerns about the implications of animal cloning for food safety, food supply and animal welfare. Others stress that animal cloning has the potential to improve animal welfare and farming productivity. It may even be used in the conservation of endangered species.

The current preferred method of cloning, somatic cell nuclear transfer (SCNT), has a number of drawbacks. Cloned animals often suffer significant health problems compared to conventionally bred animals. The technology therefore has implications for animal welfare. There do not appear to be food safety issues with this technology.

EU Regulations mean that foods derived from cloned animals need to be scientifically assessed and specifically licensed. There is a debate about whether regulations apply to the offspring of clones. In the UK, the Food Standards Agency (FSA) states that products from the offspring of cloned animals are also novel foods and therefore they need to be specifically assessed and licensed. European Commission proposals may ban the use of animal clones in food, although controls would not apply to the offspring of clones. European legislation is likely to come forward in 2011.

HIV and Hepatitis C infection from contaminated blood and blood products SN/SC/5698

During the 1970s and early 1980s some blood and blood products supplied by the NHS, mostly to haemophilia sufferers, were contaminated with HIV and Hepatitis C. More than 4500 patients contracted one or both of these diseases as a result, of whom over 2000 are thought to have died.

No-fault government payment schemes were established to provide support for those affected. These have been criticised as being insufficient but successive Governments have rejected calls for an independent inquiry and additional compensation. A non-statutory inquiry funded from private donations, the Archer Inquiry, reported in February 2009. Amongst its recommendations was a call for reform of support for those affected, in line with a scheme used in the Republic of Ireland.

The Irish scheme offers substantially higher payments than the UK schemes but successive Governments have rejected comparability on the basis that the Irish scheme was established to compensate victims for wrongdoing by a government agency but that no similar wrongdoing occurred in the UK. An April 2010 judicial review of the previous Government's response to the Archer Inquiry questioned that assertion and the current Government responded with a proposal to review aspects of support.

On 10 January 2011 the Government announced an increase in payments for some of those infected with Hepatitis C, and offered additional medical and psychological support. These new measures currently apply only to patients in England and are estimated to cost £130M. While the measures were welcomed as a step in the right direction by some contaminated blood activists and their

supporters, remaining concerns include the level of payments relative to the Republic of Ireland, and whether the provisions will extend to the rest of the UK.

Cyber Security SN/SC/5832

It is widely acknowledged that cyber attacks will increasingly be a key aspect of future warfare and organised crime. This note explains the increasing threat to national security posed by the new "front" of the cyber realm of networked, digital activities (often internet-based) and sets out the Government's response.

The National Security Strategy (October 2010) has categorised "hostile attacks upon UK cyberspace by other states and large scale cyber crime" as one of its priority risks alongside terrorism, major accidents and natural hazards and military crises. The associated Strategic Defence and Security Review (SDSR) responds to this with a new "transformative" £650m Cyber Security Programme to protect the UK from cyber attacks from both nation states and individuals.

HOUSE OF LORDS SCIENCE AND TECHNOLOGY SELECT COMMITTEE

The members of the Committee (appointed 22 June 2010) are Lord Broers, Lord Crickhowell, Lord Cunningham of Felling, Baroness Hilton of Eggardon, Lord Krebs (Chairman), Baroness Neuberger, Lord Patel, Baroness Perry of Southwark, Lord Rees of Ludlow, the Earl of Selborne, Lord Wade of Chorley, Lord Warner, Lord Willis of Knaresborough and Lord Winston. Lord Alderdice, Lord May of Oxford, Baroness O'Neill of Bengarve and Lord Sutherland of Houndwood have been co-opted to Sub-Committee I for the purposes of its inquiry into behaviour change policy interventions.

BEHAVIOUR CHANGE POLICY INTERVENTIONS

The Select Committee has appointed a sub-committee under the Chairmanship of Baroness Neuberger to conduct an inquiry into the effectiveness of behaviour change interventions in achieving government policy goals and helping to meet societal challenges.

