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Autumn 2010

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Initially people will be swayed by the argument that the Department of Business (BIS) have done well to protect the science from cuts, but of course there are cuts. Not as severe as predicted but flat cash will be about a 10% real terms reduction over the spending round which, taken with other changes will result in a net reduction in science activity even with the most optimistic efficiency savings.

Those of us outside the golden triangle will be looking enviously at the capital projects confirmed by the chancellor; the UK Centre for Medical Research and Innovation (UKCMRI), the MRC Laboratory of Molecular Biology (LMB), the Institute for Animal Health (IAH) at Pirbright and the Diamond synchrotron on the Harwell Science and Innovation Campus. These are all welcome commitments. But all of this occurs within an overall resource saving within BIS of 25%, comprising 40% savings from the reform of Higher Education and an average of 16% savings from the other areas of the Department's budget. The effect of these, added to the restrictions imposed by the Home Office on overseas students and researchers plus cuts in the budgets of every other department that funds its own science, (with the possible exception of health) means that there will be real pressure on almost every institution in the country.

My plea to those charged with distributing the available money during this period is to not to forget their responsibilities towards the whole of the UK.

Financial pressures on manufacturers to reduce their use of energy and other hidden costs, especially the loss of the rebate for carbon reduction, in the CSR, plus the uncertainty around regional support mechanisms mean it is far from clear that growth in the private sector will be sufficient to offset public sector job losses. The excellent partnerships that I see between our academic and industrial sector will not be able to support the quality science and engineering if the axe is too large.

Finally, I was delighted to see the Mersey Gateway bridge get the go ahead. It is hugely important to the NW economy but it does illustrate why you have to invest to save. The modeling shows the beneficial impact to the economy so it will be money well spent. But even today at the design stage we need to invest. Our home based engineering talent can, I am sure, solve the challenges and ensure that issues ranging from design to the toll collection to maintenance are cost effective – if we invest in the necessary research today!

Andrew Miller MP
Chairman, Parliamentary and Scientific Committee

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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.

The Parliamentary and Scientific Committee

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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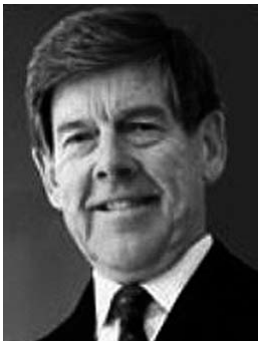
DIAMOND - ENHANCING THE SCIENCE BASE AND INDUSTRIAL COMPETITIVENESS



Lord Broers

Science and engineering are vital to our long-term economic prosperity. The Government faces tough choices, but it is essential that we continue to invest intelligently in our research infrastructure in order to maintain the UK's position as a world leader in science, and at the same time to improve the way we develop technological innovation for industry.

At a time when other advanced countries are investing more in their science base, ministers and business leaders understand that radical cuts in public spending are likely to severely damage our global competitiveness. This is not simply a matter of national prestige, but of economic necessity. The prospect of having to do more with less means that we have to focus our publicly-funded research in areas where we can both advance science and help industry innovate. Simple assessments of impact alone are not sufficient.

Vince Cable has recently called for a modified version of the Technology and Innovation Centres recommended by the Hauser review. I believe this is the right approach, and the vision for a national network of well-funded technology centres focused on areas of clear technical leadership and commercial promise, is one many of us share. Our resources need to be concentrated if we are to be internationally competitive. Cable also cited the Harwell Research campus as an effective example of 'business driven high technology clusters with academic links'. This reflects the increasing focus on industry of facilities such as the ISIS neutron source and the Diamond Light Source

synchrotron, the UK's largest science project of recent years. The light from Diamond, which extends in wavelength from infra-red light to hard X-rays, is used to enable a huge range of analytical and microscopical techniques.

The work of Diamond supporting R&D in leading companies including Rolls Royce on aerospace and energy applications, Pfizer and GlaxoSmithKline on drug discovery and development, and Johnson Matthey on improved emissions control catalysts, was also highlighted by David Willetts at the Royal Institution earlier this summer. He cited Diamond as an example of how publicly funded R&D boosts economic performance, and emphasised the importance of government support for such shared facilities.

Diamond now works with almost 30 companies. For example, Evotec is working on neurodegenerative disease and anti-infective drug discovery. Vertex, a global biotechnology company, uses the synchrotron in the design and manufacture of important new drugs that have progressed into advanced pre-clinical studies to treat major diseases. Cambridge-based Vernalis is using X-ray macromolecular crystallography to assess potential cancer treatments.

Jointly funded by STFC and the Wellcome Trust, Diamond is a good example of how a large-scale national research facility can effectively support both basic science and engineering applications across a wide range of fields. Armed with pioneering techniques in spectroscopy, x-ray diffraction, nanoscience, macromolecular crystallography, optics and magnetism, researchers at Diamond are not only advancing our knowledge of the finest details of the world around us, but are also providing advanced techniques that enable the development of new processes and products for commercialisation.

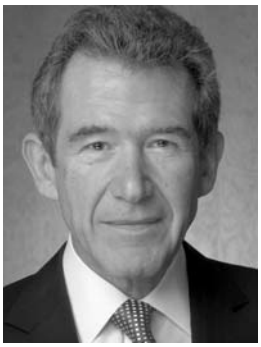
Since opening its first experimental beamlines in 2007, Diamond has rapidly expanded its capabilities and now works with over 2,000 leading researchers from around the UK. Scientific output increased by nearly 30% over the past year, with 2,700 user visits, and 887 papers and journal articles have now been published.

Working across the spectrum of physical, material and life sciences, Diamond also provides a platform for multidisciplinary collaborative work in areas such as drug design, materials engineering, nanotechnology, renewable energy technologies, environmental remediation and conservation of heritage artefacts such as the Mary Rose. Collaboration is the key to Diamond's success. Academic and industry partners are closely involved in the development and refinement of new technology, and in the operation of the synchrotron. New experimental stations are being developed on a partnership basis, such as the innovative Joint Engineering and Environment Processing beamline where it will be possible to examine industrial components several metres in size.

There are 18 experimental laboratories, so called beamlines, now operating at Diamond, and this is set to grow to 22 by 2012. Demand for beam time is intense, and a peer-reviewed application process ensures that only the most promising proposals are taken forward. Industry research for proprietary applications is set aside separately. Funding for Phase III, which looks at fully maximising the facility with an additional 10 advanced beamlines, will increase the scientific capabilities by some 45% for a further investment of under 25% of the original costs. Much of this research can only be done at Diamond.

Overall Diamond is well positioned to consolidate the UK's leadership in synchrotron based scientific research and enhance its capabilities as a platform for commercially useful innovation and knowledge transfer.

SEVEN POINT PLAN – AN INDUSTRIAL STRATEGY FOR UK COMPETITIVENESS



Lord Browne of Madingley
FREng FRS
President, Royal Academy of Engineering

A post-election summit, hosted by The Royal Society and The Royal Academy of Engineering, in May 2010, looked at the most pressing issues for the new government to address. At the summit, the following seven point plan for creating an innovation economy was presented.

The long term health of the UK economy will depend on our ability to compete successfully with other technologically advanced and entrepreneurial emerging nations, particularly in the hi-tech and lower carbon industries of the future.

I would like to offer some thoughts about what can be done to re-tool the British economy for economic growth based on science and innovation.

We have many cards in our favour. Britain leads the world in a number of fields including small satellites, aerospace, life sciences and creative design. We have world-class research facilities and world-class businesses – both small and large – capable of exploiting it.

But our track record of turning British ideas into substantial business successes is not exemplary. Time and time again, ideas generated in the UK end up being exploited commercially overseas. Improving on this track record must become a priority if we are going to build a balanced economy. It has as much to do with improving our commercial and entrepreneurial skills as it does with inventing new technologies. Moreover, British companies must now compete with a growing array of global players, not just from America and Europe, but from China and India as well.

The Coalition Government has made clear that its immediate priority is to reduce the budget deficit. But decisions must be taken with a clear vision for the future.

Policymakers agree that a diverse, knowledge-based economy is the best platform for British businesses to compete in the hi-tech and lower-carbon industries of the future. And they agree that, while businesses remain the prime vehicle for wealth creation, government can do a lot more to foster the right climate for success. But there is confusion about exactly what government should be doing to help.

The scale and urgency of the change needed means it cannot be left to chance, the priority must be to create an enabling environment in which business and industry can flourish. This will provide fertile ground on which new technologies can thrive. We need an industrial strategy that aligns policy, investment, effort and culture across government departments and brings business into the decision-making process.

Improving competitiveness is not about picking winners – either technologies, companies or products. But it is about supporting strategic sectors where the UK can enjoy a competitive advantage.

Policymakers should focus on seven areas.

First, government can support business by ensuring that there are sufficient numbers of people with the right skills. In a global competition for talent the most innovative businesses are determined by the quality and diversity of their workforce.

Second, we need to keep ideas flowing by funding the best quality scientific and engineering research and researchers. We then need an urgent and serious debate on what other research we can afford.

Third, even the best research needs support to bring ideas out of the lab and into the market. Government can play a significant role in building systems to help bridge that gap.

Fourth, only a stable policy climate will give business the confidence to invest over the long term. That includes an enabling regulatory framework to provide signals to business, encouraging experimentation and innovation.

Fifth, more tangible incentives will be needed – whether through tax regimes, capital grants or seed funding, or a combination of all of the above. These incentives will work best when they are transparent and accessible to small companies as well as large ones.

Sixth, government should recognise its influence as a customer in supporting new technologies and enabling new companies to grow. Public procurement must be used as much as a tool for encouraging innovation as for driving down costs.

And seventh, all of this must be rolled into a coherent policy framework, managed, measured and continually refined.

On the other hand, there are some areas where it makes less sense for government to take a lead. For instance, it is important that policymaking draws on this country's rich vein of scientific and engineering expertise. Technology councils, businesses and, of course, the national academies are full of people with skills in management, research and problem solving. The government should make full use of these outstanding human resources.

There is also an issue of culture. Young people still view science and engineering as somehow quite boring – something that uninspiring people do behind a desk or laboratory table. This is an area where the scientific community must take a firmer lead, encouraging its great people to get out there and communicate: through the media, in schools and colleges. We are doing this at The Royal Academy of Engineering, but we can – and will – do more in the future.

Great innovation occurs when science and engineering meet business and enterprise – where people can face in two directions at once, translating the fruits of scientific research into opportunities to create wealth and jobs. That is not a job for government, but it is an area where government can play a useful leadership role, fostering an environment that harnesses the natural power of business to innovate.

The state of the UK economy is the overwhelming concern of government and the nation, and the available Science and Research budget should be targeted where it will have most impact in the foreseeable future, as far as possible without compromising unforeseen developments. Future potential will never be realised if the nation has not created the means to exploit it.

That is how to create an innovation economy. The seven-point plan delivers this and I wholeheartedly recommend it to our government.

WHY SUSTAINABILITY IS THE KEY TO EFFECTIVE, INTEGRATED HEALTHCARE

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OUR DISEASE BURDEN

There is a fundamental disconnect between the healthcare needs of individuals in our contemporary society and that which, in the main, is presently being delivered. Derek Wanless, in his 2004 report to the UK Government on the future needs of the National Health Service (NHS), commented that the NHS had become a 'national sickness service' rather than a 'national health service'.[1]

Wanless upheld that the NHS remained medically driven and preoccupied with inpatient services. He also said that the low level of patient engagement in personal health was unsustainable. He proposed three possible models for the reform of healthcare, the most efficient being one in which the individuals are 'fully engaged' in relation to their health. Such a scenario was claimed, amongst other things, to extend life expectancy beyond current forecasts, as well as lead to a dramatic improvement in health status. Aside from this, Wanless' fully engaged scenario was considered the cheapest to implement, and the only one that might be described as sustainable.

It is clear that the overall direction of the NHS has changed little since 2002. Among the multitude of reasons for this is the fact that the primary burden on healthcare is caused by chronic, noncommunicable diseases, notably heart disease, cancer, diabetes, obesity and osteoporosis, all of which are multi-factorial in nature and strongly associated with diet and lifestyle patterns.[2] The World Health Organization (WHO) estimated that mortality, morbidity and disability attributed to the major noncommunicable diseases

would account for about 73% of all deaths and 60% of the global burden of disease by 2020.[3] In developed countries, such as the UK, the burden would be higher still given the lower incidence of infectious diseases.

The WHO has also opined that these chronic diseases, being strongly correlated to diet, lifestyle and physical activity, are largely preventable.[2] Their rapidly increasing rate is attributed particularly to factors such as recent changes in food production and processing, as well as to shifts in agricultural and trade policy. Additionally, alterations in living and working patterns, born out of the 'computer age', have led to less physical activity and less physical labour for the vast majority of people in our society.[2]

Despite the WHO's recommendations to governments, heralded by its launch in 2004 of the Global Strategy on Diet, Physical Activity and Health,[3] there has been negligible change at governmental or societal levels to address the identified failings in healthcare policy.

PROBLEM 1: DRUGS AS THE KEY TOOLS IN CONVENTIONAL HEALTHCARE

Drugs are licensed medicinal products used to prevent or treat disease. Most, however, treat only symptoms rather than the cause of disease. For the last few decades, most drugs used have been patented by one of only a small number of transnational corporations, and most can also be characterised as being 'new-to-nature'. Accordingly, given our lack of evolutionary adaptation to such chemicals, serious side effects are the norm rather than the exception.

It has been estimated that in the UK, adverse drug reactions cost the NHS £2 billion annually.[4] A recent Swedish study has revealed that 3% of Swedes die from adverse drug reactions, making them the seventh most common cause of death in the country.[5]

In the USA, deaths from preventable medical and surgical injuries,[6] preventable infections in hospitals[7] and adverse drug reactions which follow the non-error prescription of drugs[6] combine as the third leading cause of death. The situation appears more or less similar in most other western countries.

Aside from the deleterious effects of many drug-based treatments, ongoing evaluation by BMJ's Clinical Evidence group currently suggests that only 11% of orthodox medical treatments have been shown to have beneficial effects.[8] These data are submitted at 6-monthly intervals directly to the NHS Health Technology Assessment Programme (HTA). Furthermore, Dr Allen Roses, vice president of genetics for the UK's largest pharmaceutical company, GlaxoSmithKline, admitted in 2003 that: "…the vast majority of drugs – more than 90 per cent – only work in 30 or 50 per cent of the people"[9].

The clear lack of relative effectiveness of new-to-nature drug-based modalities, their high cost, the scarcity of new drugs in the pharmaceutical industry's R&D pipeline and the fact that most patents for 'blockbuster' drugs will expire by 2013,[10] strongly point to the need for a radical change in our society's approach to the management of our health.

PROBLEM 2: HEALTHCARE SERVICES

Given that chronic diseases disproportionately impact older populations and in turn take many years, often decades, to manifest, it is deeply inefficient to focus the bulk of the 'healthcare service' on the chronically diseased population. Disease prevention, as proposed by Wanless, WHO and numerous others, is a substantially more efficient and effective approach. In order to implement preventative healthcare as the primary approach, the existing system of primary care, particularly as applied by physicians in general practice, would need to be abandoned.

Even from a disease management perspective, the existing average 10-minute consultation provided by a single medically-trained practitioner is simply not sufficient to deal with complex diseases and disorders, especially given that older patients typically present with co-morbidities. There is presently no capacity for the provision of disease prevention services, nor is there adequate training in this area among mainstream healthcare providers.

It is well recognised that healthcare providers in the field of integrated healthcare (sometimes also considered as 'complementary and alternative medicine' [CAM]), are generally much more concerned with disease prevention than orthodox healthcare providers. Most integrated or 'unconventional' healthcare providers will integrate nutrition and lifestyle advice as adjuncts alongside any other modality or modalities which they are specifically trained to offer. Face-to-face consultations between integrated healthcare providers and patients or clients are often substantially longer than those in general practice. Based on limited data, extending the time of primary care physician's consultations alone appears not to yield significant improvements in diagnosis or patient outcomes.[11] This is likely to be the result both of deficiencies in diagnostic capabilities as well as treatments offered.

The perceived lack of an adequate evidence-base, coupled with powerful resistance to integrated healthcare modalities by a highly vocal, media-savvy minority of opinion leaders in the field of orthodox medicine, continues to provide a barrier to better integration of multi-factorial, non-drug approaches to healthcare.

Even more fundamentally, the disconnection that exists between healthcare policy, lifestyle and food production technologies means that only very small sectors of the population are truly able to embrace sustainable, 'fully engaged' approaches to healthcare that dramatically reduce disease incidence. The paucity of studies on the effects of high levels of engagement in personal health, along with the effects of appropriate dietary choices and lifestyles, have not been prioritised in research. A major reason for this is the lack of commercial incentive to fund such research.

THE GULF IN VIEWPOINTS

The huge gulf in opinion between protagonists of conventional and unconventional approaches to healthcare does nothing to facilitate better integration of

non-drug based healthcare and preventative healthcare approaches into the mainstream.

In fact, if anything, these contrasting viewpoints have become increasingly polarised. One reason for this is a misrepresentation of 'unconventional' approaches by those adopting a restricted approach to evidence-based medicine (EBM). Such a limited approach to evaluation of unconventional therapies is epitomised in Singh and Ernst's 2008 book *Trick or Treatment? Alternative Medicine on Trial.*[12] The approach is deficient scientifically.[13] Although discussion of the scientific deficiencies of methods of evaluation used is beyond the scope of the present article, the results of experimental trials relied upon cannot be applied to the effectiveness of a given modality in real life. The positive experience among members of the public of alternative medicine modalities, along with nutritional approaches (that have never been evaluated by Professor Ernst and colleagues) is one reason why a large sector of the public fails to be discouraged from using these modalities despite adverse media reports.

It should also be recognised that the originators of the EBM concept have complained that the concept has been misused through its over-reliance on randomised trials, to the exclusion of other forms of evidence, such as observational evidence and, in particular, clinical experience.[14]

TOWARDS A SUSTAINABLE HEALTHCARE PARADIGM

The concept of sustainability has been applied to agriculture, forestry, energy and an increasing number of other areas of human endeavour. Generally, sustainable approaches are those that work in accordance with, rather than against, natural processes. Lip service has been applied to sustainability in healthcare, but, as yet, there has been no major effort from either government or industry to instigate an approach to healthcare that, in the broadest sense, is sustainable.

The first step in developing such an approach is full recognition of the lack of sustainability in existing approaches. A second step is the identification of those factors that contribute to the most unsustainable aspects of the healthcare system. Thirdly, an appropriate scientific and regulatory framework is needed.

In the present article, six such factors contributing to lack of sustainability have been identified, these being:

- Inadequate emphasis on disease prevention among primary care providers;
- Lack of engagement in personal health management by individuals;
- Lack of adequate education and training of the public and healthcare providers in methods of disease prevention;
- Over-reliance on expensive, relatively ineffective and harmful (biologically incompatible) drugs;
- Lack of an adequate and appropriate evidence-base for sustainable, integrated (and biologically-compatible) healthcare;
- Diametrically opposed and firmly entrenched viewpoints on conventional versus alternative medicine approaches.

To increase the sustainability of our healthcare system, it is necessary to address all of these issues, among others. It is proposed that criteria for sustainable approaches to healthcare are developed so that any approach meeting these criteria, whether it involves dietary advice, use of licensed drugs, alternative modalities, nutrient or herbal supplementation, be deemed acceptable. It would be expected that such an approach would help to dissolve the existing antagonism between conventional and alternative medicine factions.

In the long term, for our healthcare system to become truly sustainable, massive shifts in critical aspects of our food and healthcare systems are required. This includes a transformation of the medical curriculum, reduced dependence on processed foods, increased reliance on regionally and locally produced whole foods, increased physical activity among all age groups, especially the young, and changes to the school curriculum to allow inclusion of nutrition, health and lifestyle training.

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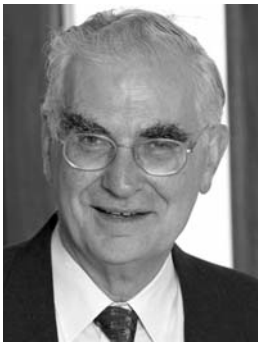
SCIENCE, ENGINEERING AND POLITICS


Lord Oxburgh

INTRODUCTION

This is not a topic on which I claim to be an expert. I have never written about or studied this subject. I don't think I have ever spoken about it before. I have however engaged with this topic to some extent. The first half of my career was as an Academic Researcher, then as a Scientific Civil Servant and more recently in Business, so I have been a little bit involved. The first thing to say is that policymakers, politicians and businessmen need professional advice in a number of areas. You can think of Law, Accountancy and Economics, and then Science comes into this spectrum. I suppose what is different about Scientists is that those receiving their advice generally have much less familiarity with the general area than they might have with the others. And for that reason we are a little bit more unconfident about dealing with it.