As governments across the world attempt to meet societal challenges such as reducing carbon emissions and alleviating the burden on health services caused by smoking, drinking and the rise in obesity, more and more attention is being focused on how behaviour can be influenced using a range of behaviour change interventions that rely on measures other than prohibition or the elimination of choice. The Committee will consider the current state of knowledge about which behaviour change interventions are effective, whether the Government's current behaviour change interventions are evidence-based and subject to robust evaluation, and how such interventions are coordinated across departments. The Committee will also be looking at the role of industry and the voluntary sector in shaping behaviour patterns and the social and ethical issues surrounding behaviour change interventions by government.

As part of its inquiry, the sub-committee is also conducting two case studies. The first will look at behaviour change interventions designed to reduce obesity. The second will focus on travel-mode interventions to reduce car use in towns and cities.

A call for evidence was published on 28 July 2010 with a deadline for submissions of 8 October 2010. A second call for evidence on the travel-mode interventions case study was published on 10 December 2010 with a deadline for submissions of 21 January 2011. The committee held a seminar as part of the obesity case study on 19 October 2010 and a second seminar on travel-mode interventions on 26 January 2011. The Committee began taking oral evidence in November 2010 and will finish in March 2011. The Committee is due to report in the summer.

ONE-OFF EVIDENCE SESSIONS ON THE IMPLICATIONS OF THE COMPREHENSIVE SPENDING REVIEW FOR SCIENTIFIC RESEARCH

On 16 and 23 November 2010 the Committee took evidence on the implications of the Comprehensive Spending Review for scientific research. Witnesses included Professor Sir John Beddington (Government Chief Scientific Adviser), Professor Sir Adrian Smith (then Director General, Science and Research, BIS), Professor David Delpy (Chief Executive of the Engineering and Physical Sciences Research Council), Sir Alan Langlands (Chief Executive of the Higher Education Funding Council for England), Mr Paul Clark (Director of Policy at Universities UK) and representatives from industry. The transcripts are available on the Committee's website.

PUBLIC PROCUREMENT AS A TOOL TO STIMULATE INNOVATION

The Select Committee, under the chairmanship of Lord Krebs, has launched a short inquiry into public procurement as a tool to stimulate innovation within industry. The inquiry is focused, in particular, on the Department for Transport and related public bodies, as a working example of the current procurement practices within departments. The inquiry seeks to investigate the extent to which the current procurement practices and processes are effective in encouraging innovation within industry and supporting the development and diffusion of innovations.

A call for evidence inviting written submissions was published on 22 October 2010 with a deadline of 13 December 2010. The Committee began taking oral evidence on 21 December 2010 and is due to report in the spring.

OUTSTANDING ACTIVITIES FROM THE PREVIOUS PARLIAMENT

Setting Priorities for Publicly Funded Research

An inquiry into the setting of science and technology research funding priorities was launched in July 2009. The inquiry was undertaken by the Select Committee under the chairmanship of Lord Sutherland.

Cuts in overall public spending due to the current economic climate will lead to some difficult decisions about how to allocate public funds for science and technology research. Effective mechanisms for allocating funds are vital if the United Kingdom science base is to remain healthy, both now and in the future, and is able to continue to meet societal needs. The Committee investigated a range of issues including how decisions about funding research are made across Government and within Government departments and other public bodies, whether the balance between funding for targeted research and unsolicited response-mode curiosity-driven research is appropriate, and how research is commissioned.

The Committee published its report on 1 April 2010. The Government response to the report was published on 30 July 2010. The report is likely to be debated in the House during the current session.

Radioactive Waste Management: a further update

The Select Committee appointed a Sub-Committee to conduct a short follow-up inquiry into the management of radioactive waste, following the Committee's previous reports on the subject, the last of which was published in session 2006-07.

The inquiry focused on the role and performance of the Committee on Radioactive Waste Management (CoRWM) which provides independent scrutiny and advice on the implementation of the Government's Managing Radioactive Waste Safely programme. The sub-committee held a one-off evidence session with representatives from CoRWM, Lord Hunt, (then) Minister of State for Energy and Climate Change, and representatives from the Department of Energy and Climate Change and the Nuclear Decommissioning Authority in February 2010, and published its report on 25 March 2010. The Government's response was received on 9 November 2010. It is anticipated that the report will be debated by the House during the current session.

FURTHER INFORMATION

The written and oral evidence to the Committee's inquiries mentioned above, as well as the Calls for Evidence and other documents can be found on the Committee's website www.parliament.uk/hlscience. Further information about the work of the Committee can be obtained from Christine Salmon Percival, Committee Clerk, salmonc@parliament.uk or 020 7219 6072. The Committee's email address is hlscience@parliament.uk.