DIFFERENCES BETWEEN SCIENTISTS AND BUSINESS PEOPLE

Let me start with an observation which sounds pretty banal but I think is quite important and I will illustrate it with a story. And that is because there is a fundamental difference in the outlook between the Scientific Community and most of those with whom they interact. Fundamentally, Scientists, and Research Scientists in particular, are interested in what isn't known, – what has still to be discovered, and what still has to be found out. The rest of us, – and I put myself on the other side for the moment – Business, Civil Servants, Government, – are much more concerned with what is known. And this may sound a silly distinction – but let me give you an example. About five years ago Columbia University Business School in conjunction with their Earth Science Department decided that something dramatic had got to be done about Climate Change by engaging with US Business. They organised a big meeting and managed to pull in senior representatives from CEO level and to the next level down from eighty of the biggest one hundred companies in the US, and a stellar cast of seven expert speakers on Climate Change – and I was the eigth speaker invited, but not as an expert on Climate Change, but speaking on behalf of "the acceptable face of business" on this occasion. Speeches were given by the experts, which were outstanding research talks. While the current knowledge base was taken as read, or delivered in a rather summary fashion, the main emphasis of all of the talks was almost entirely focused on the additional research which still remained to be done to resolve aspects of the fine detail of Climate Change and not the fundamentals. By lunchtime, the leaders of business were saying that they were all very surprised because they had thought that all this was cut and dried – and that all the relevant information concerning Climate Change was already known! And, by early afternoon, a number of them had left the meeting. I came on at the very end and tried to recover the situation. But by that time the Business Community, as represented there, was satisfied that the science was totally uncertain and that a great more needed to be done. That was simply the result of both a cultural and a difference of approach between two very different communities, and it is one which is very frequently

never really appreciated by we scientists.

PUBLIC POLICY AND RESEARCH

From the Business point of view Research is a Cost. From a Business or Government viewpoint research costs should be limited to those which are absolutely necessary, and not a penny more, in order to be able to deal with a specific issue of governance, or to stay just ahead of the competition. From the researcher's point of view, some research is "good", more research is "better". And those are very, very different approaches.

RESEARCH LEADS TO GOVERNMENT POLICY

Now let us just think about public policy and research, and I think there is probably only time to deal with one of the many aspects of this intriguing topic. Let's deal with the situation in which free and open academic research has led to some quite important implications for Government policy. Fifteen or twenty years ago one might have thought of the Tobacco Industry and the work done by Sir Richard Doll and others that really demonstrated a very clear link between smoking tobacco and lung diseases. At that time the Tobacco Industry mounted a really major attack involving questioning the research, smearing the researchers, employing professional lobbyists, with the primary goal of protecting their industry. Now, you might well expect that any industry threatened by a piece of research which implies a major change in Government policy, would question that research very thoroughly. And I think one of the interesting questions is where that questioning should end, or what the limits of that questioning are in relation to the public interest?

Another example, which is current in the US, has to do with proposed Government legislation about the sugar content of canned drinks of various sorts. But, you will also have seen in the US, that the publicity budget of the trade body concerned has increased by something like a factor of 10 over 18 months, effectively lobbying against any change whatsoever.

CLIMATE CHANGE

More recently, we have seen an example concerning Climate Change. Now, for something like twenty-five years scientific groups around the world have been working together in an informal and voluntary way as part of the Intergovernmental Panel on Climate Change (IPCC). This voluntary organisation has produced a series of reports at four to five year intervals, documenting the anthropogenic consequences of human interventions on the environment. These have become progressively more pessimist. Or looking at it another way, more confirmatory that there is a significant effect. This led on initially to the Kyoto Agreement, and more recently to the meeting in Copenhagen at which it was hoped that a new International Agreement would be reached.

As you are already aware, about six weeks before Copenhagen, the computer system servers at the University of East Anglia (UEA) Climate Group were hacked into, and a number of very damaging emails were stolen and then put on the Web. It appears that about the same time as the UEA server was hacked into, attempts were also made to hack into the servers of three or four other Climatic Research Institutes worldwide, which however were unsuccessful. Certainly, the publication of the material from some of the UEA emails was extremely damaging. It was damaging for two reasons, first of all because email conversations are extremely difficult to interpret, and secondly because these email conversations contained a great deal of material which really were the sort of thing that people might talk casually over a coffee machine, but not the sort of thing which they would ever dream of going into the public domain. And these revelations were "manna from heaven" to those who wished to discredit the arguments for Climate Change. The fact is, of course, that three different enquiries in this country and one in Holland have now disproved the most serious allegations concerning the UEA researchers, namely that they had been dishonest, and had contrived the presentation of their observations in order to appear to justify a particular conclusion. I don't think anyone who has looked at the evidence carefully thinks that is the case. They were unwise in all sorts of ways; they were perhaps not using the best methods available for their work, but in terms of deliberate deceit, all of us were convinced of their innocence. And indeed *Le Monde* had a very interesting editorial recently in which they said that we have now had all these enquiries and they have all demonstrated that the fundamentals of Climate Change have not altered. I am still waiting to see a confidently firm editorial in one of the UK newspapers.

PUBLICITY

The importance of publicity is that certain industries are clearly going to be seriously damaged if Governments take action on Climate Change. Probably the Coal Industry worldwide will be seriously damaged, but others may be as well. The question is are Governments going to be able to withstand the kind of organised pressure to which, I think, they are now being exposed? And the pressure is clever and it is subtle. Fundamentally, people in this country and other parts of the world are going to be receiving fuel bills within the next twelve months which are totally transparent, distinguishing the cost of producing the electricity and the gas which they get, from the various imposts which are there as VAT and a whole range of additional measures that are designed to address Climate Change effectively. And many people are going to see fuel bills which will be up to thirty per cent more than they would otherwise have been without the extra charges related to Climate Change. And clearly those commercial interests directly involved can take this opportunity to undermine Government initiatives by persuading people that, actually, it is all a bit uncertain. And this thirty per cent added to your bills does not really have to be there. It is just some sort of dubious scientific fallacy. That is a very serious problem for politicians!

THE COMMONS IS CRYING OUT FOR MORE SCIENTISTS – AND FOR THE EVIDENCE-BASED EXPERTISE THEY CAN BRING

Julian Huppert MP

One of the things I've most missed since becoming a Member of Parliament has been the opportunity to talk about my other life, as a science academic working in the Cavendish Laboratory in Cambridge. Remarkably, there are only two science PhDs in the Commons, myself and Dr Thérèse Coffey, the Member for Suffolk Coastal; if we widen the field to include those with any STEM degree, employment history or committee interest, then we get around 70 names, or a little over 10% of the House's composition. It is important to emphasise that there are many from non-scientific backgrounds who have worked hard to further the cause of science and technology; what is needed principally is interest, not expertise. But overall it is little wonder that evidence, the keystone of scientific and technological research, has yet to become the decisive factor in policy-making it ought to be.

As an RCUK Academic Fellow in Computational Biology, I worked on DNA structure and function, particularly on unusual, lesser-known structures that nucleic acids are capable of forming. We all know about the double helix thanks to Watson and Crick, themselves Cavendish men, but my interest was especially on four-stranded structures called G-quadruplexes and when they might form. Although much of this was fundamental, blue-sky work, it turned out to have important real applications: helping us to understand better the way that cancer cells work, leading to the development of better anti-cancer drugs. We are also hopeful that we will ultimately be able to use our other strand of research, in nano-technology, to use DNA templates to make large objects, such as improved solar panels.

Such were the esoteric surroundings from which I came to the famous green benches of the Commons. I might have been forgiven for thinking that having understood the intricacies of quantum chemistry, and coped with the Byzantine ways of the University, Colleges and Research Councils, Parliamentary life would seem rather simpler! No such luck, unfortunately: the Palace of Westminster is an even more bizarre place, a labyrinth imbued with a sense of simultaneous urgency and lethargy, where things can change either at the snap of a Minister's fingers or after years of committees, debates and divisions.

There are far more differences than similarities. Despite the influence of the plucky few who strive to further the cause of science in the Commons, there is a fundamental clash of cultures between scientific and political method. In science it is acceptable – essential, in fact – to change ideas given new evidence; in politics, any change of mind is taken as a sign of weakness, inconsistency or plain dishonesty. This isn't to say, of course, that sometimes it is not one or all of those! But the intransigence and stubbornness of some politicians can be traced to a more deep-seated problem: the deliberate dismissal of evidence in favour of head-in-the-sand ideology.

This clash of cultures can lead to some awkward situations. Consultations become less about orderly debate, based on careful consideration of available evidence, and more about scoring party political points. One recent example was the wrangling over the Coalition's proposals for fixed term parliaments, where the suggestion of a 55% figure for dissolution of Parliament was greeted by animosity and misunderstanding by some MPs, despite the widespread use of fixed terms and high dissolution thresholds in many countries around the world. A more considered response, raising legitimate questions over the purpose of fixed terms, the length of those terms and the practical arrangements for dissolution would have been more in keeping with the job Parliamentarians are supposed to be doing in holding the Executive to account. As it was, the proposals were updated in the light of criticism – only for those who had called for changes to crow about 'U-turns'!

Of course, I recognise that in politics people have an agenda

to push. That happens in science too, but thankfully less so. The challenge for people like me is to walk the line between the two worlds. Recently I had the opportunity to do just that, when the British Medical Association and the House of Commons Science and Technology Committee both called for the National Health Service to stop funding homeopathy on the basis that according to current evidence, it is no more efficacious than a placebo. The Government's response to the Committee's findings was equivocal, failing to recognise that to provide unscientific placebo "remedies" is fundamentally to mislead people, removing their right to an informed choice and undermining the trust between doctor and patient. This inability to look objectively at the evidence leads to a kind of doublethink, where the Chief Scientist at the Department for Health can conclude that "there is no plausible scientific mechanism for homeopathy", but at the same time, the DoH can claim that it "wholly supports the concept of the informed patient". By any sensible definition, these stances are contradictory, as the benefit of placebos is destroyed by informing the patient of the ineffective nature of the placebo they are being prescribed!

The report by the Science & Technology Committee, incidentally, shows what can be done if non-scientific MPs put their minds to this essential task of changing our policy-making culture. Lord Willis, the former MP for Harrogate and Knaresborough and the then Chair of the Committee, chaired it with great distinction and an admirable zeal for evidence.

Another example of ideology trumping evidence is in the area of civil liberties. The previous government's push for 'security' at all costs led to an authoritarian apparatus of jury-less secret trials, secret evidence, detention without charge, control orders, the DNA database, ID cards and more. Most egregiously, it led to the catastrophic war in Iraq, an example not of evidence-based policy but policy-based evidence; denounced by the former chief of MI5 as the cause of a huge increase in home-grown terrorist activity. In other words, it had precisely the opposite effect to the policy's aim – a clear failure, even discounting the illegality of the invasion.

We have already seen the effect of scientific illiteracy on health policy. But perhaps the most worrying thing about the lack of scientific knowledge in the Commons is that evidence-based policy is crucial in every department. On Home Affairs, for instance, there has been a lack of attention to what experts are saying about crime, or drugs policy, and successive Home Secretaries have favoured the populist, knee-jerk response. Climate change will not be taken seriously until there is a far greater emphasis on the need for sustainable transport; instead, road-building has dominated the Transport agenda for years, despite ample evidence that congestion can often worsen as a result. One ray of hope is in the Ministry of Justice, where Ken Clarke appears to have seen the light (or perhaps simply revealed his own light) on penal reform, accepting that correlation between higher prison numbers and decreasing crime levels does not necessarily imply causation.

I'm well aware of the rather gloomy picture I've painted so far. What can be done, then, to make things better? One key issue at the moment, particularly in a time of economic austerity, is funding. While we all recognise the need to tackle the deficit, we also recognise the need to do it carefully, without jeopardising the long-term prospects for our economy. STEM subjects hold particular strategic importance in this regard, and I have been working hard to ensure that leading overseas academics are still able to come and work in our country to endow our students with the skills they need, and to provide innovations that will make our economy more competitive and more sustainable.

In the short term, we need to encourage more people from STEM-based backgrounds to become part of our political discourse. It was deeply disappointing to see Dr Evan Harris lose his seat in May, and not merely because he is of my party, but because of his excellent credentials as an advocate for evidence. If scientists, mathematicians and engineers feel like fish out of water in a Commons suffused with lawyers, politicos and PR types, we are unlikely to see the sort of fundamental change in policy-making that I have advocated.

One scheme which I particularly welcomed was the Conservatives' manifesto commitment to require all new Conservative MPs to go on a science awareness course. This was an excellent idea, and one I wished had appeared in my own party's manifesto. Unfortunately the course turned out to be a one-hour seminar, interrupted by a division, and attended by only about ten MPs. Far better attended was the Royal Society for Chemistry's annual Parliamentary Links day, a good showcase for what can be done in educating MPs – several of whom attended. However, even then they were largely the usual suspects!

A lot of the onus rests on the scientific community's ability to make their arguments palatably clear to people who either have no interest in science, or are positively scared of it. The fact that this latter response exists is arguably due in part to our tendency as scientists to revel somewhat in the esoteric nature of our work. The advent of social networking websites such as Facebook and Twitter has given those of us trying to make evidence-based arguments a very powerful tool; through Twitter, for example, I can access many experts who will pull together and analyse information for me.

Another important area is that of scientific journalism. We are lucky to have in this country some excellent writers, such as Ben Goldacre and Mark Henderson, but all too often our newspapers resort to the same old binary-style reporting that leaves no room for nuance, describing everything as a wonder-drug or a terrifying killer.

Unless we in the scientific community take decisive steps to make our voices heard, whether in Parliament, in the media or elsewhere, the likelihood is that vital evidence will be ignored, and policy will continue to be based on ideological and political considerations, sometimes with disastrous consequences. For that reason, I intend to carry on beating the drum for evidence-based policy whenever possible.

Pallab Ghosh

Thank you for inviting me to speak here at your meeting. For me Science and Politics have always been intertwined. They're intertwined – because an understanding of science is empowering. It enables ordinary people to make rational choices. To see through hype and overstated claims. Key to this is the use of science and scientific advice by government. It's a system of scientific advice that's been developed in recent years by successive Chief Scientific Advisors, Lord May, Sir David King and Sir John Beddington.

ROLLS ROYCE

Their efforts have put scientific advice – not so much at the heart of government – but the veins, arteries and capillaries of the policy circulation system. Nearly each department has a chief scientist. The advisors themselves work well in a coordinated and effective manner. It's a Rolls Royce system. But I wonder how effectively it's being used. And at a time when departments are looking for savings – that Rolls that's kept too long in the garage must look very vulnerable.

HOME ALONE

Last year a survey by the Campaign for Science and Engineering showed that several secretaries of state had only sporadic contact with their department's scientific advisor, some meeting with them just once a year. Eight Secretaries of State did not meet at all with the government's Chief Scientific Advisor John Beddington. And some of the departmental advisors and former advisors I've spoken to have often expressed frustration at having to be kept in their box. They have little access to Ministers and are asked to make contributions that often don't see the light of day. Languishing and rarely retrieved files on a Whitehall server – never to see the light of day.

INCONVENIENT TRUTH

Sir John Beddington loves to quote President Obama that we should listen to advice not only when it is inconvenient – but especially when it is inconvenient. It's all very well to say that Advisors should advise and Ministers should decide. But that's only if that advice is transparent – and if that advice is rejected – the reasons should also be publicly available.

Now let's remember why the system of scientific advice was developed.

In March 1996 the Health Secretary, Stephen Dorrell announced that humans could become infected and die of eating BSE infected beef. Up until then Ministers had said beef was safe to eat.

PHILIPS REPORT

A report by Lord Phillips into the affair recommended that scientific advice in government should be independent and available to the public directly from scientists – and not be interpreted by Ministers.

In 1997 the then Government Chief Scientist, Lord May, drafted guidelines on scientific advice and policymaking in order to set out standards for the integrity of the process. And so was born our Rolls Royce system of scientific advisors, advisory committees and arms length bodies – such as the Food Standards Agency. But gradually – almost inevitably – Whitehall slipped back into its old controlling, secretive, mistake-covering ways.

FOOT AND MOUTH

In September 2007 there was a second outbreak of Foot and Mouth just days after the Government's chief Vet, Debbie Reynolds, had announced that the virus had been eradicated. The Department for the Environment Food and Rural Affairs briefed journalists that this was possibly because there had been a second leak of the virus from a nearby laboratory. A publicly funded genetic study showed that this was not true. The first outbreak hadn't gone away – Defra had simply missed cases on a nearby farm. The scientists who produced the research said that they had difficulty publishing the research because of opposition by Defra.

ORGAN DONATION

In 2008 an expert group was asked to investigate whether the system of presumed consent for organ donation would save

more lives. Gordon Brown was in favour of the plan - but the expert group concluded that it wouldn't work. They handed their report to the then Chief Medical Officer for England, Sir Liam Donaldson. He wrote an article for the Observer just days before the publication of the report – contradicting the conclusions of the report that he himself commissioned:

NDAS

Last year DEFRA published its climate impact projections – an ambitious attempt to predict the impact of climate change at a local level. Some scientists had grave doubts about the scientific basis of the projections. Defra commissioned a scientific review – but all the scientists on the review board were asked to sign legally binding non-disclosure agreements. Their review was critical and published on the same day as Defra launched its climate projections to much fanfare. The criticism is effectively buried. Some scientists are worried that government is on occasion, interfering, burying and briefing against its own independent scientific advice. Of course that happened to the former drugs advisor Professor David Nutt and the work of his committee – the Advisory Committee on the Misuse of Drugs.

NUTT STORY

As you may recall the then Home Secretary Alan Johnson sacked Professor Nutt because of what he said at a public lecture. They said that it was because he was campaigning. But the fear was that the chair of a scientific advisory committee was sacked because he was giving advice that no one wanted to hear. The episode led to 90 of the UK's leading scientists asking government to reaffirm the basic principles that arose after learning the lessons of BSE. That scientific advice should be free from political interference. I'm delighted to see that it was one of the first acts of the coalition government to make those basic principles part of the Ministerial code.

NOT ONE OFF

But as I've explained the Nutt Affair was not a one off. It was an extreme and latest case of a growing culture of complacency within government.
Officials have forgotten the lessons of the report by Lord Phillips. He knew that trust in government scientific advice was crucial. The reason that so many people – so many parts of the media wouldn't take the department of Health's advice over MMR was that there was widespread scepticism of the competence and integrity of the scientific advice from government. It had taken a decade to rebuild that trust – and it's in danger of being undermined. Not just by big falling outs between Ministers and advisors – but by more subtle and arguably more corrosive undermining of the process.

THICK OF IT

More corrosive – because it's become part of the Whitehall culture – to turn a deaf ear to inconvenient truths. No-one likes to think of themselves as being blasé about evidence or that they can't handle hearing awkward advice. But the pressures on ministers and their communications staff are very real. The Television Comedy *The Thick of It* isn't that wide of the mark – and it's when it really hits the fan their instincts are to 'control the message'. But even on calm days – small apparently harmless decisions are made not to publish the minutes of advisory committee meetings, to hold back a section of a report at DEFRA or the Home Office because of perceived media hostility .

THOUSAND CUTS

It's these thousand cuts that lead to the erosion of independent advice and breed cynicism. Chief Scientific Advisors also need to answer to the scientific community as well as their Whitehall masters. What we don't want are 'safe pairs of hands'. That's a Government's euphemism for people who tell them what they want to hear. That's great for maintaining calm in Whitehall departments but it's another threat to independent scientific advice. Another favourite Government euphemism to watch out for is being told that something you have raised is 'unhelpful' or 'taking us in the wrong direction'.

OUR RESPONSIBILITY

In other words it doesn't fit with the message. So are we left to be ground down – by Whitehall reverting to type? Or do we take responsibility and keep our policy makers under scrutiny. Among the science journalism media we are taking responsibility. The Association of British Science Journalists organised a conference just down the road at Westminster Central Hall last year – to raise standards of science journalism. Not just to explain complicated things better – but to change our culture – to what I've called a more kick-ass approach to science Journalism – to scrutinise claims made even by the most revered scientific bodies.

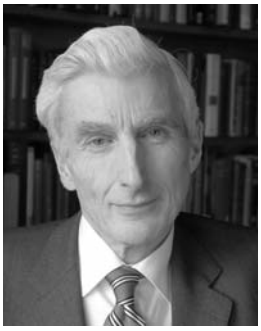
WICKED WAYS

And we are spreading our wicked ways. The Association of British Science Writers is affiliated to 40 science journalism associations across the world through the World Federation of Science Journalists. We're training African science journalists through a five million pound mentoring scheme – funded with the kind support of DFID and Canada's IDRC. Already we're producing African journalists writing and broadcasting about science issues relevant to them in African media. We're creating more kick-ass journalists. We're creating more associations of science journalism. While we are grateful for the resources we are offered by scientific bodies to "better cover" scientific issues.

NOT CHEERLEAD

But it's important that science journalists have our own conversation. Because we are here to scrutinise – not to cheerlead. Our motto at the World Federation is "Empowerment through (Science) Journalism". Science and science advice for me is what keeps our policies honest. It's too precious, too important to be undermined and hacked about with by apparatchiks. It's time to dust down and wheel out the Rolls Royce system we have in the Whitehall Garage.

THE ROYAL SOCIETY'S 350TH ANNIVERSARY



Martin Rees
President of the Royal Society

The Royal Society's 350th anniversary has offered us a pretext to learn more about its origins, and to appreciate more fully how science and technology have transformed everyone's lives.