SELECTED DEBATES

Opposite is a list of a selection of Debates on matters of scientific interest which took place in the House of Commons, the House of Lords or Westminster Hall between Tuesday 5 October and Wednesday 22 December.

From January 2011 a full digest of Debates, Questions and Answers on topics of scientific interest from both Houses of Parliament should be available 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.

HOUSE OF COMMONS AND WESTMINSTER HALL

12 Oct 2010	Offshore Wind Infrastructure Competition	HoC 57WH
13 Oct 2010	Degree Validation (Univ of London)	HoC 460
13 Oct 2010	Onshore Wind Turbines	HoC 131WH
13 Oct 2010	Coal-burning Power Stations	HoC 140WH
26 Oct 2010	Natural England	HoC 46WH
27 Oct 2010	Rarer Cancers	HoC 126WH
2 Nov 2010	SET (Women)	HoC 251WH
3 Nov 2010	Higher Education	HoC 293WH
9 Nov 2010	Clostridium Difficile	HoC 260
9 Nov 2010	Food Security (Africa)	HoC 56WH
10 Nov 2010	Science Research	HoC 108WH
10 Nov 2010	UK Software Industry	HoC 75WH
17 Nov 2010	Energy Efficiency Measures	HoC 308WH
18 Nov 2010	Deep-Water Drilling Shetland	HoC 1157
30 Nov 2010	Shoreline Management Plans	HoC 221WH
2 Dec 2010	Fisheries	HoC 341WH
15 Dec 2010	Water Supplies (Developing World)	HoC 1012
20 Dec 2010	Mobile Phones (Health)	HoC 1284

HOUSE OF LORDS

7 Oct 2010	Food: Regulation and Guidance	HoL 263
29 Nov 2010	Academic Health Partnerships	HoL 1340
6 Dec 2010	Arctic Ice Cap	HoL 84
13 Dec 2010	Population Growth	HoL 466
20 Dec 2010	NHS: Global Health	HoL 901

PROGRESS OF LEGISLATION

A comprehensive list of Public Bills before Parliament, giving up-to-date information on their progress, 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

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Wildlife
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Natural History Museum
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Society of Biology
UFAW

Research Councils UK

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- 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.

Biotechnology and Biological Sciences Research Council (BBSRC)

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BBSRC is the UK's principal public funder of research and research training across the biosciences. BBSRC provides institute strategic research grants to eight centres, as well as supporting research and training in universities across the UK. BBSRC's research underpins advances in a wide range of bio-based industries, and contributes knowledge to policy areas which include: food security, climate change, diet and health and healthy ageing.

Economic and Social Research Council

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EPSRC

Engineering and Physical Sciences Research Council

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EPSRC is the main UK government agency for funding research and training in engineering and the physical sciences, investing around £850 million a year in a broad range of subjects – from mathematics to materials science, and information technology to structural engineering.

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Medical Research Council

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For almost 100 years, the MRC has been improving the health of people in the UK and around the world by supporting the highest quality science on behalf of UK taxpayers. We work closely with the UK's Health Departments, the NHS, medical research charities and industry to ensure our research achieves maximum impact as well as being of excellent scientific quality. MRC-funded scientists have made some of the most significant discoveries in medical science – from the link between smoking and cancer to the invention of therapeutic antibodies – benefiting millions of people.

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, and National Oceanography Centre.

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. The STFC partners in the UK's two National Science and Innovation Campuses. It also manages international research projects in support of a broad cross-section of the UK research community. The Council directs, co-ordinates and funds research, education and training.

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.

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

AIRTO

airto
making innovation happen

Contact: Professor Richard Brook OBE FREng
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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 exceeding £2 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.

Association of Marine Scientific Industries

AMSI

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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.

Biochemical Society

THE BIOCHEMICAL SOCIETY
Founded 1911

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

British Science Association

BRITISH SCIENCE ASSOCIATION

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Our vision is a society in which people are able to access science, engage with it and feel a sense of ownership about its direction. In such a society science advances with, and because of, the involvement and active support of the public.