At the Society's earliest meetings Christopher Wren, Robert Hooke, Samuel Pepys, and other 'ingenious and curious gentlemen' (as they described themselves) viewed all kinds of experiments, sometimes rather gruesome ones – blood transfusions and the like. They peered through newly-invented telescopes and microscopes; they heard travellers' tales, and dissected weird animals. They were, in Francis Bacon's phrase, 'merchants of light '– seeking knowledge for its own sake. Their curiosity seemed boundless. But for Bacon, discovery had a second motive: 'the relief of man's estate'. And our founders were indeed immersed in the practical agenda of their era – improving navigation and the navy, exploring the New World, and rebuilding London after the Great Fire.

350 years later, human horizons have hugely expanded; no new continents remain to be discovered. Our Earth no longer offers an open frontier, but seems constricted and crowded – a 'pale blue dot' in the immense cosmos.

The Royal Society is also a vastly different institution, but its essence actually hasn't changed. Today's Fellows – and all the young scientists we support – have the same motivations as their forebears. They probe nature and nature's laws for their intrinsic value. And their engagement with society and with public affairs is still strong – though today's focus is of course not just on London, but on issues that are often global.

Science itself is a global culture that should transcend all national differences – and all faiths too. But it's more than that. A former President, George Porter averred that 'There are two kinds of science: applied and not yet applied'. He was echoing Francis Bacon's sentiment in different words. And of course the insights of Newton, Faraday, Maxwell, Rutherford and others on the distinguished roll-call of our Fellowship – have spawned technologies that have transformed lives worldwide.

Indeed innovations happen with staggering speed. Many things we take for granted would have seemed magic even 50 years ago. The World Wide Web is only 20 years old – and we're proud to have its inventor, Tim Berners Lee, as a Fellow. Computers double their power every two years. Spin-offs from genetics could soon be as pervasive as those from the microchip have already been.

Although the Royal Society's priority has been the backing of individuals, it also advances research by its publications – printed and electronic – and by its high-quality discussion meetings on topical scientific themes. But its reach extends beyond the professional community – into science education, and public engagement.

In the past the Society wasn't much engaged with school-level education.

However, there's now a crisis that we surely cannot ignore. We risk falling behind other nations at all skill levels – top-rate postgraduates, but also highly competent technicians and apprentices. There's an ageing population of experts in areas such as the nuclear industry, and it's not clear that there will be enough replacements of the same quality. Young children are generally fascinated by at least some aspects of science – whether it be space, dinosaurs, or tadpoles. But too many bright pupils turn elsewhere in their teenage years, because the curriculum and teaching don't inspire them. The Society intends to provide expert advice on the science curriculum to policymakers and to support efforts to enhance the flow of good scientists into teaching. I

. . . The World Wide Web is only 20 years old – and we're proud to have its inventor, Tim Berners Lee, as a Fellow. . .

had the privilege of serving last year on Alan Milburn's panel on 'access to the professions'. In science (unlike in law and banking, for instance) the worst inequalities occur before age 18. The playing field is fairly level for those who have secured entry into a high-quality university course. But that opportunity is foreclosed to all those – perhaps half the population – who never encounter specialist science teachers. Ensuring that all children receive a high quality science education is essential to sustaining the UK's edge as discoverers and innovators. Key creative ideas of the coming decades should germinate here, and we must make sure that we have the skills and resources to exploit them.

It's the Society's responsibility, as an independent body, to provide independent advice to governments, and – through the media – to the public. We cherish our independence – advice is offered, via our recently expanded Science Policy Centre, whether asked for or not. We must confront widely-held anxieties that the uses of genetics, brain science and artificial intelligence may 'run away' too fast. To stem the risk of environmental degradation; to adopt clean energy, and sustainable agriculture, to prevent pandemics, it's essential to develop appropriate technology, and to apply it optimally in all parts of the world. The Royal Society should be at the forefront of these projects – our Fellowship spans the Commowealth; our distinguished Foreign Members hale from all over the world. We join forces with all the world's academies, through the Interacademy Panel and other collaborations, to promote these goals.

Our recent policy reports have dealt with topics as diverse as synthetic biology, climate geoengineering and nuclear security. In March we published a report 'Our Scientific Century: Securing our Future Prosperity', which was widely cited during the election campaign. And our well-established 'pairing scheme' between young scientists and MPs can, in a modest way, help to convey some scientific and techncal background among 'generalist' parliamentarians.

The Society celebrated its anniversary with a year-long series of events, exhibitions, and publications to increase both the public's involvement in and the profile of science. Our scientific programme aimed to addres the most important cutting-edge topics: ageing, biodiversity, consciousness, energy, web science, risk analysis, and so forth. A series of special publications and surveys have been published: in partcular, Bill Bryson edited a very well-received book, 'Seeing Further', which offered the perspective of 20 high-profile authors on scientific topics. We made special efforts to highlight the Society's history, as well as a range of programmes delivered with regional museums and cultural centres. A BBC radio series by Melvyn Bragg reached a wide audience.

The anniversary activities peaked with a ten-day science festival at Southbank Centre which attracted 50,000 people: its centrepiece was a 'convocation' in the Royal Festival Hall attended by HM the Queen and several other members of the Royal Family along with representatives of scientific organisations from around the world .

One of the highlights of the year was the conversion of Chicheley Hall, a grade I listed house in Buckinghamshire, into a residential centre for the advancement of science – a 'scientific Ditchley'. In recognition of a major donation from American philanthropist Fred Kavli, the centre will be known as The Kavli Royal Society International Centre. It will permanently enhance the Society's footprint, both metaphorically and literally.

> . . . The Society intends to provide expert advice on the science curriculum . . .

The UK is strong in science – second only to the US, and by some measures number-one in 'brain for the buck'. And it's not coincidental that the UK is the only country apart from the US with several universities in the premier league. This success is achieved despite the fact that OECD comparisons reveal us as low spenders on R and D compared to the US – and also compared to our new competitors in Asia.

It would be tragic to jeopardise our competitiveness. Moreover (and this is crucial in the context of the current cuts) other countries have singled out R and D for enhanced 'stimulus' funding despite the overall squeeze. The UK has already become less attractive relative for investment to the US than it was two years ago, and the Far East is rising fast. Additionally, the market for top talent is global. Any leading laboratory, whether it is run by a university or by a multinational company, contains a similarly broad mix of nationalities wherever it is located. The UK has had some 'brain gain' in recent years: talent attracts talent. But if public support for UK science is perceived to be heading downwards when it's being boosted elsewhere, it will become far harder to attract and retain mobile talent. The most savvy and ambitious young people will conclude that this country offers poor prospects for careers in world-class science and engineering. This would seem an 'own goal' at a time when the government accepts the need to boost graduate recruitment (in quality as well as volume) in these subjects.

Planning in R and D has to be long-term; the tap cannot be turned on and off. In a global context where other nations are forging ahead, even cuts of 10 per cent are be hard to recover from. An atmosphere of 'confidence' – intellectual as well as economic – is essential if our society is to sustain vibrant and innovative science, technology and engineering. The perception that the UK is losing ground and lacking commitment compared to other nations will destroy this confidence. There are all too few areas where this country is as high as number two in the world; it is surely foolish to jeopardise any that remain – especially one that is so crucial to the nation's long-term prosperity.

350 years ago, the Royal Society helped pioneer a new mode of thought – an enlightenment, where evidence would trump traditional authority. It's a mindset that has changed the world. We can't now be polymaths as our founders were. As knowledge expands, we need to specialise. We're mindful of how much we owe to our predecessors, but also of how much opportunity our science base can offer – given the right support.

Invigorating STEM Vocational Education
THE TECHNICAL COLLEGE OF THE FUTURE

Professor Sa'ad Medhat, CEO and Founder of the New Engineering Foundation (NEF)

Thirty years ago Kenneth Baker famously described the Further Education sector as the 'Cinderella Service'. This view is still relevant, particularly in STEM: for example, rarely is vocational training and FE mentioned in the Science in Parliament magazine – reflecting the importance given to vocational training and education. This has to change and for a very good reason: the right STEM vocational skills are vital if innovative and new technologies are to be exploited and commercialised fully.

It is five years since Sir Andrew Foster's report on the future of FE Colleges[1] held a mirror to them and invited colleges and stakeholders to respond. The main conclusion of his report was that the key purpose of FE colleges is *the acquisition of skills and employability.* The Leitch Review later the same year[2] placed greater emphasis on those whom colleges serve, and set targets on skills at the lower levels with an eye to progression beyond. The purpose of STEM vocational education and training was confirmed as supporting industry in the application of technology, and enabling individuals to develop recognised and flexible skills in growth areas.

The period since, however, has been dominated by debate about providers with an emphasis on size: is larger better? There have been other significant developments: the economic downturn and its consequences for public spending cuts; the transfer of responsibility for funding 16-19 education to local authorities and the associated demise of the Learning and Skills Council; the 14-19 curriculum and raising the participation age; the capital crisis in funding college building; and questions about the accuracy of the reliance of data that suggests colleges have greatly improved. And yes, the Comprehensive Spending Review, and three parliamentary bills which undoubtedly will have an impact on further and vocational education: the Welfare Reform Bill, the Public Bodies Bill and the Education Bill.

CHALLENGES AND FREE FE

There have been a number of ideas to address some of these post-Foster issues. The Learning and Skills Network and NEF have published papers arguing that FE should enjoy the freedoms of HE to raise cash (from students) and create qualifications[3 4]. A paper by Eversheds for the 157 Group argued for the possibility, if not necessarily the desirability, of new forms of legal structure and governance arrangements to enable more entrepreneurial colleges to emerge.[5] Part of this thinking is about the capacity of the colleges to meet the needs of their customers better.

But a lot of what is written seems still rooted in the question of how to make colleges themselves better and stronger – rather than make services improve *for employers and employees.*

The UK Commission for Skills and Employment (UKCES) sets out, in 'Skills, Jobs, Growth',[6] a vision for the way the employment and skills sector should work in the UK. Clear principles define the way that the content of learning and qualifications should be shaped by the relevant sector; whilst informed customers – employers and learners – should drive supply, performance and quality.

When it comes to proposals to make this happen, the attention is focused on three areas:

- A 'balanced scorecard' to supplant current assessments of colleges and make them more responsive
- Simplifying funding through personal learning accounts and increased individual and employer 'co-investment' in skills
- A modular qualifications system driven by employer need

Each of these responds to the drive to make demand for skills shape what the employment and skills sector delivers. They are not new ideas but their endorsement by UKCES will carry significant weight. They are congruent with the direction of travel suggested by Foster and the aims for the system shaped by the Leitch Review of Skills.

The UKCES report adds a key message about investing in *strategic skills.* Much of the debate about what colleges should do blurs the distinction between meeting the immediate needs of employers and investing in the future skills needs of the economy. The Leitch Review was of course concerned with both, but its focus was on up-skilling the entire workforce in distinct strategic areas.

'Strategic skills' require proper investment to stimulate increased provision and participation in those strategically important areas, including significant skills shortages and emerging sectors. This must depend on significant private investment, but, the UKCES argues, it should also be incentivised by price premiums to public funding to increase provider commitment and marketing.

Excellent technical education will depend on getting this right – alongside the challenges of raising the 'employability skills' of the workforce, particularly its young new entrants, and of continuing to respond to the immediate training needs of employers.

The three areas identified by UKCES have presented colleges with real challenges and some of the commentary about their success have been at best mixed. The challenges, however, are even more important as the world itself changes.

INDUSTRY REQUIREMENTS AND NEW TECHNOLOGIES

At the broadest level, there are some obvious economic imperatives on the horizon: the need to develop carbon-neutrality at work and in life; the rapid pace of technological change; the continuing revolution in the application of IT; the decentralisation of semi-skilled labour away from the advanced economies; the consequent need for higher-

level skills to predominate in the advanced economies. All predictions point to the need for the UK to make itself a high-skills economy in which jobs will only really be available in work demanding either a high level of technical skill or a high level of interpersonal skill – or both.

Demand for flexible, work-based approaches to training is increasing. This is aligned with qualifications that recognise skills and abilities – often acquired through experience but substantiated through further study. In some economic sectors, real emphasis is placed on updating these skills and linking them more clearly with career progression. There is growing demand for professional recognition at technician level, allied to achieving and sustaining the status of a leading-edge performer through first-class CPD. For example, developing a 'portfolio based learning' that embraces employability, innovation and professional skills could be one of the proposed approaches.

The demand for changes in the way we train people is reflected in the deliberate attempt to define career paths and associated training requirements in a variety of sectors of the economy. For example, in health care, 'Modernising Scientific Careers: the UK Way Forward',[7] proposals are set out to introduce a new simplified healthcare science pathway and to develop new training and education programmes to ensure that tomorrow's health care provision is as good as it can be and takes full advantage of perpetual scientific discovery.

DEVELOPING A FORWARD THINKING STRATEGY

Our vocational education and training strategies tend to focus on the 'here and now' and in many cases are backward looking to what has appeared to work in the past, for instance apprenticeships. In addition, some of the new proposals such as the University Technical College are also confusing and lack contemporary thinking. Unfortunately, such initiatives force artificial relationships and structures that are not necessarily effective nor do they serve business and industry needs. Moreover, these initiatives tend to be unsustainable: it is not training for the sake of training that is required; it is training for a purpose. Policy and strategy has to address needs first: training requirements will naturally follow.

Colleges will need to be encouraged and supported (and even rewarded) to think smartly about their future economic needs in such areas as low carbon technologies and advanced manufacturing and to break away from the existing mould of embracing more and more beauty and therapy salons and catering restaurants!

Today, there are a number of contemporary approaches that re-position workplace learning and occupational competence in an effective way to be delivered in a just-in-time fashion at the point of need. Further education colleges can do much to help themselves and become more agile and responsive, by adopting a strategic approach to improve performance in planning and funding.[8] NEF suggests a four-step approach to change management (NEF Diamond)[9]:

- Carry out an appraisal of internal capabilities, identifying weaknesses, and more importantly strengths
- Map market trends, involving horizon scanning, to identify immediate and future requirements for skills
- Formulate a strategy to re-focus, re-shape and re-position the college, making clear the purpose and focus of the new organisation
- Implement the strategy and evaluate impact, so supporting efficient delivery of training truly appropriate to industry needs whilst driving technical innovation and exploiting capabilities.

In parallel, colleges can re-assure employers that their STEM training provision is of the appropriate quality and led by industry needs. Quality assurance schemes, such as NEF's STEM Assured,[10] that assure the use of **integrated cross-curricular STEM strategies** in education and training, enable stronger collaboration between providers and employers and the delivery of innovative and multi-disciplinary teaching and learning.

Furthermore, there is potentially a new role for advanced vocational education and technical education centres. In the last *Science in Parliament* magazine, Dr David Dent commented on the gap in the innovation market.[11] Here is an opportunity for forward thinking colleges to transform into power-houses of market-led innovation, driving new prosperity and shaping new technologies. This could take the form of new *polytechnic colleges* that embrace applied and near market research.

TECHNICAL COLLEGES OF THE FUTURE

Developing a Technical College of the Future will be different from what we have been used to: it will encompass different access points to learning and training, new learning spaces with a variety of delivery channels and mechanisms, and take on technical innovation and knowledge transfer capabilities. In all this, the learning and training organisation will need to adapt and adopt new thinking to sensitise learners, employers and higher education to engage and develop new economically viable areas.

Technical colleges can add real value to technical developments and innovation – through up-skilling and re-skilling based on best practice and a clear idea of emerging needs. The technical college of the future needs to grasp these fundamental changes: to see itself as the engine for horizon-scanning, partnerships with employers, the incubator for business innovation that is able to deliver skills for tomorrow's world on time and in the right sectors. The wealth of the future depends on getting our vocational STEM education and training right so that a high-skilled, high value-added economy can develop.

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THE SCIENCE COUNCIL
WORKING COLLECTIVELY TO ADVANCE UK SCIENCE

Diana Garnham, Chief Executive, The Science Council

When launching the Science Council in 2000, Sir Gareth Roberts, the founding President, said: *"There are many challenging issues facing the world in the 21st Century and the science community will need to work both collectively and collaboratively to tackle these: I believe the Science Council will play a central role in enabling this to happen."*

The Science Council, which received its Royal Charter in 2003, has the twin aims of bringing together the learned societies and professional bodies in science and advancing professionalism. There are now more than 30 member organisations from across the spectrum of science – learned societies including chemistry, biology, physics, mathematics, psychology and professional bodies from nuclear physics to soil science. The Science Council is funded collectively by these organisations and by individual professional scientists through the Chartered Scientist scheme.

COLLABORATION AND MULTI-DISCIPLINARITY

It is important that the Science Council adds value to the work of its individual member bodies and does not get in the way of the valuable contribution they already make. Through its work on special projects, on science communication and outreach, careers and skills, science policy and advice and input to Government, the Science Council is now demonstrating the value of its role as an umbrella organisation in a sector that previously was often described as fragmented. This commitment to collaboration is illustrated by the understanding of science as a methodology rather than a discipline: the Science Council's definition of science is that it is the pursuit of knowledge and understanding of the natural and social world following a systematic methodology based on evidence. This also underpins the Science Council's key strengths in its breadth across science and the application of science, and multi-disciplinarity.

As well as providing a forum in which member organisations can share information on their own activities, the Science Council can and does seek to establish shared positions on policy issues. While there are obviously challenges in trying to achieve a single position on all key issues, the organisation has developed ways of working through special interest groups and issue specific round table discussions that have enabled the identification of consensus issues and shared priorities for policy. The Science Council now has a broadly based policy statement that sets out its key areas of concern and policy priorities for science – from investment in research through to science education, careers advice, public engagement and science in government.[1]

ADVANCING PROFESSIONALISM IN SCIENCE

In addition to its role as an umbrella organisation the Science Council promotes professionalism in science. In 2004 the designation of Chartered Scientist was introduced, modelled initially on the well established register of Chartered Engineers. Chartered Scientist – CSci – encapsulates the multi-disciplinary nature of 21st Century science in which scientists can often practise or specialise in different areas of science during their careers. CSci benchmarks standards and codes of practice across science disciplines and professions and recognises high levels of professionalism and competence in science; it also

offers recognition and portability across employment sectors. The designation is awarded to individuals through 21 Licensed Bodies who are also members of the Science Council. To remain on the register, Chartered Scientists must undertake Continuous Profession Development and an annual monitoring process ensures that Chartered Scientists operate to a high level of current competence.

The register of Chartered Scientists has grown to 15,000 practising across all fields of science. CSci is gaining recognition as the 'gold standard' across government, academia, industry and professional bodies. It has also been described as a badge: *"CSci is a way of saying to the world 'I am a professional scientist and proud of it' ".*

CHARTERED SCIENCE TEACHER

Chartered Science Teacher – CSciTeach – is a specialist section of the Chartered Scientist register developed in partnership with the Association for Science Education. CSciTeach is set at the same high level as CSci and recognises the combination of skills, knowledge, understanding and expertise required by individuals involved in the practice and advancement of science teaching and learning.

PUBLIC AWARENESS AND TRUST

Through a number of different projects and activities the Science Council is increasing the visibility of professionals in science and is also raising awareness of the contribution they make to science and society. These aims are important if we are to encourage people to enter the profession and to achieve both the level of knowledge, and the high standards of practice that will serve to underpin public trust and confidence in science and the application of science.

The Science Council is now moving forward with the development of a professional register for science technicians and for graduate scientists, establishing at long last a progressive professional pathway appropriate for the practice of science in today's world.

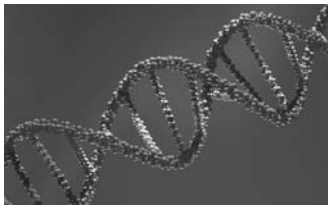
UK SCIENCE EDUCATION AND SKILLS – CAREERS FROM SCIENCE

The Science Council believes it is essential that the UK invests in science, technology, engineering and mathematics education and skills at all levels to create the highly skilled workforce that will be essential to a high added value economy and UK competitiveness. The science community itself has long recognised the need to attract young people into science and to raise awareness of the career opportunities arising from the study of STEM subjects. One of the leading projects for the Science Council works towards providing better STEM careers information for school students, science teachers, careers advisers and parents. *Careers from Science* is a collaborative project led by the Science Council which is addressing this need and now works with more than 65 partner organisations across STEM including learned societies and professional organisations, government departments, charities, industry sectors and individual businesses.

FUTURE MORPH

As part of the *Careers from Science* project the www.futuremorph.org web site was launched in November 2008. Rather than the more usual specific employment sector, qualification, or occupation approaches, Future Morph brings all these together developing content around themes such as climate change, the environment and health. The aim is to engage with young people and encourage them to appreciate why they study science and maths in school. Content is informed by audience need, and a wide range of stories, case studies, games and multi-media all show the breadth of career opportunities that are available from studying STEM. Working as a portal, the web site links across to a variety of existing content and information providers (for example by qualification, occupation, profession, discipline and employment sector) and makes it possible for young people, and those who advise them, to access information more easily. Alongside this, the Science Council, working with Engineering UK, is developing greater awareness of good practice in careers IAG by providing advice and support for science and engineering institutions that produce more sector specific careers information.

SCIENCE IN HEALTH



The Science in Health Group is one of the Science Council's special interest groups and comprises a panel of experts from within and beyond the Science Council member bodies, extending outside beyond biological and medical sciences. In January 2008 the Group published a report – I*ntegration and Implementation of Diagnostic Technologies in Healthcare,* which explored the opportunities for improving diagnostics – from the point of testing to the interpretation of results – taking account of the molecular revolution, automation and the application of informatics. For the past 18 months the group has been working on a report looking into the future careers opportunities in health science which it hopes to publish by the end of the year.