Established in 1831, the British Science Association is a registered charity which organises major initiatives across the UK, including National Science and Engineering Week, the British Science Festival, programmes of regional and local events and the CREST programme for young people in schools and colleges. We provide opportunities for all ages to discuss, investigate, explore and challenge science.

The British Ecological Society

British Ecological Society

The British Ecological Society
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Ecology into Policy Blog
http://britishecologicalsociety.org/blog/

The British Ecological Society's mission is to advance ecology and make it count. The Society has 4,000 members worldwide. The BES publishes five 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

BRITISH Nutrition FOUNDATION

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www.foodafactoflife.org.uk

The British Nutrition Foundation (BNF) was established over 40 years ago and exists to deliver authoritative, evidence-based information on food and nutrition in the context of health and lifestyle. The Foundation's work is conducted and communicated through a unique blend of nutrition science, education and media activities.

BPS BRITISH PHARMACOLOGICAL SOCIETY

Today's science, tomorrow's medicines

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The British Pharmacological Society has been supporting pharmacology and pharmacologists for over 75 years. Our 2,700+ 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 quality of life by developing new medicines to treat and prevent the diseases and conditions that affect millions of people and animals. Inquiries about drugs and how they work are welcome.

The British Psychological Society

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The British Psychological Society is an organisation of over 48,000 members governed by Royal Charter. It maintains the Register of Chartered Psychologists, publishes books, 11 primary science Journals and organises conferences. Requests for information about psychology and psychologists from parliamentarians are welcome.

British Society for Antimicrobial Chemotherapy

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

CABI
(Centre for Agricultural Bioscience International)

www.cabi.org

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CABI is an international not-for-profit development organization, specializing in scientific publishing, research and communication. We create, communicate, and apply knowledge in order to improve people's lives by finding sustainable solutions to agricultural and environmental issues.

We work for and with universities, national research and extension institutions, development agencies, the private sector, governments, charities and foundations, farmers, and non-governmental organizations. We also manage one of the world's largest genetic resource collections: the UK's National Collection of Fungus Cultures.

Cavendish Laboratory

UNIVERSITY OF CAMBRIDGE

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The Cavendish Laboratory houses the Department of Physics of the University of Cambridge.

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

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

High Energy Physics: 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

Founded 1882 Royal Charter 1891

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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. Through its new regulatory Board, 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 attorneys 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 Limited

C-Tech Innovation
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Leading innovation management and technology development company.
We help companies, universities, government bodies and non-governmental organisations to benefit and grow through innovation. Vast experience of project and programme management, implementation of novel technologies, contract and collaborative research and technology development, business and technology consultancy, commercialization, IP exploitation, market and sector research. **www.ctechinnovation.com**

Eli Lilly and Company Ltd

Lilly
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Lilly UK is the UK affiliate of a 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.

EngineeringUK

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EngineeringUK is an independent organisation that promotes the vital role of engineers, engineering and technology in our society. EngineeringUK partners business and industry, Government and the wider science and technology 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.

The Food and Environment Research Agency

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The Food and Environment Research Agency's over arching purpose is to support and develop a sustainable food chain, a healthy natural environment, and to protect the global community from biological and chemical risks.

Our role within that is to provide robust evidence, rigorous analysis and professional advice to Government, international organisations and the private sector.

GAMBICA Association Ltd

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GAMBICA Association is the UK trade association for instrumentation, control, automation and laboratory technology. The association seeks to promote the successful development of the industry and assist its member companies through a broad range of services, including technical policy and standards, commercial issues, market data and export services.

The Geological Society

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The Geological Society is the national learned and professional body for Earth sciences, with 10,000 Fellows (members) worldwide. The Fellowship encompasses those working in industry, academia and government, with a wide range of perspectives and views on policy-relevant science, and the Society is a leading communicator of this science to government bodies and other non-technical audiences.

Institute of Food Science & Technology

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IFST is the independent qualifying body for food professionals in Europe. Membership is drawn from all over the world from backgrounds including industry, universities, government, research and development and food law enforcement.

IFST's activities focus on disseminating knowledge relating to food science and technology and promoting its application. Another important element of our work is to promote and uphold standards amongst food professionals.

The Institute of Measurement and Control

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The Institute of Measurement and Control provides a forum for personal contact amongst practiioners, publishes learned papers and is a professional examining and qualifying organisation able to confer the titles EurIng, CEng, IEng, EngTech; Companies and Universities may apply to become Companions. Headquartered in London, the Institute has a strong regional base with 15 UK, 1 Hong Kong and 1 Malaysia Local Section, a bilateral agreement with the China Instrument Society and other major international links.

IOP Institute of Physics

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The Institute of Physics is a scientific charity devoted to increasing the practice, understanding and application of physics. It has a worldwide membership of more than 36,000 and is a leading communicator of physics-related science to all audiences, from specialists through to government and the general public. Its publishing company, IOP Publishing, is a world leader in scientific publishing and the electronic dissemination of physics.

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 30,000 members.

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Institution of Civil Engineers

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ICE aims to be a leading voice in infrastructure issues. With over 80,000 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 including infrastructure, energy generation and supply, climate change and sustainable development.

Institution of Engineering Designers

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The only professional membership body solely for those working in engineering and technological product design. Engineering Council and Chartered Environmentalist registration for suitably qualified members. Membership includes experts on a wide range of engineering and product design disciplines, all of whom practise, manage or educate in design.

The Institution of Engineering and Technology

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The IET is a world leading professional organisation, sharing and advancing knowledge to promote science, engineering and technology across the world. Dating back to 1871, the IET has 150,000 members in 127 countries with offices in Europe, North America, and Asia-Pacific.

Institution of Mechanical Engineers

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The Institution provides politicians and civil servants with information, expertise and advice on a diverse range of subjects, focusing on manufacturing, energy, environment, transport and education policy. We regularly publish policy statements and host political briefings and policy events to establish a working relationship between the engineering profession and parliament.

LGC

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LGC is an international science-based company and market leader in the provision of analytical, forensic and diagnostic services and reference standards to customers in the public and private sectors.

Under the Government Chemist function, LGC fulfils specific statutory duties as the referee analyst and provides advice for Government and the wider analytical community on the implications of analytical chemistry for matters of policy, standards and regulation. LGC is also the UK's designated National Measurement Institute for chemical and biochemical analysis.

With headquarters in Teddington, South West London, LGC has 27 laboratories and centres across Europe and at sites in China, Brazil and India.

The Linnean Society of London

The Linnean Society of London
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The Linnean Society of London is the world's oldest active biological society. Founded in 1788, the Society takes its name from the Swedish naturalist Carl Linnaeus whose botanical, zoological and library collections have been in its keeping since 1829. The Society continues to play a central role in the documentation of the world's flora and fauna, recognising the continuing importance of such work to many scientific issues.

London Metropolitan Polymer Centre

Sir John Cass Faculty of Art, Media & Design

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The London Metropolitan Polymer Centre provides training, consultancy and applied research to the UK polymer (plastics & rubber) industry. LMPC is one of the departments within the Sir John Cass Faculty of Art, Media & Design (JCAMD) and provides a broad perspective of materials science and technology for the manufacturing and creative industries. JCAMD contains Met Works, a unique Digital Manufacturing Centre, providing new technology for rapid prototyping and manufacture. The Faculty will offer short courses in a range of polymer, rapid prototyping and practical areas.

MERCK SHARP & DOHME

UK Subsidiary of Merck & Co., Inc

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Merck Sharp & Dohme Limited (MSD) is the UK subsidiary of Merck & Co., Inc., of Whitehouse Station, New Jersey, USA, a leading research-based pharmaceutical company that discovers, develops, manufactures and markets a wide range of innovative pharmaceutical products to improve human health. Our mission is to provide society with superior products and services by developing innovations and solutions that improve the quality of life.

The National Endowment for Science, Technology and the Arts

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NESTA is the National Endowment for Science, Technology and the Arts – an independent organisation with a mission to make the UK more innovative. It operates in three main ways: by investing in early-stage companies; informing and shaping policy; and delivering practical programmes that inspire others to solve the big challenges of the future. NESTA's expertise in this field makes it uniquely qualified to understand how the application of innovative approaches can help the UK to tackle two of the biggest challenges it faces: the economic downturn and the radical reform of public services.

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 History Museum

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We maintain and develop the collections we care for and use them to promote the discovery, understanding, responsible use and enjoyment of the natural world.

We are part of the UK's science base as a major science infrastructure which is used by our scientists and others from across the UK and the globe working together to enhance knowledge on the diversity of the natural world.