1 The Science Council's Priorities for UK Science and Innovation Policy 2010 – 2015 can be found on the web site at http://www.sciencecouncil.org/sites/default/files/WebfinalSciencePolicy.pdf

For more information about the Science Council and the work of its member bodies go to www.sciencecouncil.org and for Chartered Scientist to http://www.charteredscientist.org/about/index.html

SOUND ANALYTICAL MEASUREMENT FOR A SAFE, SOLVENT UK

Dr Derek Craston
Government Chemist

When George Phillips became, in effect, the first Government Chemist, appointed to help protect Her Majesty Queen Victoria's excise revenue in 1842, the strange new world of the rare earth elements was unfolding, while organic chemistry was still in its teens (Wöhler having synthesised urea in 1828). I wonder what my predecessor George would make of today's challenges, and a Government Chemist remit that has expanded to focus on easing business burdens while safeguarding public health and consumer choice. He might observe that my staff still rely on applying the best practical methods of measurement to solve complex, unpredictable problems.

The need for cutting edge science and technology has so far been served well by another significant change – the 1996 privatisation of the Laboratory of the Government Chemist. As a public authority in a corporate laboratory, the Government Chemist has benefited from new networks, strategic investment and an increasingly global purview. From a standing start 14 years ago, LGC – as the laboratory was renamed on privatisation – has grown to become a thriving international science company which recently changed hands for £257 million. Whereas the laboratory employed only 270 around that time, I can now draw on the expertise of a multi faceted enterprise with 1400 staff. Over the summer, I took on a new LGC Science and Technology divisional directorship as a way of streamlining input to core Government Chemist responsibilities while maintaining strategic links with the wider genomics, forensics and standard reference materials businesses that have grown up within the company.

In operational terms, the growth of LGC means that public functions ascribed directly to the Government Chemist now represent a relatively small part of the laboratory's portfolio. However, the company's new management are cognizant of our history, and the sense of identity and purpose that the Government Chemist role continues to engender. LGC's overarching value statement 'Science for a safer world' succinctly embraces my more specific public functions.

Let me turn now to those functions. While a 'theory of everything' may be able to simplify the way we appreciate the physical world as a whole, many of the practical problems of day-to-day living remain intractably complex. For example, as an ever-increasing variety of food products appears on the supermarket shelves, safety, nutrition and consumer choice are paramount; we are coming to expect that any required packaging will be both clean and green; and the environment should be safeguarded from poorly understood chemical and biochemical cocktails. These circumstances pose increasingly complex analytical requirements, while global supply chains make it harder to predict the nature of chemical risks.

Local authorities are at the forefront of efforts to enforce risk management legislation. Three pillars of the consumer protection law they uphold are the Food Safety Act 1990, the Agriculture Act 1970 and the Medicines Act 1968. A network of Public Analysts (Official Control Laboratories) provides valuable scientific support as the front line of regulatory enforcement. But because public safety and wellbeing are at stake, these acts enshrine an additional safeguard – the right of appeal to a scientific referee, the Government Chemist, who acts independently of businesses and enforcement authorities. The referee role is the salient feature of the Government Chemist's statutory function, which currently derives from seven Parliamentary acts in all.

Prior to enforcement action against a business, officials have powers to take formal samples, which they are typically required to divide into three portions. The business, which may analyse one of the portions, sometimes reaches conclusions at variance with those of the Public Analyst. The Government Chemist may then be required to analyse a further portion. When a formal sample is received, my staff develop a case-specific work plan to tackle the main areas of contention and uncertainty. Referee analysis usually prompts tactical research on related sample types and potential measurement methods. It also entails advice from a professional statistician and exploits an array of state-of-the-art LGC instrumentation, ranging from advanced mass spectrometers to DNA-based technologies. I discuss the results with experts and senior staff, and sign the certificate of analysis only when I am satisfied with the quality of the evidence presented.

The particular virtue of this statutory safeguard lies in its all-round economy. A Government Chemist opinion can be obtained without recourse to the

law courts – or, if a judge orders the referral, can be adduced to minimise the trial costs. If the appeal succeeds, business operators are spared unnecessary compliance costs and fines, while regulators and the public they represent benefit from a streamlined means of boosting confidence that only safe and appropriate products are available for sale.

In recent years, most of the samples referred to me have been of food or animal feed – a reflection of the variety, complexity and rate of change in these sectors. For instance, the risk of aflatoxins occurring in imported food products has been a persistent issue (see inset). Other cases have included the nutrient content of animal feed, food choking hazards, the authenticity of spirit drinks and fruit products, allergens, banned antibiotics and animal remains in organic cattle food.

Perhaps it is to the credit of effective local regulation that formal samples are not analysed more frequently. And as only a proportion are escalated to the Government Chemist, my staff can commit to the samples they do receive with an intensity which often spins off innovation such as more powerful and flexible methods of measurement. The fruits of this labour are disseminated to all interested parties, for example at a spring conference which is expanding rapidly through collaboration with leading research associations and the Food Standards Agency. Exchanges with countries such as India, China and Korea help to share best practice worldwide.

Historically, the Laboratory of the Government Chemist was a free-standing central department, with the resources to tackle just about any sample that the many and varied organs of government had cause to present for analysis. This flexibility lives on in a successful LGC, but more particularly through the wider function of the Government Chemist as 'a source of advice for HM Government and the wider analytical community on the analytical chemistry implications on matters of policy and of standards and of regulations'[1].

I fulfil this wider advisory function by responding to government requirements, bringing together public and private sector scientists with a common interest in meeting regulatory requirements, and working to ensure that analytical science adds value to emerging measures. For example, my staff recently issued a set of questions and answers on the measurement implications of REACH[2], designed to help industry identify practical approaches and avoid the urgency premiums that could arise if essential analytical work is put off until the last moment. Here, as elsewhere across chemical and environmental regulation, the cost-effective co-ordination of sound scientific measurement and modelling approaches will be of concern in the months ahead.

Within a privatised LGC, the authority of the Government Chemist rests on sound governance. The National Measurement Office (NMO) funds the programme of work supporting my public functions, and in so doing is advised by an independent expert working group representing both public and business interests. Last year an independent audit concluded that the Government Chemist function is highly regarded, delivers excellence, and fulfils the need for an independent and impartial service; maintaining the historical ties with LGC has worked well, and should continue to do so.

My work depends heavily on advice and resources available through complementary NMO-funded projects at LGC. These share in the vision of a universal chemical and biological measurement system needed to underpin free and fair global trade, rationalise scientific endeavour and create the conditions for long-term prosperity. They contribute to grand challenges ranging from advanced diagnostics and therapies to renewable fuels.

Meanwhile, a private sector LGC continues to benefit my work through investment in cutting-edge technology, economies of scale and a global perspective. In the UK, I believe we rightly stake our future on innovation, but securing prosperity on this basis means managing risk effectively. Thus the Government Chemist functions as a scientific referee and a voice for effective, evidence-based regulation are increasingly needed to protect the public and provide a level playing field for business.

Aflatoxins are genotoxic carcinogens, implicated mainly in liver cancer, produced by *Aspergillus* moulds. Imported consignments of fresh foods, which may have been stored in warm, moist conditions, can be susceptible to contamination. UK port health authorities (PHAs) conduct official controls to check on compliance with legal concentration limits, but aflatoxin contamination is usually patchy and sporadic. Government Chemist staff have worked with PHAs to validate an optimised sampling protocol that is protective of consumers and fair to traders.

In most recent cases, the Government Chemist conclusions confirmed those of the Public Analyst. When the science points to a non-compliance, the risk that the consignment poses to the public may be eliminated by requiring re-export. In 2008-09, it is estimated that over 200 tonnes of products contaminated with aflatoxins were prevented from entering the UK by direct action of the Government Chemist, as well as many more by PHAs and their Public Analysts. Of course, the business under investigation would prefer to be acquitted, but an adverse expert opinion may be a blessing in disguise – hard evidence can curtail costly legal proceedings, and forestall an expensive recall of the contaminated product from the supermarket shelves. Moreover, opportunities for competitive ways of supplying similar products can only be enhanced.

1 Government Chemist Agreement between the Secretary of State for Business, Innovation and Skills and LGC Limited

2 Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals

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A VOLUNTARY APPROACH TO FOOD SAFETY

Jon Poole
Institute of Food Science and Technology

The Institute of Food Science and Technology (IFST) is a membership organisation and professional body whose main aims are focused around the advancement of food science and technology.

As with many membership organisations, our activities are focused on sharing and disseminating knowledge, in our case based broadly around food science and technology and related issues – both within the scientific and industrial communities and to the wider community. Another important activity for IFST is concerned with setting and upholding standards of competence and integrity within the profession.

Our remit of food science and technology is based on applied sciences and is something we see as one of our great benefits and strengths. Supporting all aspects of food science and technology means engaging professionals who cross-cut many other pure sciences and disciplines. This brings with it two distinct advantages:

Firstly, our qualifications, awards and levels of membership recognise the mix of sciences that make up the many different applications within the food sector – from bio-engineering and crop science, through to food safety and sensory sciences. This eclectic mix helps to attract members from a broad range of scientific backgrounds.

Secondly and most importantly, as our qualifications and professional registers have been developed very specifically for the application of food science, they have direct applicability to organisations and individuals working in the food sector. We believe our membership accreditation levels and registers can therefore be used to directly support and encourage best-practice in the food sector.

It is around the assessment and maintenance of individuals' professional skills, knowledge and experience that IFST is currently focusing its attentions. As an independent charity our objects clearly require us to focus on providing public benefit. One of the most effective ways in which we believe we can achieve this is by encouraging those working in the sector to strive to achieve the highest levels of professionalism – whether they are researching and developing novel foods; auditing food processing standards within a food processing plant; processing and packaging own-grown produce on a farm or displaying food on market shelves. Notwithstanding a minority of operators intent on breaking the law, higher levels of professionalism in the sector will generally lead to better food safety for the general public.

ACADEMIC VS. NON-ACADEMIC

We recognise that professionalism does not need to be purely about academic qualifications. As with many science degree courses, numbers of students interested in pursuing food science, food technology or related subjects through further or higher education are falling well short of the numbers needed by the sector. There are many reasons for this – some understandable but many based on misunderstandings over the career paths available. There are, however, many other avenues by which people find their way into food science and technology-based roles other than through academic paths.

With a shortfall in the numbers of food science and technology graduates entering the sector, food businesses need to focus on other ways to attract, develop and promote individuals who don't have food science-based degree qualifications. One avenue has been the recruitment of more general science graduates and then to cross-train them with the necessary food science background. Another option is to develop employees with lower academic qualifications, providing them with workplace training and development, sending them on technical courses and programmes and encouraging them to learn through experience. The last two options of providing the specific skills and knowledge in-house is only really a viable option for larger businesses with the resources to do so.

There are some other potential disadvantages in this type of career development

path. From an employer's point of view it can be more difficult to determine whether individuals have the appropriate level of skills and knowledge relating to the roles they are required to fulfil. When recruiting, individuals who have built up their C.V. based on a variety of roles and experiences can also prove difficult to assess. From the food professional's viewpoint, they may find it difficult to demonstrate they meet the required standards for a role in food science and technology and may also lack the confidence that they are capable.

PROFESSIONAL STANDARDS

Providing sector-recognised registers, encouraging appropriate levels of membership within IFST or encouraging food professionals to apply for Chartered Scientist can be an effective way of setting and encouraging high standards in food safety. By signing up to a specialist register, food professionals are encouraged to develop their careers based on three important drivers:

Firstly, to apply to for a qualification or to join a relevant register, candidates need to prove an appropriate level of skills, knowledge and experience. Just the application process alone helps to raise an individual's awareness of the standards required of them. Once registered, following a rigorous assessment process, candidates will have confirmation and therefore the confidence that they meet a set of professionally recognised and accredited standards.

Secondly, to maintain their position on a professional register, registrants are obliged to maintain a log of their continuing professional development (CPD) thereby encouraging individuals to at least maintain their professional standards and currency of knowledge. Registrants are also required to sign up to a code of professional conduct which carries with it the power to discipline individuals who fail to comply with the code.

Furthermore, where a register defines different levels of professional attainment and experience, individuals may choose to use the different levels of the register as a benchmark for their professional development and career – they may even target themselves to strive towards higher levels within the register as an acknowledgement of their standing and achievements.

Within the food and drink sector, where high levels of (often scientific) knowledge and skills are required by key roles within most organisations relating to food safety, these drivers can prove valuable ways of raising overall professionalism.

TRACK RECORD

IFST already has experience in operating professional registers within the food sector. One particularly successful register is linked to the Safe and Local Supplier Approval (SALSA) scheme, a scheme supported by the Food Standards Agency and DEFRA.

IFST's role is to accredit and maintain the register of the food auditors and mentors to ensure they have the required professional skills and experience to operate as auditors of SALSA suppliers. Through this voluntary scheme, consumers can be assured that micro and small-sized local food and drink producers, registered through SALSA, meet minimum levels of food safety and hygiene.

After just over three years of operating, most of the UK's leading retailers and food service providers recognise and support SALSA thereby demonstrating that voluntary codes can deliver the necessary standards needed to ensure the supply of safe food to the consumer.

BIG SOCIETY

Building on the success of the SALSA register IFST is now developing a more far-reaching 'Food Safety Professional Register' aimed at all food and drink producers and outlets. We would like to think of this as an example of the Government's Big Society in action whereby IFST, a registered charity is encouraging industry to sign up to a voluntary code of conduct with the aim of delivering safe and nutritious food for public benefit. For this to be successful, though, the scheme will need to gain support and momentum from all stakeholders, such that employers actively register their key food safety professionals. Ideally, then, employers will actively seek out and recruit those who are registered at an appropriate level and employees will see registration as a necessary career development and promotional tool. Government support will clearly be critical to its success as well.

We recognise there will always be the need for tight control and enforcement within certain high risk situations and businesses. However, given the ever increasing pressures on both the FSA and Environmental Health Officers working through local authorities, trying to deliver within ever tighter budgetary constraints, some form of voluntary code seems a very viable and cost-effective second option.

CHANGING EMPHASIS

For IFST and many other similar bodies membership is and always will be a fundamental part of our activities. It is, after all, through the generosity of our volunteer members that we are able to operate at all. Volunteers deliver our governance, participate on our advisory and technical committee structures but, most importantly, they also form the basis of our valuable independent knowledge base. However, the traditional membership model operated by many institutes is changing and will need to continue to change to cater for very different environments in which we find ourselves operating.

In the past, the main activity for institutes and other bodies similar to ours has been focused around the sharing of knowledge in the form of seminars, lectures and events. Whilst these still have an important part to play there are now other, sometimes more immediate and cost effective, ways in which individuals can share knowledge. Web-based knowledge hubs and forums can provide specialist information literally at people's fingertips. Much of this information is still being provided by professional membership bodies but in much less resource-intensive ways.

This change in emphasis enables bodies like the IFST to look at new and more direct ways in which we can deliver our objects and so deliver valuable public benefit. Many of our volunteer members continue to be actively involved on behalf of the Institute, freely giving of their time and experience in new ways, helping us to promote and operate our registers and CPD schemes.

INNOVATION TO SAVE LIVES IN ROTORCRAFT OVER AFGHANISTAN

Defence Science and Technology Laboratory (DSTL)

The Defence Science and Technology Laboratory (Dstl), in conjunction with industry partners, has developed the world's first application and demonstration of a technology designed to help helicopter pilots land more safely and efficiently in Afghanistan. Air and Weapons Systems Department of the Dstl, part of the Ministry of Defence (MOD), has led the technical development of a pioneering approach to the problem of a phenomenon known as 'helicopter brownout'. Helicopter brownout occurs when a pilot loses visual references due to dust or sand re-circulating during take-off or landing, which is a major problem in desert conditions. This can present potentially life-threatening issues when performing operational duties on the battlefield with helicopters.

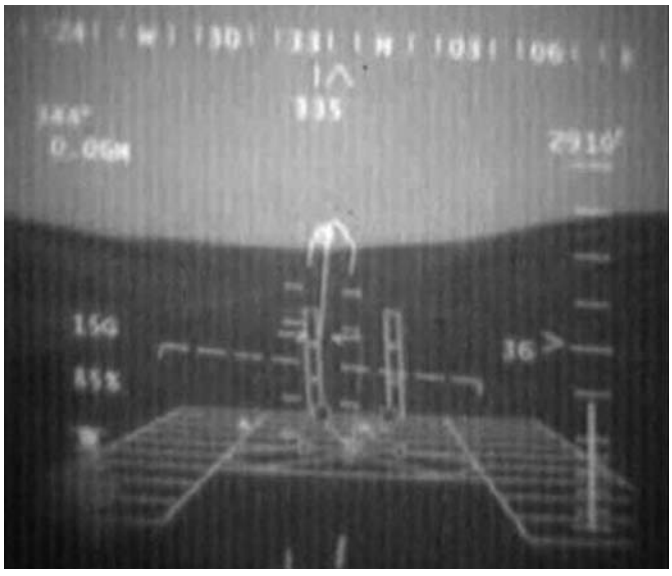
Working in conjunction with Agusta Westland, Dstl analysed the incidents to understand what had happened and identify the causal factors. Over a six month period scientists conducted a rapid technology assessment of as many available solutions as possible. This included a simulator trial of one of the most promising technologies, 3D conformal symbology. Presented on a small helmet-mounted display, this innovative approach provides a virtual 3D representation of the landing zone that stays fixed to the earth as the pilot approaches.

With this helmet-presented innovation, the pilot views all the relevant information needed to judge the height, speed and drift to replace the real-world cues obscured by dust. The display can be also be fitted to night vision goggles to provide a night time capability. As a result, 3D conformal symbology developed by Ferranti Technologies was selected as the most promising short-term solution to address the specific problem in Afghanistan. The Dstl/industry team has conducted flight trials that demonstrated the feasibility of 3D conformal symbology in a Lynx helicopter from the Army Air Corp Development and Trials (D&T) Squadron based at Middle Wallop in Hampshire. These showed that the system worked in a real helicopter.

The team, comprising members of Dstl, Ferranti and Agusta Westland, also conducted a further simulator trial using front-line Merlin helicopter crews to refine the solution and conduct a large number of helicopter take-offs and landings to show that the system did indeed make these safer. Once follow-on development and production work has been completed, it is anticipated that the technology will be deployed to front-line helicopters in Afghanistan. Dstl built a large-scale dust chamber on their 7,000 acre range at Porton Down to assess sensor technology which might be able to see through the dust and advise aircrew whether there are unseen obstructions. This innovative, temporary test facility used an inflatable hangar. Typical landing site obstructions were put inside the chamber and it was filled with known concentrations of commercially-sourced dust specifically chosen for its similar characteristics to Afghan soil. The team invited eight different companies to demonstrate the performance of their equipment in the facility.

The ability to penetrate the dust and allow pilots to see through dust clouds is one of the areas for future development. The ground-breaking work has earned the team a nomination for a Civil Service award, designed to recognise the very best practice across the civil service. The team's research has been recognised as among the most novel work carried out in Britain this year as low visibility landing team appeared on the shortlist for the innovation award.

For more information contact the Dstl press office on 01980 658088, 07766 134768, press@dstl.gov.uk.



BIOREFINING : PREPARING FOR THE PERFECT STORM

Professor Robert Edwards, Chief Scientist, The Food and Environment Research Agency.

With news from Russia that grain harvests may be some 30% lower than expected due to drought and an associated export ban on cereals likely, we seem a step closer to Professor Sir John Beddington's perfect storm of global food, fuel and water shortages by 2030.

As plant scientists are mobilized to meet the challenges of increasing crop production, we are constantly faced with the debate over food Vs. fuel. In terms of energy, we know we have to move from a world running on the photosynthetic products of ancient sunlight to one where we are part of the ambient carbon cycle. We also know that unless your country is blessed with spare growing capacity, that in the current agronomic model, biofuel crops are bound to compete with food production. But what if we could efficiently use crops for both food and non-food uses?

Consider this scenario. As the last of the grain trucks depart our farms for the granaries the business of the secondary harvest begins with the residual straw in the form of pellets fed into silos and wetted with water containing degrading enzymes. After a week, the syrupy liquid extract, full of sugars, is pumped into waiting tankers and the solid residue retained by the farmer for soil conditioning or energy production by combustion. Meanwhile the liquid extract is fermented into a range of simple precursor chemicals at regional centres prior to national distribution to the chemical and fuel industries.

This is the world of biorefining, where biomass is used as an alternative to oil to provide us with the liquid fuels and chemicals we need to operate a modern society. Furthermore it is not a new vision. In the 1930s agricultural chemists fearful of our growing dependence on fossil fuels had already proposed the large scale use of plants as alternative chemical feed-stocks and termed the science 'chemurgy'. Now some 70 years later we have made significant progress in realising their ambitions for chemurgy, though in terms of competing with the near atom efficiencies of chemical refining we still have a long way to go to make biorefining a commercially sustainable industry.

By examining the scenario above and the proposed use of wheat straw as a chemical feedstock we can identify some of these challenges.

THE STARTING MATERIAL

While the straw is rich in sugars, their ability to be released into forms which can be usefully fermented is limited by other chemical constituents present and the complexity of the polymerized matrix they need to be extracted from. Unlocking these sugars from plant cell walls (lignocellulose) using sustainable biological processing is currently the subject of multi billion dollar investments in the private and public sectors around the word. As an alternative, chemical processing of lignocellulose is possible, though the plant required is expensive, energy intensive and unlikely to be deployed at multiple small sites.

TRANSPORTATION

Unlike crude oil, in terms of energy 'density' straw is bulky and energetically expensive to transport. It therefore makes sense to process the biomass to a more energy intensive form prior to shipment from its site of production; hence the bioprocessing of the straw to a more easily shippable liquid form on site. Ultimately it may be possible to both digest and ferment plant material in a single process, though that would require the generation of effectively novel microbes through techniques such as synthetic biology. For the purposes of the scenario presented here it is instead proposed that the outputs of primary processing on the farm

would be the nutrients required for secondary fermentation at a regional hub.

AGRICULTURAL SUSTAINABILITY

Though straw is of secondary importance to grain, it still has a great value to agronomy and some of its carbon and nutrient value needs to be retained on the farm. In effect, crop utilisation in countries like the UK is already very efficient and diverting biomass for industrial processing would need some careful environmental evaluation.

BIOREFINED PRODUCTS

The outputs of biorefining need to be compatible with the needs of the chemical industries which have been built up around oil refining for decades. This is where the ability to engineer metabolic pathways in microbes to produce chemicals which are entry points into existing chemical processes is vital.

By identifying these challenges we can immediately see that the science of biorefining requires inputs from the public and private sectors at levels ranging from the international to regional. At the higher level, biorefining needs concerted science and technology programmes integrating the disciplines of plant breeding, microbiology, enzymology and chemical engineering. In the UK this level of organisation is provided through the BBSRC's 'Integrated Biorefining Research and Technology Club' (IBTI), in a partnership with UK-based industries. At the regional level, biorefining has the capability of addressing the local needs of farmers and food processors with the ability to fine tune the processes to the needs of the available biomass or waste stream.

Working at both the national and regional level, the Food and Environment Research Agency (Fera) has identified biorefining as a key area for development in partnership with public and private sectors and one which complements its existing science capability. For example, its work with seed breeders could be usefully developed to look at new traits for feed-stock use in biorefining, while its analytical services would help develop efficient processing technologies for the wide diversity of plant materials used by the food industry. The agency would also be able to provide expertise in environmental impacts of this new industry. Whatever the inputs, importantly in a rapidly changing world organisations such as Fera need to be able to flexibly partner with Universities and industry to develop new technologies such as biorefining which address national needs in food security and environmental sustainability as we draw closer to the storm ahead.

RUSSIA: MODERNISATION THROUGH SCIENCE AND INNOVATION

Dr. Julia Knights, First Secretary, Science and Innovation (S&I), British Embassy, Moscow

Russia is taking many positive steps towards modernising its innovation infrastructure and strong opportunities for UK industry, consultancy and research collaborations exist.

This year the UK Science and Innovation Network (SIN), funded jointly by FCO and BIS with a remit to cover international science and innovation, set up a new section within the British Embassy in Moscow to capitalise on recent opportunities for the UK in research and industry collaboration with Russia.

President Medvedev's Commission of "Modernisation and Technological Development of Russia's Economy" set up in May provides one of the major opportunities for the UK. £211 million is available this year for technological breakthroughs in five themes: energy efficiency, nuclear, space and communications, energy efficiency, medical and information technology (including supercomputers).

A £3.23 billion energy efficient innovation city named "Skolkovo" dubbed "Russia's Silicon Valley" by the Russian media, will act as a testing ground for new economic policies to stimulate commercialisation of scientific research through the Commission's five themes. International architects have been invited to design for the masterplan project worth over £90 million covering 380 ha of

greenfield on the outskirts of Moscow.. And up to three major international partners for each of the five themes are being invited to set up joint R&D programmes with Skolkovo's university partners as well as business incubation and innovation ecosystem support. MIT, Boeing, Google, Microsoft and Intel have all shown interest. Both S&I and UKTi have made UK business aware of these opportunities and the first energy efficiency project under negotiation is between the Moscow Institute of Steel and Alloys (MISA) and the UK's Cambridge University.

Investment in National applied science projects offers another opportunity for the UK. Up to seven designated National Research Centres are being created of which the Kurchatov Institute (KI), on the outskirts of Moscow, famous as the brainchild of the Tokomak, is one. Boasting a new state of the art "Nano Bio Info Cognitive" Centre, a new synchrotron radiation centre with over 30 beamlines, a neutron research reactor for nuclear and solid state physics research and a 600 TB supercomputer, its director Professor Kovalchuk welcomes further collaboration with UK researchers.

Opportunities for collaboration in applied Nanotechnology also exist through £1.41 billion dedicated for applied nanotechnology over 5 years and a "National Nanotechnology Network" (NNN) encompassing leading Russian universities and research centres. The KI will co-ordinate their scientific research and Rusnano (the Russian Nanotechnology Corporation) will take the nano products to market.

Space industry opportunities exist too. £520 million will be spent over the next three years on the new Vostochny Cosmodrome in the Amur Region, to take on some satellite launch duties from the existing Baikonur Cosmodrome in Kazakstan. £370 million will be spent over nine years on developing a nuclear-powered spaceship that will fly to Mars. A new generation Angara rocket is due to be tested in 2013. And "Glonass" a navigation system to rival the US's GPS is being developed as one of four space projects funded under President Medvedev's Commission.

UK researchers also have much to gain from Russia's increasing international engagement. This summer for example, Russia's Ministry of Education and Science (MES) announced a call for £254 million open to the international science community for joint research projects lasting three years with Russian science groups. Involvement in international large science facilities is also a reason for UK researchers to have an interest in Russia. The largest financial contributor (£210 million) to the International Thermonuclear Experimental Reactor (ITER) in Hungary, Russia is also a strong contributor to the European ExFel project in Hamburg. Whilst around 700 Russian engineers and researchers work on the Large Hadron Collider at CERN in Geneva, Russia also participates in The European Synchrotron Radiation Facility (ESRF) and the Facility for Antiproton and Ion Research (FAIR). MES has requested to become an Associate Member of EU Framework Programme 7 which if successful would also involve a substantial financial contribution from Russia.

Challenges for any UK business or researcher do of course exist, not least red tape, poor IP protection, weak law enforcement and trained expertise. Most of the civilian R&D research budget is spent on applied research and links between research and industry need to be strengthened.

President Medvedev aims to tackle all these challenges through his Modernisation Commission and in his landmark "Forward Russia" article in September 2009 he instilled some confidence in businesses with his words "We have to create a modern efficient judiciary, acting in accordance with new legislation on the judicial system and based on contemporary legal principles".

Although the volume of research publications has weakened considerably in recent years (29,000 papers in 1994 vs 27,600 in 2008)*, Russia certainly has no shortage of intellect, remaining notable in Nuclear Physics, Particle and Fields and Multidisciplinary Physics representing 10.2%, 9.9% and 8.0% of World output. Further opportunities for UK researchers to collaborate in joint research can also be found in areas where Russia maintains its strength including in Petroleum Engineering (8.9%) and Geochemistry and Geophysics (7.9%)*. Key growth areas between 2004-2008 which reflect opportunities for UK researchers include Neuroscience and Behaviour, Environment Ecology, Clinical Medical and Geosciences*.

The UK is in a strong position to forge new and enhance existing collaborations and industry links in all of President Medvedev's five Modernisation Commission themes. With that in mind our Science and Innovation (S&I) section in Moscow is working to identify such opportunities within Russia's key science cities. We are doing this through a raft of activities including science missions, innovation round tables, Science Cafes and business breakfasts throughout Russia showcasing the UK's expertise of research to commercialisation.

The first business breakfast will focus on energy efficiency to coincide with the Nano Knowledge Transfer Network delegation of clean tech companies attending the Rusnano Forum in Moscow in November. The first Science Cafe will be held during Moscow Science Festival this October on the UK's and Russia's joint contributions to the Linear Collider.

The S&I section is also working to highlight the UK's science offer through bilateral agreements including a "Year of Space Science" in 2011 as a follow up to the UK Russia MOU on Space Science which was signed in July between the UK Space Agency and the Russian Federal Space Agency, Roscosmos. This will also coincide with the celebrations of the 50th anniversary of Gagarin's heroic space flight.

* Thomson Reuters. (2010). Global Research Report – Russia – Research and collaboration in the new geography of science

To find out more about the work of the S&I section in Moscow, please visit us at http://ukinrussia.fco.gov.uk/en/about-us/working-with-russia/004-embassy-departments/science-technology

TOWARDS IMPROVED RESERVOIR SAFETY

Dr Peter J Mason
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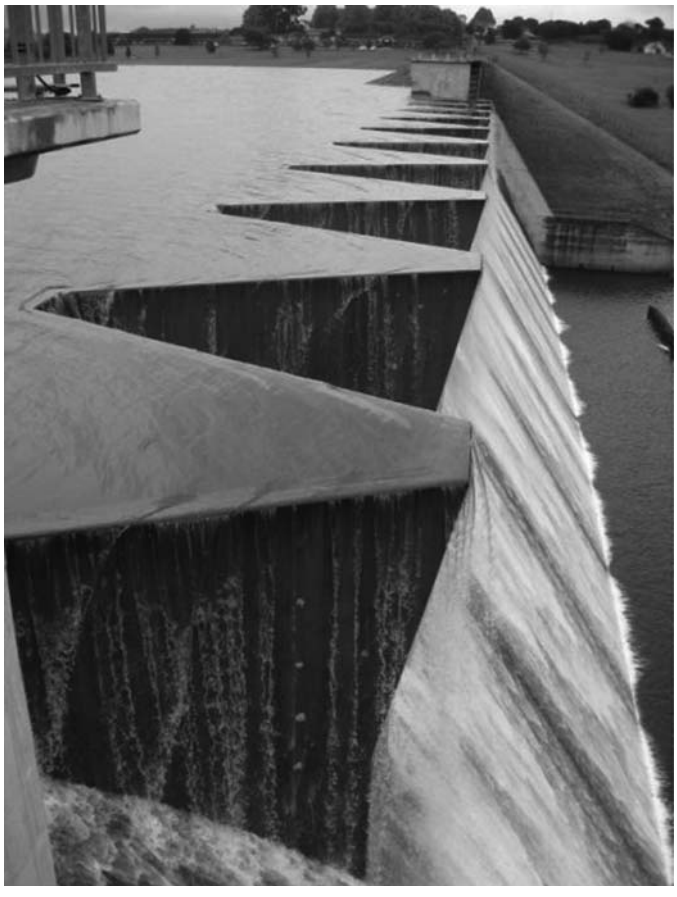
The floods in 2007 and 2008 highlighted the vulnerability of some UK infrastructure, such as electrical distribution centres and water treatment works, to inundation and failure. There were concerns that Climate Change could make such floods more common. The Pitt Review in 2008 suggested such works be given greater security against these events.

The near failure of Ulley dam in 2007, with approx £10 million of consequential costs, highlighted the damage potential that could result from a UK dam and reservoir failure. Consequently the Pitt Review also recommended changes to the UK Reservoirs (1975) Act. The 1975 Act was built on the foundations of the 1930 Reservoirs Acts but was not fully implemented until 1986/87. The 1975 Act relies on reservoir supervision and periodic inspection by specialist Engineers selected by peer interview and re-assessed and certified every 5 years.

The changes to the Reservoirs Act are enshrined in the Flood and Water Management Act 2010, which was pushed through Parliament in the final days of the last administration. Consultation occurred although many industry participants felt that much had been pre-decided. One key change included the option of reducing the size of storage to which the Act would apply from the current 25,000 cubic metres. A new threshold of 10,000 cubic metres is suggested, though not yet prescribed. This would more than double the number of reservoirs to which the Act would apply in England in Wales.



To offset this increase in numbers it is suggested that "low risk" (or more accurately low hazard) reservoirs be taken out of an active monitoring regime, although they would remain listed. To assist in this assessment government-funded, "broad brush" Reservoir Inundation Mapping (RIM) has now been completed for over 2,000 UK Reservoirs at a cost of £2 million. Emergency action plans for the 100 highest hazard reservoirs will also be prepared with £1.25 million of Government funding. Owners will be expected to fund action plans for the remainder, which is causing some resentment in the industry, especially amongst fishing clubs and recreational or ornamental lakes where available revenue is limited or non-existent. The proposal that reservoir owners fund future Environment Agency reservoir-related costs has also surprised and alarmed many.

The Pitt Review also recommended future reservoir safety be "risk based" but two problems have emerged. One is mixed legal messages and requirements. The emergency evacuation of a reservoir requires the reliable operation of low level outlet valves. Annual, or ideally three monthly, testing is needed to avoid possible seizure. Inspecting Engineers may stipulate this in their reports with ultimate enforcement of such requirements by the Environment Agency (EA) in its role as Enforcement Authority under the Act. However the EA have also issued a recent protocol, itself a legal requirement, which prevents this being done without costly and extensive risk analysis in terms of effects on downstream flora, fauna and water quality. While laudable there is little doubt that this will put the safety of some of our reservoirs at risk by discouraging routine outlet testing.

The second problem relates to assessing risk of dam failure. While various methods exist, all ultimately rely on judgement. Probable risk cannot be assessed to the level of accuracy often implied and there is much controversy among practitioners about the viability of current methods. However all such methods rely on accurately assessing reservoir water level during flood and hence likely flood magnitude. The Flood Estimation Handbook (FEH) introduced in 1999 was found to be deeply flawed when applied to estimating the long period rainfalls required for reservoir safety purposes. Recent work by CEH, Wallingford has redressed the matter but the results are not available in an industry usable form. It would seem that the EA only fund "research" and not the implementation tools needed to turn such research into practice.

This policy will also present problems if and when the new Act is implemented and when the many guides to the existing Act and associated practices need to be revised and re-written.

It took 12 years to fully implement the 1975 Act. It is to be hoped that sufficient time will also be taken to implement the new Act to ensure that it is workable.

Dr Peter J Mason is currently Chairman of the British Dam Society, Chairman of the Inst of Civil Engineers' Reservoir Safety Advisory Group, Technical Director for International Dams & Hydropower at MWH Ltd and Director of Damsolve Ltd.

FOOD SECURITY: WHY PLANT HEALTH MATTERS

Dr Julie Flood
CABI

Rapid food price rises have highlighted serious concerns about food security globally and have had a huge impact on achieving Millennium Development Goal 1.

Feeding a predicted world population of 9.5 billion in 2050 when there are an estimated 1 billion still going hungry today will be a challenge requiring the application of the best scientific techniques as well as the development of new approaches.

Over the last 30 to 40 years there has been chronic under-investment in agriculture at all levels. Development aid to agriculture has declined and often in-country policies do not support the sector. Low crop yields are common in many developing countries.

Improved productivity is vital to reducing rural poverty and increasing food security. Scientists throughout the world are working on developing new crop varieties, improving land use, and enhancing soil fertility and water management. This work is important, but there is also a way that we can feed millions more people right now, without the need for extra land, water, fertilisers, or chemicals – and that's by making sure that we lose less of what we already grow.

Currently, it is estimated that one third to one half of all food produced is lost from 'field to fork'. This is due to pre- and post-harvest losses as well as waste in the retail sector and at the consumer's table. Quantitative data on crop losses is very limited, but estimates of 30 to 40 per cent are common in scientific literature. A large proportion of this is due to pests and diseases. And with climate change, trade flows, and population movement all increasing, the rate at which these plant health problems arise and spread is also multiplying.

For example, the wheat rust Ug 99, which was discovered in Uganda in 1998 and reported in 1999, is now established in the Eastern Africa highlands and spreading. In Kenya, wheat losses due to Ug99 are over 70 per cent of total production in some areas. Production losses have led to higher prices in local markets with a resulting impact on low income families and an increase in food insecurity. Imagine what will happen as it spreads into the high-yielding production systems of South Asia and beyond.

Another example of a disease that has had a significant impact is Coffee Wilt disease, which attacks coffee species in Central and Eastern Africa. Whilst coffee is not a staple food crop, its production has indirect implications for food security through decreasing income security. Coffee Wilt disease kills coffee bushes so that, very soon after its detection, farmers experience a complete loss of income from coffee. A 77 per cent loss in yield of robusta coffee at the national level in Uganda was reported in 2009.

Trans-boundary pests and disease such as these are serious threats to food security. They jeopardise the livelihoods of millions, and therefore national economies and political security too. Ug99 is also a threat to wheat production worldwide – and yet few people outside the specialist scientific community are aware of it. There is a need for increased awareness about plant health issues by the public, by policy-makers, and by decision-makers who should be aware of the impact on food security and should be committing funds to dealing with plant health issues.

Management of pests and diseases is heavily dependent on early detection so that eradication can be attempted and, if this is not possible, management practices can be established. Just as there are few systems in place to gather data on pest losses, so systems for effective detection, identification and monitoring are not in place, and in some cases information about new threats are ignored by the authorities.

With the right knowledge we could identify pests and diseases earlier, slow down their spread and provide the correct treatments before yields are significantly affected. For every 1 per cent reduction in crop losses, we could potentially feed up to 25 million more people.

So how do we get that knowledge? A solution will be to develop better systems for monitoring and detection. In order to do that we need to make the general public more aware of the issues involved, as well as governments and aid agencies. But with the appropriate support, a "knowledge bank" covering all major food and cash crops could be up and running within three years. Indeed, CABI has already made a start on developing a prototype that could be delivering useful data on a few key crops within a year. Using this in conjunction with the CABI-led Plant Health Clinics, which provide advisory services to the hardest to reach smallholder farmers, we will have the beginnings of a field-based early detection system.

ACCREDITATION OF BIOLOGY DEGREES

Dr Mark Downs FSB
Chief Executive

The Society of Biology is a single voice for over 80,000 biologists in the UK, with both individual and organisational members. As both a professional body and a charity, education will always be high on our agenda.

The recently published Browne review recommends sweeping changes to the way in which higher education is funded. Understandably the media focus has been almost exclusively on the student loan element of the proposals and the removal of the cap on tuition fees for higher education institutions. But Lord Browne's report also seeks to address the gaps between the skills required by employers and those which University graduates are able to demonstrate. University education must, surely, above all be about development of intellectual rigour and the analytical skills so valuable for life whatever the chosen career of the individual. Nonetheless, if students are to pay the significantly enhanced fees, their interest in employability skills will inevitably grow.

The Browne review highlights something which professional institutions have known for a long time – and have been acting on: that graduates need specific skills for individual professions in addition to their basic educational grounding and, once in employment, need to continually develop their professional skills. The Society of Biology, in common with many other professional organisations, offers a chartered route to recognising professional skills, alongside a continuous professional development programme to ensure standards are maintained. But there is also an important role to be played in helping students to identify courses which have the strongest likelihood of providing them with the skills and education they require for a particular career path. It is for that reason that the Society of Biology has been working for the last year to develop an accreditation programme for undergraduate biology degrees.

As has frequently been made clear in the run-up to the comprehensive spending review announcements, science in its totality contributes enormously to our economic and social prosperity. The life sciences are a particularly successful story for the United Kingdom. In many areas we are second in the World only to the United States and often first. Over the last ten years, University life science research groups have spun out over 200 companies, worth in excess of £720 million. Our success at post graduate and post doctoral level is clear to see. But there remains a gap for graduates who often lack the skills suitable for research careers. Working with the Office for Life Sciences, and with support from the BBSRC, the Society of Biology has developed a new framework for the accreditation of biology degrees for students who hope to embark upon a research career.

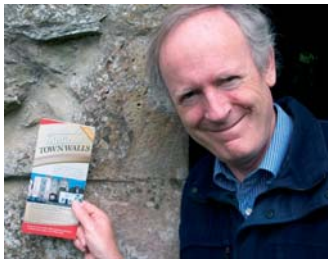
These degrees would typically be at least four years in length, including a major project with hands-on experience in either industry or within a University research group. Intellectual rigour and experimental design will be high on the agenda, along with a capability to demonstrate strength in mathematics. Biology is far from a soft option amongst the sciences and a future career in the life sciences inevitably involves the application of numeric skills. It is an issue which has been ignored for far too long.

Of course, biology is a huge field and the Society cannot hope to accredit the entire breadth of degrees in one step. With this in mind, we are starting with a pilot programme in *in vivo* sciences and biochemistry. Host institutions have already expressed interest and we hope that the first students will be recruited in 2011. The challenge is to ensure that the system is not over bureaucratic, does not place undue cost burdens on universities, and meets the needs and expectations of employers. But above all, an accredited degree also needs to meet the expectation and aspiration of students.

To try and meet these challenges and requirements, the Society has opted for an outcomes based approach. We will not be dictating to universities the way in which they should teach a subject, or the particular topics they should cover. Rather, we will set out clearly the outcomes we (and employers) expect from the Degree programme, based on wide consultation. We believe this programme, alongside our Chartered Biologist and Continuing Professional Development approaches can contribute, along with many other professional bodies, to helping meet some of the aspirations outlined in Lord Browne's report. However university degrees are financed, and whatever the debt students incur, one thing is certain: with a more market-based approach the customer, or can we still say student, will become increasingly demanding in return for the investment they make. The Society of Biology is keen to make sure we can enable students to make more informed choices and to be more certain of the outcomes they can expect from their university education.