Our value to society is vested in our research responses to challenges facing the natural world today, in engaging our visitors in the science of nature, in inspiring and training the next generation of scientists and in being a major cultural tourist destination.

The Nutrition Society

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Founded in 1941, The Nutrition Society is the premier scientific 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. Disseminating scientific information through its programme of scientific meetings and publications
2. Publishing internationally renowned scientific learned journals, and textbooks
3. Promoting the education and training of nutritionists
4. Engaging with external organisations and the public to promote good nutritional science

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PHARMAQ is the only global pharmaceutical company with a primary focus on aquaculture. Specialising in the supply of veterinary pharmaceuticals for the salmon and trout farming industries including vaccines, anaesthetics, antibiotics and sea lice treatments. In the UK we also support an extensive range of biocides and cage and aviary products.

The Physiological Society

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Physiology is the science of how humans and other animals function in an integrated way and is the basis for many biological and clinical sciences. Founded in 1876, The Physiological Society is a learned society with over 2,900 Members drawn from over 60 countries. The majority of Members are engaged in research, in universities or industry, into how the body works.

Plymouth Marine Sciences Partnership

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The Plymouth Marine Sciences Partnership comprises seven 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. PMSP research addresses the fundamental understanding of marine ecosystems and processes that must be applied in support and development of policy, marine and maritime industry and marine biotechnology.

Prospect

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Prospect is an independent, thriving and forward-looking trade union with 122,000 members across the private and public sectors and a diverse range of occupations. 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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Founded in 1976, The Royal Academy of Engineering promotes the engineering and technological welfare of the country. Our activities – led by the UK's most eminent engineers – develop the links between engineering, technology, and the quality of life. As a national academy, we provide impartial advice to Government; work to secure the next generation of engineers; and provide a voice for Britain's engineering community.

Royal Botanic Gardens, Kew

RBG Kew is a centre of global expertise in plant and fungal diversity, conservation and sustainable use housed in two world-class gardens. Kew receives approximately half of its funding from government through Defra. Kew's Breathing Planet Programme has seven key priorities:

- Accelerating discovery and global access to plant and fungal diversity information
- Mapping and prioritising habitats most at risk
- Conserving what remains
- Sustainable local use
- Banking 25% of plant species in the Millennium Seed Bank Partnership
- Restoration ecology
- Inspiring through botanic gardens

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Inspiring and delivering science-based plant conservation worldwide, enhancing the quality of life

The Royal Institution

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The core activities of the Royal Institution centre around four main themes: science education, science communication, research and heritage. It is perhaps best known for the Ri Christmas Lectures, but it also has a major Public Events Programme designed to connect people to the world of science, as well as a UK-wide Young People's Programme of science and mathematics enrichment activities. Internationally recognised research programmes in bio- and nanomagnetism take place in the Davy Faraday Research Laboratory.

The Royal Society

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The Royal Society is the UK academy of science comprising 1400 outstanding individuals representing the sciences, engineering and medicine. The 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.

The Royal Society of Chemistry

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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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Website: www.rss.org.uk

The Royal Statistical Society is a leading source of independent advice, comment and discussion on statistical issues. It promotes 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. In 2009, the RSS celebrated 175 years since its foundation in 1834.

Semta

the Sector Skills Council for Science, Engineering and Manufacturing Technologies

Contact: Customer Services
14 Upton Road
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WD18 0JT
Tel: 0845 643 9001
Fax: 01923 256086
E-mail: customerservices@semta.org.uk
Website: www.semta.org.uk

Semta's skills service for UK science, engineering and manufacturing employers

- Training needs assessment against a company's business objectives.
- Quality programmes from The National Skills Academy for Manufacturing
- A training management service.
- Access to available funding and accredited training providers.
- Research into training needs to influence governments' support for skills strategies

Society for Applied Microbiology

Contact: Philip Wheat
Society for Applied Microbiology
Bedford Heights, Brickhill Drive
Bedford MK41 7PH
Tel: 01234 326661
Fax: 01234 326678
E-mail: pfwheat@sfam.org.uk
Website: www.sfam.org.uk

*Sf*AM is the oldest UK microbiological society and aims to advance, for the benefit of the public, the science of microbiology in its application to the environment, human and animal health, agriculture and industry.