For more information please visit:
www.societyofbiology.org/education/hei/accreditation

TEME BANK TRAIL
TAKE A WALK THROUGH LUDLOW'S SILURIAN GEOLOGY



Professor Michael Rosenbaum
Shropshire Geological Society
msr@waitrose.com

There are eight stops on this walk which allow you to examine the famous rocks along the banks of the River Teme.

This walk will take around 1 hour to complete. The paths are generally good but the ground is uneven in places with some steep slopes and steps in others. You should always wear appropriate footwear and watch out for slippery surfaces especially after rain.

Start your walk in front of and facing the gates of Ludlow Castle, SO 510 746 and follow the path to the right.

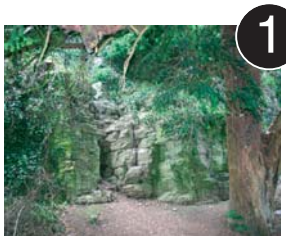
Background

Although most key geological exposures are still known, many are in a state of decay or overgrown, and few have any readily accessible description as a guide to their intrinsic interest or indeed their value.

Shropshire has a higher than average number of such important exposures: the result of an accident of geological evolution which has seen this region located on the edges of continents as they have evolved.

The development of a trail along the banks of the local river: the Teme, uses a dozen exposures illustrating not only the local rocks and fossils but also an anticline: a broad up-fold of rocks which causes the sequence to be repeated and thereby illustrate some of the basic principles of geological science.

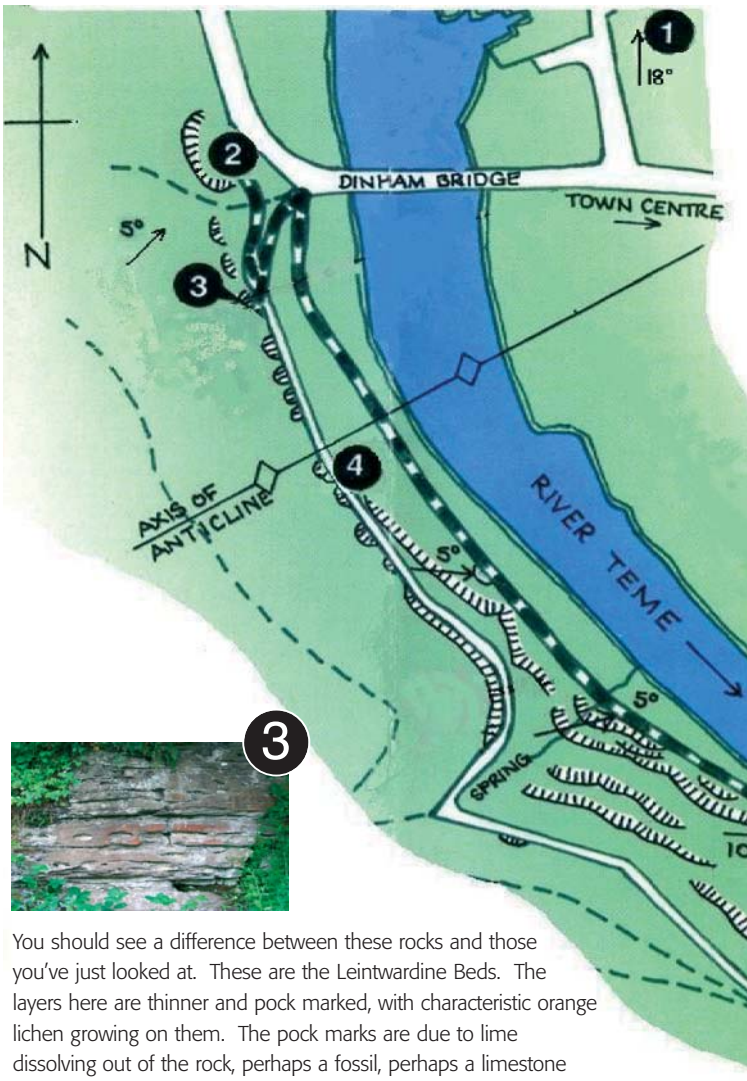
This has been achieved by a partnership between local government through the Museum Service and volunteers from the Shropshire Geological Society and the Shropshire Wildlife Trust, experts in their own scientific disciplines.



Follow the path past the castle until you reach a bench on the left hand side beside a large yew tree SO 508 747. Here, beneath the castle this tiny exposure of rock sets the scene for what you will see on the rest of this walk. The castle stands overlooking the town and countryside, resting on a plinth of rock, the same rock that much of the town is built of. It is hard to believe that these rocks were made beneath a warm shallow sea that was teeming with life, when Ludlow was south of the Equator some 419 million years ago. Now continue down the path and join the tarmac path on the right which joins the road by Dinham Bridge. Cross the bridge to reach stop 2.

Beside a picnic table you'll find an information board facing toward the river, SO 506 745. Behind this you'll see a quarried rock face. Stand back a little and look at these rocks. You should be able to see that the layers or beds in the rock are tilting at an angle. These rocks are made of lime-rich silt and as the lime has leached out of the rocks it has formed a white crust on the surface that gives the area its name, Whitcliffe or White Cliff. Indeed these rocks are called the Whitcliffe Beds.

Before you move onto stop 3, make sure you remember which direction these beds are dipping! Stop 3 is just a few yards up the path which slopes up from the river, and is beside another bench at SO 506 744.



You should see a difference between these rocks and those you've just looked at. These are the Leintwardine Beds. The layers here are thinner and pock marked, with characteristic orange lichen growing on them. The pock marks are due to lime dissolving out of the rock, perhaps a fossil, perhaps a limestone nodule once filled the gap but has long since been eaten away by rain and river water. Now return to the lower path and walk along until you come to the first bench on the right.

Behind the bench at stop 4 are the oldest rocks you'll find on this walk at around 423 million years, SO 507 743. They don't appear tilted like the other rocks you've seen. This exposure forms the heart of a huge fold, like an overturned bowl, where rocks have been bent out of shape in response to pressure deep inside the earth. Years of erosion from ice and water have brought them to the surface to form the landscape around Ludlow.

You now need to walk along the path past the point where a stream runs under it until you reach stop 5, where a large section of rocks filled with holes can be found.

You are now on the other side of the fold, SO 508 742. Look at the beds; you can see they're dipping in the opposite direction to those you saw at stop 3 but it's the same rock type, the one with the tell-tale orange lichen and pock marked surface. Here you can really see the effects of water on lime-rich rocks; it has worn out deep holes and crevices in the rock, making a mini cave system (right hand side of photo).

Now continue up the path for another 100 metres or so until you reach stop 6 which is adjacent to the weir at SO 509 742.

You need to take care at this stop, the natural rock has been used as the path and it can be very slippery. Some of the fallen blocks at the foot of the steps are enormous, perfect for building stone. These are the Whitcliffe Beds again and this particular rock was used to build much of the medieval splendour of Ludlow, and was cut and shaped on the platform above. An inscription commemorates the sweeping away of the old path by a flood and the construction of this new route. If you look above the inscription you can see some really thin layers in the rock, a huge contrast to the giant blocks resting at the foot of the steps.

If you branch off to the right at the top of the first flight of steps you'll see a large cliff face. This is Whitcliffe quarry, SO 509 741. Wander along the path around 35 metres and you should find some evidence of turbulent times. You'll need sharp eyes, but there's one layer in the cliff face, about one third of the way up that doesn't appear level, it looks scooped and twisted.

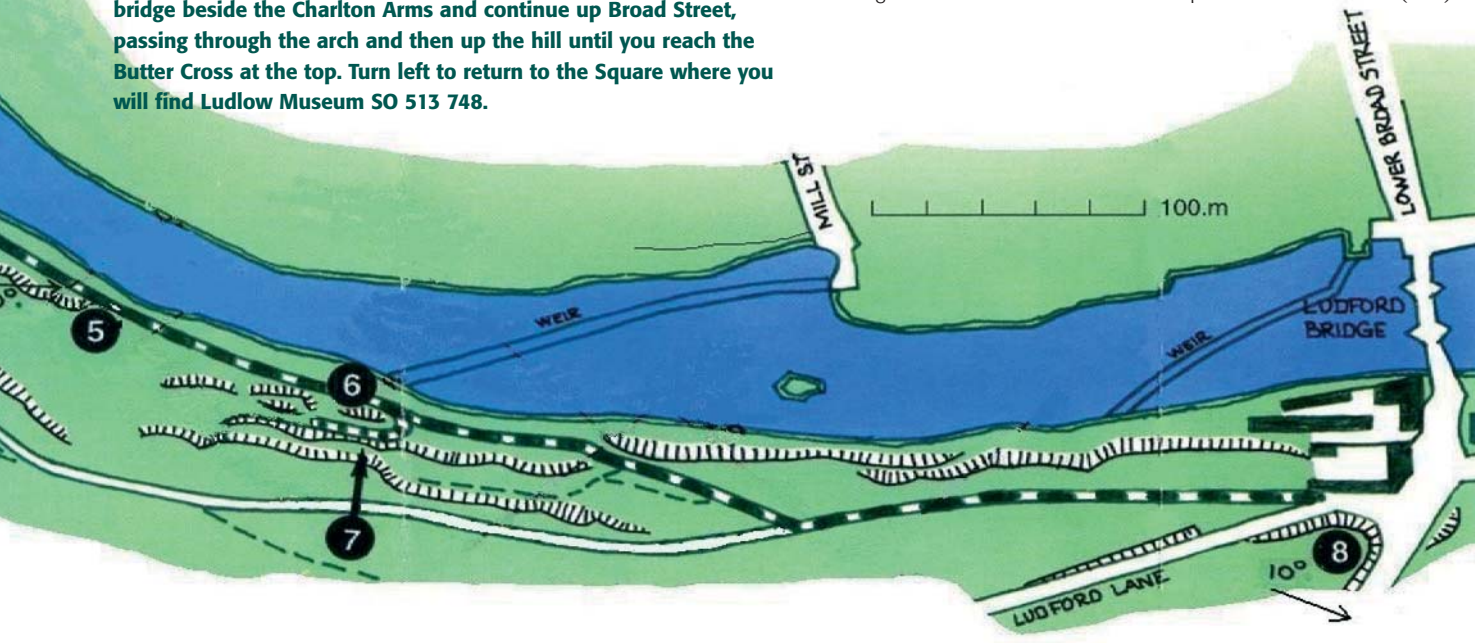
This buckled layer is the result of an earthquake millions of years ago, shaking the soft sediments on the seabed out of their neat layers.

The cliff face is sometimes unstable but if you look closely at some of the fallen blocks away from the rock face you may see layers of semi-circular holes where there were once fossil shells. Return to the main path and continue up the steps.

Follow the path down to the road and on the corner a small metal plaque marks the site of the world famous Ludlow Bone Bed, SO 512 741. Don't expect to see dinosaur bones poking out of the rocks; the bones are the remains of prehistoric fish and fragments of charcoal, tiny but very important since this marks a change from the shallow seas where the other rocks on this walk were made, to a point much closer to the sea shore, eventually becoming land cloaked in primitive vegetation which caught fire and burned.

The Bone Bed itself is actually beneath ground level at this site and collecting is not allowed as this is a Site of Special Scientific Interest (SSSI).

Number 8 is the last stop on this walk. You may now return via the route you took to the centre of town, or alternatively cross the bridge beside the Charlton Arms and continue up Broad Street, passing through the arch and then up the hill until you reach the Butter Cross at the top. Turn left to return to the Square where you will find Ludlow Museum SO 513 748.



A DEMAND DRIVEN INNOVATION MODEL AND CONSUMER ENGAGEMENT

Dr Suzanne King

Mark Dyball

Directors of People Science & Policy Ltd

Two articles in the Summer 2010 edition of *Science in Parliament* made us pause for thought. Both, we think, are linked, although perhaps the link is not immediately apparent. The articles are: *A Gap in the Innovation Market* by David Dent and *Consumer Engagement with Emerging Technologies* by Rob Reid.

David Dent is commenting on the supply driven model of innovation in the UK and Rob Reid on the need for more public engagement early in the development of new technologies. Bringing public engagement into the innovation model could be the way forward for those concerned that innovation models do not consider demand and for those who want to see the public more engaged with research.

Since the House of Lords report in 2000 *Science and Society* the concept of 'public understanding of science' has been derided and the focus has been on two-way dialogue between policy-makers, scientists and the public. In 2004 Demos published *See Through Science* which championed 'upstream engagement', that is, researchers and policy-makers engaging with the public about new scientific developments as technologies emerged, rather than waiting until they were close to market. Survey work from that time suggests some public support for this approach. In the Office of Science and Technology's 2005 nationally representative survey of public attitudes to science *(Science in Society Findings from Qualitative and Quantitative Research)* 79% of respondents agreed that *"I would like more scientists to spend more time than they do discussing the implications of their research with the general public"* and 74% agreed that *"We ought to hear about potential new areas of science and technology before they happen, not afterwards".*

'Upstream engagement' was largely seen within a policy context and was described as having the potential to inform decisions about the nature of developments before *"entrenched or deeply polarised positions appear".* This tends to see public engagement as a tool for averting conflict through early conversations between researchers, policy-makers and the public about research priorities.

Nevertheless, some researchers resist the drive for more public engagement. Our survey for the Royal Society *(Factors Affecting Science Communication,* 2005) found that many cited the lack of time and competing pressures as the main barrier. Some researchers fear the public will veto research in their field, although such a specific veto seems unlikely. This year Paul Benneworth's *review of the evidence base surrounding the value of public engagement by scientists* for the Science for All Expert Group (convened by BIS to help develop the science and society strategy) refutes this possibility. He states that *"there is no reasonable prospect of encouraging engagement which significantly impinges on scientists' autonomy to pursue interesting avenues".* Indeed, DIUS's more recent nationally representative survey of the public published in 2008 *(Public Attitude to Science)* shows that there is public support for basic research, with 86% agreeing that *"Even if it brings no immediate benefits, scientific research which advances knowledge is necessary and should be supported by government".*

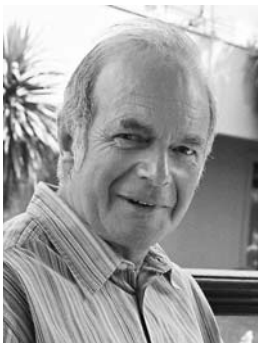
Perhaps a more realistic fear, given the way that plant science was affected by the GM furore of a decade ago, is a loss of a broader licence to operate. Benneworth suggests that *"a little more engagement, of the sort already being undertaken, but more effectively organised, can help to secure science's licence to practice in these increasingly sceptical times".*

Despite the recommendation in *Science and Society* that "*… direct dialogue with the public should move from being an optional add-on to science-based policy making and to the activities of research organisations and learned institutions, and should become a normal and integral part of the process",* public engagement remains something of an add-on. However, *Factors Affecting Science Communication* shows that many academic researchers believe that public engagement positively helps their research. Over half (53%) agreed that public engagement could help researchers make new contacts and only a fifth (21%) agreed that there were no personal benefits associated with public engagement.

Based on this positive response we see a role for public engagement in the innovation process, not to avoid conflict, but to promote better, more usable, satisfying products that are commercially viable. We suggest that engaging the public in innovation as partners could update and improve our innovation model and ensure that market pull complements technological drive. After all, market research is increasingly facilitating the co-production of products that are nearer to market with the public and new commercial products and services have long been tested with potential consumers. Such co-production is becoming ever more the norm in service delivery, especially in healthcare environments.

We conclude that the innovation process could benefit from public engagement, not only in an upstream fashion to *"promote and protect"* public interests as Rob Reid describes, but downstream as a potentially crucial element in David Dent's *"market-led"* innovation model.

CHALLENGED BY CARBON: THE OIL INDUSTRY, CLIMATE CHANGE - AND DEEPWATER HORIZON



Dr Bryan Lovell

You can't argue with a rock. Thanks to geology, the scientific case for human-induced climate change has recently become significantly more plausible. New observational science based on cores taken deep beneath the floor of the Atlantic Ocean offers crucial support for the computer-based forecasts of those creating models of future climate change. Thanks to the work of the late Sir Nick Shackleton and his colleagues, the record of Earth's past climates recorded in rocks can now be measured with far greater definition than before: divided into thousands rather than millions of years. This major scientific breakthrough means that changes in climate that took place long ago can now be examined on a human timescale.

One of these ancient past changes in climate is a particularly important guide to present-day concerns: a dramatic warming event that took place 55 million years ago (55 Ma). Comparison of the volume of carbon released to the atmosphere at 55 Ma and the volume we are now releasing ourselves strongly suggests that we are indeed facing a major global challenge (see Figure). We are well on our way to repeating that 55 million-year-old global warming event, which disrupted Earth for over 100,000 years. That event took place long before *Homo sapiens* was around to light so much as a camp fire. Now we have no excuses, we are here and we are aware of our capacity to precipitate major inimical changes to our habitat on this planet. We can cope, but only by adopting a new intellectual framework for energy policy that is based on that awareness.

This is an unusual challenge to the established order, comparable to the greatest periods of political and social change. Successful resolution will require an unusual degree of cooperation between all sorts of tribes: academic, social, financial, industrial, political and national. This kind of cooperation was the real value of the 1997 Kyoto Protocol, and was the original hope for the disappointing successor meeting in Copenhagen in 2009. That hope has now been transferred to the imminent Cancun climate summit. The Kyoto agreement was never going to be a sufficient answer in itself to coping with climate change, but it was a sign that the global community has the capacity to edge towards the scale of cooperation that is required.

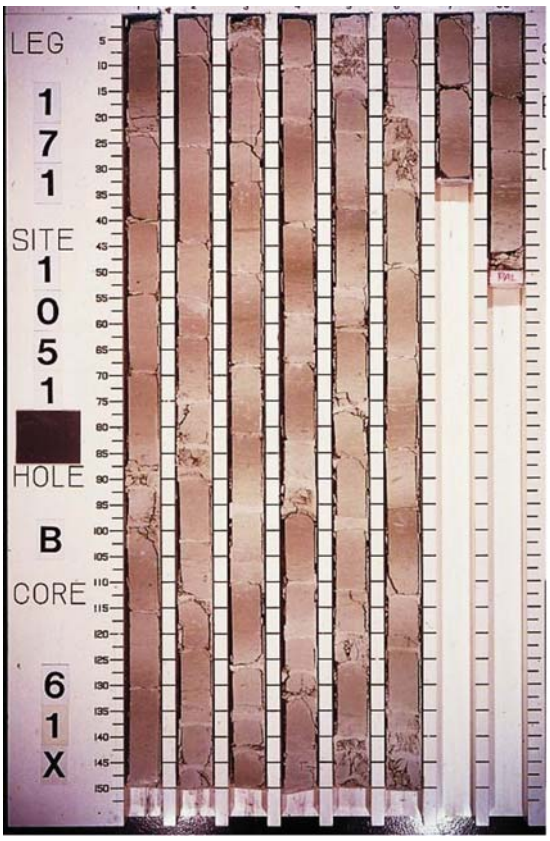
That cooperation clearly has to embrace China and India. These two countries are moving along paths of development that emulate those followed previously in the developed world, with heavy reliance on fossil fuels – especially coal. How can such countries achieve their aspirations for rapid development while maintaining their current relatively low per-capita output of fossil carbon? Can the developed countries maintain the confidence of their consumers and voters while reducing per-capita output of fossil carbon?

Here the oil companies may have a chance of redemption from their classical role as the villains of climate change, by giving a positive response to being challenged by carbon. In

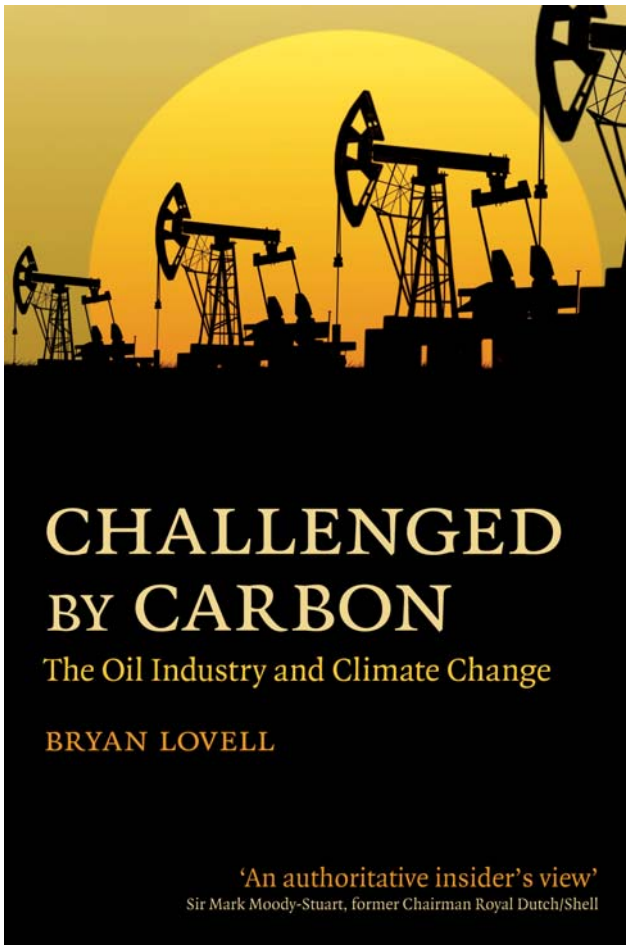
principle they could capture and then store safely underground a good part of the fossil carbon released to the atmosphere through their agency – and that of the coal industry. Although the price in energy and dollars of that capture and safe storage is still not clearly defined, I for one would put effort into such a venture – given the creation of a fungible market for carbon comparable to that we now have for oil.

Can the major international non-state oil companies, who control only a few per cent of the world's reserves of oil and gas, persuade their shareholders to keep investing when they seek to make money by disposing of fossil carbon (in the form of anthropogenic carbon dioxide), as well as profit by pumping it out of the ground (in the form of oil and natural gas)? And can the major state oil companies, who control the greater part of the world's reserves of oil and gas, persuade their governments that part of their role should be the safe disposal of carbon dioxide?

Yes, but only if political, economic and financial institutions adapt to a global imperative to regard the safe capture and disposal of carbon dioxide as an activity as important as taking fossil fuels out of the ground. This adaptation clearly requires a widespread and deep conviction that there really is a problem to be solved. That depth of conviction can be achieved by reading what is written in the rocks.



Cores of 55 million-year-old sedimentary rock recovered in 1997 from beneath the deep sea floor of the North Atlantic Ocean by Ocean Drilling Programme.



The oil industry is based on rocks found across the planet. Will that industry be able to seize the advantage of its geological and global perspective to bring general environmental benefit to its customers, while protecting its own profits? We have long relied on the oil folk to use their ingenuity to supply us with their mighty handy products: now we need their inventiveness to help us manage our transition from that dependency. But can we trust the oil companies to help us with that transition, in the wake of the Deepwater Horizon blowout in the Gulf of Mexico in April 2010? The short answer is still yes, but to see why we need to look at that tragic accident from a number of angles.

My first and main comment on Deepwater Horizon is this: you don't have to have been involved in oil exploration to recognise that loss of life on a drilling rig dwarfs all other considerations. After that come reckonings of environmental impact, costs and corporate and personal responsibilities – and assessment of technical competence.

An extraterrestrial visitor to the scene of the spill in the Gulf of Mexico, versed in geology but not in history, might ask: why does humankind seek high-cost oil and gas here rather than drilling much more cheaply onshore in Iran? As a veteran of early deepwater Atlantic drilling in the 1980s, and former Middle East exploration manager for BP, I'm happy to have a go at that question.

Only part of Earth was formerly covered by the ancient

Tethys Oceans, the geological evolution of which led over tens of millions of years to the generation and preservation of abundant oil in what is now the Middle East. By the 1980s access to much of that oil could be gained only on post-imperial service-fee terms, which had limited attraction for the many oil companies used to high risk-high reward equity-based deals. Hence the move into deepwater Atlantic exploration, hence the subsequent big successes in finding oil for our continuing eager use off the shores of Angola, Brazil — and in the Gulf of Mexico.

The human spill from Deepwater Horizon will wash across the Gulf to the next prospectively querulous climate summit that is about to begin in Cancun. During the weeks that oil leaked into the gulf from the Macondo well, at rates an order of magnitude greater than natural regional seepage, around the world we continued to add to the hundreds of billions of tonnes of carbon that we have already released into the atmosphere (see Figure). We have dumped this carbon deliberately, not accidentally, as we burn fossil carbon taken from beneath the gulf and elsewhere: coal, gas and oil.

The fossil carbon spilt in the form of oil from Deepwater Horizon has been obvious to those nearby, and to the world at large. The invisible and odourless carbon dioxide added to the atmosphere by mankind burning fossil carbon is not at all obvious. In the atmosphere it is measured in mere traces: if it smelt, it would catch the attention of a springer spaniel but might still not alert a human being. Yet the effects are significant: the dog barks urgently and we need to act now.

It was an early cliché of the climate debate that we are carrying out an experiment with the planet with an unknown outcome: that is no longer true. We can now see quite clearly what happens when you dump carbon into the atmosphere at the rate and volume of the past couple of centuries. There is significant global warming. The temperature of the deep ocean waters rises by several degrees centigrade, leading to a rise in sea-level of several metres. Acidification of the oceans contributes to widespread extinction of marine life, accompanied by widespread extinction of life on land. This natural experiment has been repeated several times on planet Earth. Unless we are curious to see if our own species can survive, we should stop pulling the carbon trigger.

Once most of us are convinced by the message from the past that we really do have a problem in the future we will find an unlikely potential ally. The oil industry can pump carbon dioxide released by coal-fired power stations into safe underground storage using routine technology, without depending on the frontier technology used in deepwater operations in the Gulf of Mexico and elsewhere. This underground storage will be opposed by some on the grounds that it prolongs the life of the villainous fossil-fuel industries. Yet it is inevitable that coal will continue to supply much of the world's demand for electricity for years. The oil industry should prepare to act on the heroic scale required to make a dent in the problem of carbon release.

Deepwater Horizon reminds us that terrible accidents may take the lives of the skilled workers who probe rocks to find the fossil carbon that has fuelled so much of our material prosperity over the past century. What is written in those same rocks tells us, with increasing urgency, that we cannot simply burn that carbon with impunity.

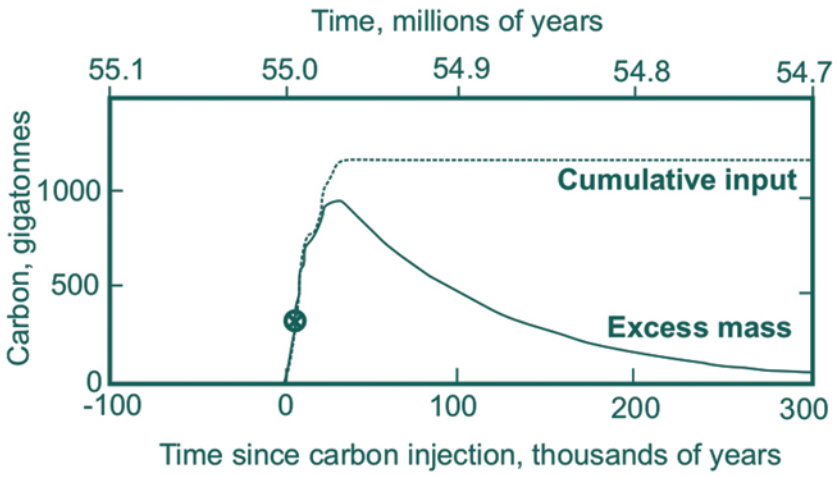
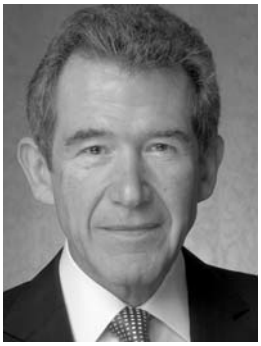


Figure (figure 2.3 in Challenged by Carbon, CUP 2009)
Sketch after a section of an illustration used by Professor Gerald Dickens in his discussion of the work of Richard Norris and Ursula Rohl in *Nature* in 1999. This figure shows the rapid release 55 million years ago of carbon and its subsequent removal (see 'Excess mass') from the atmosphere and oceans over 100 000 years. We may use this 55 Ma event as a guide to the effect of our present-day release of carbon, should this remain unchecked. We have so far climbed at least 300 gigatonnes (a gigatonne is a thousand million tonnes) up the steep slope of 'Excess mass' that begins at zero (55 Ma), so we have already reached at least as far up the curve as the point marked X.

Bryan Lovell has been Senior Research Fellow in Earth Sciences at Cambridge University since 1996. He was formerly with BP Exploration, and at Oxford, Harvard, and Edinburgh Universities. Lovell is currently President of the Geological Society, writing here as an individual. This article is drawn from his *Challenged by Carbon: the Oil Industry and Climate Change*, published by Cambridge University Press in 2009, and from his article on Deepwater Horizon in *The Times* of 4 August, 2010.

SECURING A SUSTAINABLE FUTURE FOR HIGHER EDUCATION

AN INDEPENDENT REVIEW OF HIGHER EDUCATION FUNDING & STUDENT FINANCE 12 October 2010



Lord Browne of Madingley

England has an internationally respected system of higher education. There are now a record number of people enrolled, studying an increasingly varied range of subjects at a diverse set of higher education institutions ('HEIs'). Graduates go on to higher paid jobs and add to the nation's strength in the global knowledge based economy. For a nation of our scale, we possess a disproportionate number of the best performing HEIs in the world, including three of the top ten.

However, our competitive edge is being challenged by advances made elsewhere. Other countries are increasing investment in their HEIs and educating more people to higher standards.

In November 2009, I was asked to lead an independent Panel to review the funding of higher education and make recommendations to ensure that teaching at our HEIs is sustainably financed, that the quality of that teaching is world class and that our HEIs remain accessible to anyone who has the talent to succeed. Over the last year, we have consulted widely and intensively. Our recommendations are based on written and oral evidence drawn from students, teachers, academics, employers and regulators. We have looked at a variety of different systems and at every aspect of implementing them – financial, practical and educational – to ensure that the recommendations we are making are realistic for the long term. I would like to thank all those who have contributed their knowledge, experience and time to this review. Our findings are contained in our full report and summarised here.

Great advances have been made in making it possible for more people from all backgrounds to enter an HEI. Currently 45% of people between the ages of 18 and 30 enter an HEI, up from 39% a decade ago. Improvements have been made to ensure that students from disadvantaged schools or backgrounds are given a fair chance to study for a degree. Our recommendations build on this success. Support by way of cash for living ('maintenance') will be increased. Those studying for a degree part time will be given proportionate access to funding to those studying full time.

The quality of teaching and of the awarded degrees is the foundation upon which the reputation and value of our higher education system rests. Our recommendations in this area are based on giving students the ability to make an informed choice of where and what to study. Competition generally raises quality. The interests of students will be protected by minimum levels of quality enforced through regulation.

England's HEIs are very varied, in the type of student they attract, the standards of attainment they require for entry, the courses taught and so on. While most of higher education takes place in an HEI called a university this one word does not capture the reality of their diversity. Our recommendations reinforce this diversity. And since one size does not fit all, we would expect the result to be that HEIs will set varied charges for courses.

A degree is of benefit both to the holder, through higher levels of social contribution and higher lifetime earnings, and to the nation, through higher economic growth rates and the improved health of society. Getting the balance of funding appropriate to reflect these benefits is essential if funding is to be sustainable. Our recommendations place more of the burden of funding on graduates, but they contribute only when they can afford to repay the costs financed.

Students do not pay charges, only graduates do; and then only if they are successful. The system of payments is highly progressive. No one earning under £21,000 will pay anything.

We estimate that only the top 40% of earners on average will pay back all the charges paid on their behalf by the Government upfront; and the 20% of lowest earners will pay less than today. For all students, studying for a degree will be a risk free activity. The return to graduates for studying will be on average around 400%.

In formulating our recommendations we had to balance the level of participation, the quality of teaching and the sustainability of funding; changing one component has an impact on the others. What we recommend is a radical departure from the existing way in which HEIs are financed. Rather than the Government providing a block grant for teaching to HEIs, their finance now follows the student who has chosen and been admitted to study. Choice is in the hands of the student. HEIs can charge different and higher fees provided that they can show improvements in the student experience and demonstrate progress in providing fair access and, of course, students are prepared to entertain such charges.

Our recommendations will lead to a significant change; we do not underestimate the work that will be required. Since this review was commissioned the pressure on public spending has increased significantly. This will add urgency to make funding sustainable. We hope that, as these recommendations are debated, no one loses sight of the powerful role that higher education will play in continuing to build the greatness of this nation.

Respectfully submitted on behalf of the Review Panel, by Lord Browne of Madingley FRS FREng, Chairman

www.independent.gov.uk/browne-report

THE COLLAPSE OF COMPUTING EDUCATION IN SCHOOLS

Simon Peyton-Jones (Microsoft Research Cambridge)

Bill Mitchell (BCS, The Chartered Institute for IT)

There is a serious problem with the way we are educating our young people about Computing. The majority of students leave school actively disliking what they mistakenly believe to be Computing. As a result applications to UK University Computer Science courses have collapsed by 60% since 2000, yet the demand for software professionals across the EU has grown by 33% in the same period. The value added to the EU economy directly from IT products and services is around £480b each year. Computing is a vital part of Science, Technology, Engineering and Mathematics. It is also an academic discipline in its own right, underpinned by scientific and mathematical principles. It is the silent 'C' in STEM. The UK economy is missing out because we cannot meet the urgent demand from UK companies for software professionals who have the expertise necessary to create business growth.

The problem in schools is widely acknowledged by bodies such as Ofsted, the Royal Academy of Engineering, the Council for Industry and Higher Education (CIHE), BCS The Chartered Institute for IT, the Council for Professors and Heads of Computing (CPHC), the UK Computing Research Committee (UKCRC), and e-Skills UK, among many others. Yet nothing is being done about it, and the underlying causes remain. The upcoming Curriculum Review offers an opportunity to address these challenges.

The concern is that, in too many cases, children learn only how to use office software such as word processors or spreadsheets, and miss out entirely on the excitement of learning how computers actually work. An analogy would be if classes in English consisted only of learning how to spell, but missed out how to write good prose, how to analyse literature and omitted how to articulate ideas and arguments concisely, elegantly and in a compelling way.

There is such a level of universal concern that the Royal Society has begun a study into the state of Computing in schools and its importance and implications for the economic and scientific wellbeing of the UK. This has been reported by the BBC and widely picked up in the technical press. The Royal Society has set up an Advisory Group for the study and their first meeting was held on 20 July 2010, chaired by Professor Steve Furber FRS of Manchester University and former BCS trustee. BCS, the Chartered Institute for IT, is the professional body for IT and Computing in the UK and has over 70,000 members.

ICT, Information and Communication Technology, is part of the National Curriculum and taught as a GCSE by all secondary schools. It teaches students the skills needed to use everyday software applications. Computing as a discipline is concerned with the fundamental principles that underpin computer based systems and the programming languages they can execute. It is about how computers work. The ICT syllabus contains almost nothing about Computing. The March 2009 Ofsted report into ICT GCSE 'The Importance of ICT' states "Too many of the lessons seen during the survey emphasised the development of skills in using specific software at the expense of improving students' ICT capability."

There is plenty of anecdotal evidence that suggests the ICT GCSE is sometimes used as a soft option that will help a school climb the league tables. University admission tutors in private will say the gold standard for applicants to their Computer Science degree courses is A2 level Maths. In some cases, the only A2 level subject explicitly referred to by an elite University in their entry requirements for a Computer Science Degree course is Maths. For example see Manchester University's entry requirements.

A2 level Computing is seen by many Universities as desirable for their Computer Science Degree, although not essential, if the applicant is also taking Maths or Physics. For example see Surrey University's entry requirements. The fact that A2 level Computing is not a prerequisite must, in part, be a reflection of the small numbers that take the subject compared to Maths. If large numbers of students took A2 level Computing that would enable Universities to significantly enhance their degree courses, because students would already have mastered elementary Computing concepts at school before starting at University. For that to happen the ICT curriculum would have to be radically changed in order to make A2 level Computing an appealing prospect. At the moment less than 5,000 students take A2 level Computing, which is 57% lower than 2001, and is likely to collapse further if we leave things as they are.

A number of Universities now run a HND in Computing, which is also used by some as a means of direct entry to second year undergraduate programmes. In other words, some Universities are using alternative routes to deliver post GCSE education in Computing. This enables them to cover the foundations of Computer Science; covering topics that are

completely missing from the majority of school classrooms. All of this suggests there are significant systemic problems in the design and delivery of the Computing curriculum.

The problem is not lack of concern from school teachers; many of whom are working extremely hard to improve the way computing is taught within the National Curriculum. There is, however, a serious shortage of Computing specialist teachers and of easy to use, inspirational classroom-ready Computing material. Many non-ICT specialist teachers end up teaching ICT at GCSE and would very much like support in delivering more interesting and intellectually stimulating Computing material, but have no local network of peers to turn to. They struggle to convince their school senior management of the need for more Computing within the ICT curriculum.

BCS believes that Computing is as fundamentally important as Maths as an academic discipline and one that all school children should learn. In the twenty-first century every advanced economy will need the majority of its citizens to be capable of computational thinking. That is why BCS is working with groups such as Computing At School and CS4fn to promote the teaching of Computing in schools.

BCS has been a long standing provider of vocational qualifications and will continue to do so because we believe they are an important benefit to society. Ensuring everyone can be an intelligent user of IT is vital. However, being an accomplished IT user is not the same as having a basic understanding of the principles of Computing. This is where there is general confusion in the National Curriculum, and why Computing as a discipline has been virtually lost in schools.

BCS is one of twenty-four organisations, including the Royal Academy of Engineering, supporting the Royal Society with their study.

BCS coordinated an initial fund raising activity in March 2010 to demonstrate the level of commitment from the Computing community for such a report on behalf of the Royal Society. Many thanks go to all those who provided financial assistance and pledges of funding. Namely the Universities of Cambridge, Edinburgh, Glasgow, Greenwich, Imperial, Leicester, Loughborough, Manchester, Open University, Oxford, Queen's University of Belfast, Sheffield Hallam, Surrey, UCL, York, and Dundee, and larger pledges from BCS, CPHC, EPSRC, Google, Microsoft Research and Praxis. Without this support, the study would not have been possible.

EDUCATION FOR ENGINEERING – A NEW VOICE ON EDUCATION, TRAINING AND SKILLS

Dr Rhys Morgan
Head of Secretariat E4E
Royal Academy of Engineering

The professional engineering community has come together to present a single voice to Government on the education, skills and training needs of UK engineering.

Over the last 12 months the professional engineering community has created Education for Engineering (E4E), a collaborative body to represent the profession and provide a single coherent voice to Government on education, training and skills needs for engineering.

It has been a very busy first year for E4E. The Coalition Government are writing new policies on schools, the further education sector and higher education, all of which are key to ensuring an adequate supply of engineers and technicians for the future. E4E has been working to shape and communicate our position on all these areas.

To meet the challenges facing engineering, E4E has developed a set of immediate policy priorities for Government which it feels are important across all engineering sectors and have implications for engineering and technology industries.

The six immediate policy priorities that E4E has identified for the Coalition Government are:

- Promoting the standing of qualified technicians and highlighting their contribution to society and the economy;
- Supporting careers education and guidance on professional engineering and technology careers;
- Promoting engineering-related qualifications;
- Reinforcing specialist STEM teaching expertise;
- Ensuring adequate subject CPD and industry experience for STEM teachers, and
- Taking steps to enable a more diverse engineering workforce.

Over the next twelve months E4E will be working with Government and Parliamentarians to ensure that decisions made are in the best interest of engineering which will be of benefit to the broader economy. A copy of the E4E briefing on education and training for engineering can be found at: http://www.educationforengineering.org.uk/e4e_briefing.pdf

ENGINEERING OUR FUTURE NOW!

Barry McGregor
Primary Engineer

Following on from MP Andrew Miller's article 'Engineering the Future' which concerned itself with the relationship between engineering policy and government. I was prompted to add to the debate that if we truly are going to Engineer the Future then it is about time we started to look carefully how we invest in our greatest natural resource – primary schools – yes primary schools. Primary teachers are a dedicated bunch they teach class sizes larger than at any other level of education, their expertise extends over 9 subject areas, they work with the same class every day of the academic year – the differences between our primary and secondary schools structure is evident – yet we expect children to move between them without turning a hair. How then are primary schools the focus – given the impact of Primary Engineer we can see that the root of the engineering debate should begin in our primary schools.

Perhaps it would do well here to identify a number of issues surrounding the teaching and the inspiring of pupils into engineering. After all if 11 and 12 year olds have a fair idea of what they want to be when they grow up and have held that idea for a number of years – they must have formulated them in primary schools. In the primary curriculum there is no such subject as engineering, secondly the closest, possibly design and technology is in many instances not taught with the confidence that would do it justice – why would that be? Perhaps, just perhaps, for decades a teacher during their training unless very lucky will only receive half a day, perhaps as much as two on the skills required to teach it to 30 children at a time. Perhaps that goes some way to explaining the paltry coverage of the subject, the erosion of advisors leaves the subject floundering, and yet it's potential to draw together the essential STEM elements and emphasise the E is missed, yet acknowledged by many teachers, educationalists and parents. STEM as an acronym which is stronger than the sum of its parts but in many instances the implementation can leave out the 'E'.

Do we have a light at the end of the tunnel – well you may well be surprised to hear that there is an organisation called Primary Engineer that is supported by the Royal Academy of Engineering, Engineering UK and LRET that has hit the nail on the head. It is also a programme that I have watched grow not only in terms of its breadth and quality of delivery but also in the numbers of schools engaging with it and, vitally, its impact. Primary Engineer works with secondary (subject specialist teachers) who they train to deliver targeted design and technology with practical maths and science to primary teachers. This linkage of teachers gives the opportunity to develop much needed subject

networks, whilst at the same time offering secondary teachers an insight into the 'primary experience'. These subject networks develop true links across the curriculum. Understanding the experiences of primary pupils they will soon be teaching – goodness, that would allow them to build on what primary children have been learning – surely this is what we should be doing, and work towards fighting against the recognised dip in enthusiasm seen so often on poor 11 and 12 year old faces.