*Sf*AM is the voice of applied microbiology with members across the globe and works in partnership with sister organisations to exert influence on policy-makers world-wide.

Society for General Microbiology

Contact: Dariel Burdass
Marlborough House, Basingstoke Road,
Spencers Wood, Reading RG7 1AG.
Tel: 0118 988 1802 Fax: 0118 988 5656
E-mail: pa@sgm.ac.uk
Website: 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 Biology

Contact: Dr Mark Downs
Chief Executive
Charles Darwin House
12 Roger Street
London WC1N 2JU
Tel: 020 7685 2550

The Society of Biology is a single unified voice for biology: advising Government and influencing policy; advancing education and professional development; supporting our members, and engaging and encouraging public interest in the life sciences. The Society represents a diverse membership of over 80,000 - including, students, practising scientists and interested non-professionals - as individuals, or through learned societies and other organisations.

Society of Cosmetic Scientists

Contact: Lorna Weston,
Secretary General
Society of Cosmetic Scientists
Langham House East
Suite 6, Mill Street, Luton LU1 2NA
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

Contact: Dr James Kirkwood
Chief Executive and 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 in England Charity No: 207996

UFAW is an international, 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
Tel: 020 7222 7085
lloyda@pandsctte.demon.co.uk
parliamentaryandscientificcommittee@hotmail.org.uk
www.scienceinparliament.org.uk

Monday 14 March
SET for BRITAIN
Poster Competition and Exhibition for early-stage researchers

12.30 - 14.30	Engineering
15.30 - 17.30	Biological and Biomedical Sciences
18.30 - 20.30	Physical Sciences (Physics and Chemistry)

Thursday 17 March 10.00-13.00
Space – How can we use it?
National Science and Engineering Week Seminar
Grand Committee Room, Westminster Hall
This will be followed by a Reception in the Jubilee Room from 13.00 to 14.00 hrs.
The Meeting and Reception are co-sponsored by the Parliamentary and Scientific Committee and the Department for Business, Innovation and Skills (BIS).

Further provisional meeting dates for 2011:
Tuesday 26 April
Tuesday 17 May
Tuesday 14 June
Tuesday 12 July
Tuesday 18 October
Tuesday 22 November
Tuesday 13 December

THE ROYAL INSTITUTION

The Royal Institution
21 Albemarle Street
London W1S 4BS.

All events take place at the Royal Institution. Unless otherwise stated tickets cost £10 standard, £7 concessions, £5 Ri Members. For more information and to book tickets visit www.rigb.org

Wednesday 23 February 18.00-19.30
Science experiments
An event for both children and adults, Scientist and TV presenter Robert Winston talks about his new book *Science Experiments*.

Tuesday 22 March 19.00-20.30
The limits of science
Are there limitations to science? Nobel Prize winner Peter Medawar famously thought so, and others have supposed that science cannot poke its nose into the various sensitive spots of a supposed spiritual world. But is that in fact the case? Scientist, Peter Atkins examines the great questions of existence to see whether science is confronted by a brick wall, and if not, what it reveals.

Saturday 2 April 11.00–16.00
Family fun day: Food
There'll be a range of activities, exciting demonstrations and captivating talk for kids and families to explore the science behind the food we eat.
Tickets cost £10 adults, £5 Under 18s.

Thursday 7 April 19.00-20.30
Let there be light- sunlight, DNA and skin ageing
Paul Matts, Research Fellow at P&G Beauty and Mark Birch Machin, Professor of Molecular Dermatology discuss new insights into the effects of UV exposure within the skin cells, the visible effects on skin ageing and perception of age, health and attractiveness, and most importantly what can be done to prevent the damage.

Tuesday 19 April 19.00-20.30
Zero degrees of empathy: a new theory of human cruelty
Psychologist, Simon Baron-Cohen presents a new way of understanding what it is that leads individuals down negative paths, and challenges all of us to consider replacing the idea of evil with the idea of empathy-starvation.

THE ROYAL SOCIETY

The Royal Society hosts a series of free events, both evening lectures and two-day discussion meetings, covering the whole breadth of science, engineering and technology.

All Royal Society lectures are available from the Royal Society website. The collection includes over 200 lectures with speakers including David Attenborough, Ottoline Leyser and James Lovelock. Details of all of these plus our forthcoming events programme can be found at royalsociety.org

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

THE ROYAL SOCIETY OF CHEMISTRY

For details please contact Dr Stephen Benn
benns@rsc.org

ROYAL SOCIETY OF EDINBURGH

22-26 George Street
Edinburgh EH2 2PQ
Tel: 0131 240 5000
events@royalsoced.org.uk
www.royalsoced.org.uk

BRITISH SCIENCE ASSOCIATION

Friday 11 – Sunday 20 March
National Science & Engineering Week
As part of National Science & 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 coordinated by the British Science Association in partnership with EngineeringUK and funded by the Department of Business, Innovation and Skills (BIS).
Visit www.nsew.org.uk for further information, including an online programme of events, or contact nsew@britishscienceassociation.org.

Wednesday 25 and Thursday 26 May
Science Communication Conference at King's Place, London
The annual Science Communication Conference addresses the key issues facing science communicators in the UK and brings together people involved in public engagement. For further information visit:
http://www.britishscienceassociation.org/ScienceCommunicationConference/

ROYAL PHARMACEUTICAL SOCIETY

events@rpharms.com
Tel: 0845 257 2570
www.rpharms.com

Monday 21 – Wednesday 23 February
Stability testing of pharmaceuticals
A three-day residential course organised by the Royal Pharmaceutical Society in partnership with the Academy of Pharmaceutical Sciences.
at the Moller Centre, Cambridge

Tuesday 15 March
Biomarkers 2011: Analytical challenges in the qualification and validation of pharmacodynamic biomarkers
Joint Pharmaceutical Analysis Group
at the Royal Society of Chemistry, London

Thursday 24 March
Counterfeit medicines: the regulatory and industry challenges
Joint Pharmaceutical Analysis Group
at the Royal Pharmaceutical Society, London

Tuesday 5 April
The 12th joint conference on the Qualified Person: professional development symposium
A joint conference organised by the Royal Pharmaceutical Society, the Society of Biology and the Royal Society of Chemistry.
at the Royal Pharmaceutical Society, London

Sunday 15 – Thursday 19 May
The 13th advanced level workshop on PK/PD data analysis
An advanced and well-established four-day residential course organised by the Royal Pharmaceutical Society in partnership with the Swedish Academy of Pharmaceutical Sciences, at the Moller Centre, Cambridge

Wednesday 25 May
International clarke's conference on analytical toxicology
A one day conference organised by Royal Pharmaceutical Society in association with the FSS, JPAG, LTG, and ChromSoc
at the Royal Pharmaceutical Society, London

THE LINNEAN SOCIETY OF LONDON

Burlington House
Piccadilly
London W1J 0BF
Tel: +44 (0)20 7434 4479 ext 11
www.linnean.org
Unless otherwise stated events are held at the Linnean Society of London

Thursday 17 March 18.00
What's so special about British Mammals?
Pat Morris FLS

Thursday 24 March 14.00
Strain-induced assembly hypothesis and the growth of form
David Knight (meeting organised by Andrew Packard FLS)

Thursday 14 April 18.00
Seeing REDD: Science, Policy and Politics in Biodiversity and Climate Change
Peter Bridgewater FLS

Thursday 12 May Day meeting
Visions from the Blind Seer of Ambon – A Celebration of Georg Everard Rumphius (1627-1702) and his Amboinese Herbal
Pieter Baas

SCIENCE IN PARLIAMENT sip
3 Birdcage Walk, London SW1H 9JJ
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semta

The Sector Skills Council
for Science, Engineering and
Manufacturing Technologies

Right People

Right Skills

Right Time

Invest in skills for the future

Research shows companies that invest in the skills of their workforce are two and a half times more likely to survive tough times than those who don't.

Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies, can help you identify your company's skills needs, provide solutions and help you to access funding for skills investment. Its National Skills Academy for Manufacturing delivers an independent national standard for manufacturing training content, delivery and process by focusing on business return which is typically 6:1.

The National Skills Academy
FOR MANUFACTURING

To find out more about how Semta can help your company contact **Semta Customer Services**:
T: **0845 643 9001** E: **customerservices@semta.org.uk**

www.semta.org.uk
www.nsa-m.co.uk