The programme looks to be used in the classroom, not as a club to the already converted but to inspire latent learners and the disengaged alongside the curious, using materials that are embedded in the national curriculum. The projects are designed and named to engender an engineering ethos for example for 5 to 7 year olds Primary Engineer Apprentice Levels 1 and 2 and for 8–10 year olds Primary Engineer Levels 1 and 2. Not only are the key words engineer and apprentice now part of the primary pupil and teacher vocabulary but also the manner that science and maths are applied to the problem solving required for design technology activities. This has resulted in children not creating subjects silos – the 'I can't do maths' is not heard, frequently the children don't recognise the separate elements as they are so naturally embedded in the projects they undertake. A phrase Primary Engineer coined came from a teacher who was approached by a disgruntled pupil saying that she, the teacher, was no longer liked! When asked why, the pupil said it was because she had been teaching them maths and science without them knowing it – STEM by Stealth – a perfect compliment for any teacher and a perfect description by which to describe primary engineering education.

Every year Primary Engineer invites children to participate in a number of regional events leading to a National Final sponsored by THALES and showcased at the Big Bang Fair. The IMechE have been huge supporters of these events providing judges who are frequently taken aback at 9 year olds competently describing mechanical advantage and the iterations their design has undertaken. Parents have been hugely supportive of these activities delighted to see that something for once that is hard rather than frivolous can be fun and exciting. This slowly develops the essential personal satisfaction ethic we must have if the generation after next are to become the confident, inspired and curious learners engineering requires and all other careers would benefit from.

Since being in the position of National Specialism Coordinator: Engineering Colleges working for the Specialist Schools and Academies Trust and then Director of Engineering at Jarrow School, South Tyneside, I have watched primary teachers and pupils grow in confidence supported by a programme that exists on a shoestring compared with budgets that are being squeezed and quangos dismantled. Their programme covers core skills in design technology with applied maths and science, and recently in order to inspire further they launched the Primary, Secondary and Advanced Leaders Award for STEM asking pupils to apply to become leaders for STEM activities in the school, help others and, vitally, ask pupils to interview professionals in STEM careers to ask the questions that not only interest and intrigue them but will open the doors on horizons they and their teachers didn't know existed – if this coordinated impact in Primary schools doesn't inspire the next after next generation of engineers I don't know what will – perhaps the only thing to hold it back is lack of recognition from those organisations and companies these engineers will work for and a government to whose future it is inextricably linked.

How many of the generation after next will have fond memories of Primary Engineer? Witnessing the enthusiasm on the faces of the primary pupils, and at events their parents, quite a few I would say. Perhaps it is time someone had a quiet word with Primary Engineer, given how we need to be engineering our future now.

An invitation to attend events and gather a greater understanding of the impact on pupils, teachers and parents is extended by myself and from Susan Scurlock, Chief Executive of Primary Engineer

www.primaryengineer.com and www.leadersaward.com

Primary **Engineer**

IMPACT OF CUTS ON PRIVATE AND CHARITABLE FUNDING FOR MEDICAL RESEARCH

The Academy of Medical Sciences

The Academy of Medical Sciences has warned that the UK's competitive advantage in medical science is reliant on a Government commitment to maintaining a thriving publicly funded research base. Any cuts risk damaging the UK's rich landscape of medical research funders and would jeopardise the private and charitable funding leveraged by public spending.

In a submission prepared for Government in the build up to the next spending review the Academy warns that it would be a mistake to believe that industry and charities could simply fill the gap if public sector funding were reduced.

Academy President Professor Sir John Bell said, 'Public spending on medical research leverages, rather than displaces private and charitable funding. During this time of economic uncertainty we must retain researchers and life science industries and ensure that medical research charities continue to invest in UK research. A long term commitment to publicly funded research is vital if we are to harness the competitive advantage previous investment has generated.'

Investment in biomedical science has helped the UK to create one of the most significant and productive sectors in the UK economy after financial services. In addition to public funding, each year medical charities invest £1.1bn in UK health research and every £1 increase in public funding stimulates up to £5 investment into research by the pharmaceutical industry. As well as leveraging this increased investment, close funding relationships between academia, industry and the charity sector ensure that the outcomes of publicly funded medical research are quickly translated into actual health and wealth benefits.

The submission urges Government to make a long term commitment across the science base to retain increasingly mobile researchers and industries about the future of medical research in the UK. It recommends publishing a new science framework in the context of the current economic climate which should:

- Prioritise excellence.
- Safeguard the UK's world-class universities.
- Protect the autonomy of universities and research councils.
- Focus on reversibility to maintain capability to regenerate key areas when funding becomes available.
- Maintain and grow the essential partnerships between public, private and charity sector funders.
- Ensure limited funds are spent effectively by promoting coordination amongst funders and reducing unnecessary bureaucracy.

The spending review submission was accompanied by a paper detailing how biomedical research can be a platform for increasing health and wealth in the UK that was prepared at the request of David Willetts MP, Minister of State for Science and Universities. It highlights how if properly supported, medical research will create new jobs, catalyse sustained economic growth and help to restore public finances by improving health and making the NHS and public services more cost effective.

In response to the Academy of Medical Sciences submission to the 2010 Spending Review

Simon Denegri, Chief Executive, Association of Medical Research Charities said, 'With the support of the public, medical research charities put over £1 billion on the table for health research last year. Whether this investment will pay dividends for patients and their families will be influenced heavily by the decisions the government makes over the next few months. They must demonstrate that they share the public's vote of confidence in research with policies and funding for the long-term.'

Dr Liam O'Toole, Chief Executive Officer, Arthritis Research UK 'About 10 million people suffer from the many different forms of arthritis in the UK, and this number is increasing. For a rapidly growing charity such as Arthritis Research UK it is crucial that we are able

to plan long-term research. A joined up approach between Government, charity and industry over the last few years was just starting to make it easier to translate research ideas into benefits for people who suffer from arthritis. If the Government stops doing its bit now, this will seriously reduce the impact we can have on the 10 million sufferers of arthritis and their ability to be independent and actively contribute to society.

Dr Allison Jeynes-Ellis, Director of Medical and Innovation at the Association of the British Pharmaceutical Industry said, 'Last year, the pharmaceutical industry invested £4.3 billion in R&D in the UK to develop new medicines – we are by far the largest private sector investor. Every year, pharmaceutical companies decide on where they wish to conduct research, and they are increasingly collaborating with academia. The UK must continue to be globally competitive to attract this level of interest, it must maintain public sector investment in science, and ensure that innovative medicines are valued appropriately.'

Dr Patrick Vallance, Head of Drug Discovery for GlaxoSmithKline, said: 'A strong science base takes years to build up – it's not something you can break up and then pick up again 5 years later. It takes a very long time to create the right environment, and to have sustainable investment. The UK's excellent biomedical research base is one of the reasons GSK locates around 40% of our pharmaceutical R&D in the UK.

'We know it will be a tough spending review, but we hope the Government will focus funding on research in centres that are world class and further encourage collaboration with industry. The areas of real excellence do need to be protected for current research and also for the future generations of scientists.'

Jon Sussex, Deputy Director of the Office of Health Economics, said, 'Research by the Office of Health Economics and others has shown that public investment in medical research offers exceptional economic returns and stimulates additional R&D by the pharmaceutical and life sciences industry. Strong, sustained Government support for medical science is a very good investment, enabling the UK to benefit from the economic prosperity produced by this vital sector as well as from the advances in health care that result.'

The Academy of Medical Sciences was one of seven organisations invited by Professor Adrian Smith, Director General, Science and Research, Department for Business, Innovation and Skills to provide advice on the science budget in the context of the spending review.

The independent Academy of Medical Sciences promotes advances in medical science and campaigns to ensure these are translated into benefits for patients. The Academy's Fellows are the United Kingdom's leading medical scientists and scholars from hospitals, academia, industry and the public service.
www.acmedsci.ac.uk

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SCIENCE, RESEARCH AND INNOVATION

The Rt Hon Dr Vince Cable MP. Secretary of State for Business, Innovation and Skills and President of the Board of Trade
8 Sep 2010, Queen Mary University of London

Over the next few weeks and months, major decisions will be made on Government spending priorities as part of a wider move to stabilise the country's finances and rebalance the economy. They will help to define what we value as a nation and the direction in which we want to head. Investing in science and research is a critical part of that. I cannot prejudge the outcome but I know that my colleagues, including at the Treasury, value the contribution of UK science.

I have been arguing for years my concern over the way the British economy was distorted. Money borrowed for property speculation rather than productive investment and innovation. Too many top performing graduates heading straight for high finance rather than science and engineering.

It was clear to me and my colleagues that the British economy was becoming increasingly unbalanced in the short term, as the mountain of household debt built up. We were also unprepared for a long-term future where we need to earn our living in the world through high-tech, high-skills and innovation.

One of the unhappy by-products of the burst bubble, banking crisis and recession is a massive budget deficit that we inherited. As a consequence, we face the tightest spending round

since post-War demobilisation.

My department is the largest department in Whitehall without a protected budget and science, alongside Further Education and Higher Education, is one of its largest components.

We know that the Labour Government was planning deep cuts of 20%-25% in the budget of that department. Economies on this scale are clearly a very major challenge.

There is a school of thought which says that Government commitment to science and technology is measured by how much money we spend. Money is important both for the quality and quantity. But it is an input, not an output, measure. The question I have to address is can we achieve more with less?

In deciding priorities, there is a limit to how much I can dictate the course of events. Nor do I wish to. Research priorities and technical priorities are set at arms length from Government, and through peer review. That is right. Yet the Government spends £6bn a year supporting science and research and it is right that I should speak about strategic priorities.

I feel I should start by registering a personal interest when it comes to science. I'm one of few MPs to have at least started a science degree – well, it began as natural science and ended up as economics.

My constituency, Twickenham, is one of the major centres of scientific enquiry. It contains the National Physical Laboratory, a world-leading centre; the Laboratory of the Government Chemist; and a wide variety of companies involved in science, research and innovation.

I recently discovered one accidentally as a result of a parking dispute with local residents: FT Technologies which is one of two major companies in the world making wind monitoring and airflow measurement applications, much of its production being exported to China.

And one of my constituents is inventor Trevor Bayliss, best known for inventing the wind-up radio. He constantly reminds me of the parlous status and minimal support given to inventors whose ideas so often fail to find commercial application in the UK but are used overseas.

I would add that my youngest son, Hugo, is a very theoretical quantum physicist – based in Singapore.

You could say that a little knowledge is a dangerous thing. But I am familiar with the language of science and the sorts of difficulties faced by scientists, researchers and inventors.

It is apt that I am giving this speech at Queen Mary, University of London, one of the UK's leading research-focused higher education institutions and home to 16,000 students.

The Mile End campus is historically the home of Queen Mary College, which began life in 1887 as the People's Palace, a philanthropic endeavour to provide east Londoners with education and social activities.

It was an innovation then, and continues to be innovative today.

I know that it collaborates with a Chinese university, plus it has a good record of producing spin-out technology, most notably a company called ApaTech, which eventually sold for some $330m. Indeed, Queen Mary was called "the biggest star" among research intensive institutions by Times Higher Education.

And that leads me to set out a central question for the future of science and research in this country: how far should policy be driven by economic impact?

I fully accept that scientific enquiry, like the arts, has its own intrinsic merit. It is a public good. It helps to define the quality of our civilisation, and embeds logical scientific thinking into the decision-making of Government, businesses and households. Superstition and irrational prejudice about the natural world are rarely far from the surface and scientists help inoculate society against them – a far from risk-free task as Simon Singh and others have discovered.

The big scientific ideas that changed the world were often far removed from practical, let alone commercial, applications. I suspect Newton and Darwin would have struggled to attract venture capital investment, or justify an R&D tax credit, for their work in gravity and natural selection. Newton in particular was hopeless with money and he lost a personal fortune investing in the South Sea Bubble.

More recently, Tim Berners-Lee did not develop the World Wide Web in an IT company but as a way to share information about work on fundamental physics (at CERN). Indeed, Lord Sainsbury in his 2007 report described a high correlation between successful commercial spin-offs and high-quality fundamental research.

So I regard the old debate about common room versus board room as tiresome and unproductive. We need a wide spectrum of research activity.

That said, it is reasonable to ask the question: how does Government spending in scientific research contribute to the economy?

There is a lot of evidence of the connection between innovation and economic performance.

Innovation, the introduction of new or improved products, processes or methods – has been shown to be the key driver of economic growth in advanced economies.

The 2010 OECD innovation report shows that investment in intangible assets helped account for between two-thirds and three-quarters of labour productivity growth. It also suggested that innovation is also a key source of future growth for emerging economies.

It concluded that "Governments must continue to invest in future sources of growth, such as education, infrastructure and research. Cutting back public investment in support of innovation may provide short-term fiscal relief, but will damage the foundations of long-term growth."

Some countries are acting on that advice. The US is doubling basic science spend between 2006 and 2016. China has seen a 25% increase in central government funds to the science and technology sector. In Sweden, central government funds for R&D will increase by over 10% between 2009 and 2012. And in 2009, Germany announced it was injecting €18 billion into research and higher education during the coming decade.

The OECD adds, crucially, that "there is considerable scope to improve the efficiency of government spending."

We in the UK are severely financially constrained. I want to pose the question to you: how do we economise without damaging science?

The lazy, traditional way to make spending cuts is to shave a bit of everything: salami slicing. This produces less for less: a shrinkage of quantity and quality – I have no intention of going there.

Another approach superficially more attractive would be to specialise, to say there are certain branches of science and technology that we should do or not do. My response to this is two-fold.

First, we should not politicise choices of this kind. Treasury and BIS ministers and officials, working under pressures of time as well as money, are not the people who should be making arbitrary, far-reaching decisions such as whether Britain should or should not "do" nanotechnology or space research.

Moreover, many of the suggested choices are not choices at all because disciplines interact. I recently went to Professor Bhattacharya's outstanding centre at Warwick and the whole point about his centre is innovation depends on lateral thinking between apparently different disciplines.

And my son tells me that some of the most interesting quantum work is closely linked to disciplines such as neurosurgery and optics.

There is however a strong case for identifying broad problems. For example, the challenges thrown up by an ageing population – the increased prevalence of Alzheimer's for example – need people working across biology, medicine, biochemistry and the social sciences in order to better address needs.

So too for environmental challenges, such as providing clean water or alternative energy sources, pooling different disciplines to get a better understanding of low carbon.

There is also a case for identifying and building up the areas where the UK truly is a world leader.

This includes stem cells and regenerative medicine, plastic electronics, satellite communications, fuel cells, advanced manufacturing, composite materials and many more.

There is inevitably a process of selection and choice. So, how to prioritise?

My preference is to ration research funding by excellence and back research teams of international quality - and screen out mediocrity – regardless of where they are and what they do.

Its is worth noting in the last RAE 54 per cent of submitted work was defined as world class and that is the area where funding should be concentrated.

Even a rationing of this kind presents problems. How do we allow room for new, unknown but bright people? How do we reduce, not increase, the time spent on applying for funding in a more competitive market?

There is a separate but critically important question of how we maximise the contribution of Government supported research to wealth creation.

I support, of course, top class "blue skies" research, but there is no justification for taxpayers money being used to support research which is neither commercially useful nor theoretically outstanding.

As I said earlier, it would be wrong to measure this in monetary terms alone. There are wider questions, regarding the UK's openness as a society and its attractiveness as a destination for the brightest scientists, researchers and engineers from all over the world.

It is well known that the United States first leapt ahead of other scientific nations when it welcomed the brightest thinkers from across Europe, both before and after the Second World War. Enrico Fermi, Albert Einstein, Niels Bohr, John Von Neumann and many others formed the foundation stone upon which American scientific leadership was built.

Despite considerable pressures, the US continues to garner huge benefits from the talents of immigrants. Over 25% of US high-tech start-ups in the last 10 years had at least one immigrant founder. The list of great American companies started by entrepreneurial immigrants is long. Google is the most famous recent example, but also DuPont, Intel, Proctor and Gamble, eBay and even US Steel, started by that great Scotsman, Andrew Carnegie.

I am determined that we continue to benefit from our proud history of openness in this science.

Take the Faculty of Engineering at the University of Leeds. This is ranked 7th in the UK for the quality of its research, and over 75% of its output is rated as internationally excellent. It produces work in vital areas like civil engineering; computing and electronic and electrical engineering.

One third of its students are from outside the UK, representing over 90 nationalities. Many of those students may even go on to work within the UK, lending vital skills to industries that desperately need such talent if they are to grow and innovate – passing on immeasurable benefits to the whole economy.

And openness has reciprocal benefits. UK researchers already have an excellent record of working across borders. Almost half of more than 90,000 research articles published by UK researchers in 2008 had a co-author from another country. Co-authorship with non-UK collaborators tends to produce significant impact gains: e.g. papers with USA, Germany and France have impact 50% higher than the UK research base average.

What other reforms are needed to help us achieve more with less? One approach is to break down barriers to collaboration. There is already a fair degree of international collaboration between UK and overseas institutions and companies. International collaboration is an important way for us to stay at the cutting edge of research whilst reducing the cost to the UK taxpayer.

Singapore, for example, a country with global ambition in terms of science, sends some 75% of its top scientific scholars to UK universities for their undergraduate studies. Partly due to these strong links, Imperial College announced its first overseas footprint on 29 August – a joint Medical School with Nanyang Technological

University in Singapore.

Brazil has established a laboratory in agricultural sciences in the UK (at the Rothamsted Institute) to undertake research into sustainable agriculture.

When I was in Brazil last week there was great interest in collaborative research, building on networks which have led to Britain becoming second only to the USA in science collaboration.

The key is to find ways of transforming research into innovation. The UK has a strong record but we need to do more. This involves building stronger links between the UK's science and research base and the business community; to create more spin-out companies; and to provide a magnet for attracting overseas investors to the UK.

On the last point, the fact that the UK is home to some of the leading universities in the world, and has such a strong research base, undoubtedly helps us attract overseas investors.

Examples include Tata near Warwick in the West Midlands, Boeing at Sheffield, Pfizer in Kent, IBM and Microsoft at Cambridge, and Hewlett Packard at Bristol. Research Councils work directly with over 2900 companies.

UK universities have an improving track record in terms of commercialising knowledge derived from science and research. Between 2003 and 2010, 37 university spin-outs were floated on the stock exchange with an IPO value of £1.7 billion, while 24 university spin-out companies were acquired by other business for a total value of £2.4bn.

Solexa, a Cambridge University spin-out, was sold to a US-based company in 2007 for $600 million. And NovaCem Ltd, which produces "carbon negative cement" that could potentially revolutionise the construction industry, was spun out of Cambridge and Imperial College – and the R&D for this product was supported by the Technology Strategy Board, which is one of the key government institutions in this field.

The important point from a national economic perspective is that we continue to increase the level of economic interactions between business and the research base, including spin-outs, licensing, consultancy and commissioned research.

This leads us on to the wider question of intellectual property and how we deal with it. Universities make only 5% of their externally earned income from patents and licensing. There are some striking exceptions, notably Imperial, Cambridge and Manchester, who have developed a strong professional capacity in the commercialisation of research, but more needs to be done.

Part of this revolves around intellectual property protection. UK business invests around £65 billion annually in creating IP, which is about 30% of total business investment in tangible and intangible assets.

ONS data indicates that knowledge-based services make a substantial positive contribution to the UK balance of trade. And a recent CBI survey shows 60% of UK businesses believe that IP has gained importance over the last five years, 70% believe it would continue to do so in the next five.

There are some tricky issues around IP. I have some understanding of the issues – I was responsible, in 2002, for pushing through a private members bill to strengthen copyright. We do need to look in more detail at how we strengthen IP arrangements in the UK.

The final question is how to encourage academics to collaborate with industry to maximise the benefit of their research.

The Hauser review suggested a sensible approach – establishing a network of Technology and Innovation Centres, based on international models such as the Fraunhofer Institutes in Germany. Both science minister David Willetts and I agree that it is a good way forward, and I am looking closely at the recommendations in the review and the value of investing in these in the context of the Spending Review.

But we should not simply be copying overseas models. The key point is that what works are business driven high technology clusters with academic links. We already have several: such as the Research Council campus at Harwell, and others such as Cambridge and potentially St Pancras – and we are working at how to develop this model further.

Under the previous Government we invested in over 60 of these centres, but as highlighted by Hermann Hauser, the funding was thinly spread resulting in activity that has largely failed to achieve a national impact in areas of leading UK capability such as nanotechnology.

If we are to establish a national network of technology centres we should look to drive this number down and establish well-funded centres with long-term vision, focused on areas of clear technical leadership and commercial promise. Opportunities identified by Hauser include high-value manufacturing, composites, low carbon energy, plastic electronics, space, stem cells and regenerative medicine.

Public sector procurement is another area where we can improve. Across many sectors, from health and transport to education and defence, the public sector can play a vital role as a first customer for innovative products and services.

Programmes such as the Small Business Research Initiative, managed by the Technology Strategy Board, helps to drive innovation and ensure that this takes place in areas where there is real future demand from the public sector. I am committed to making greater use of this programme to facilitate economic growth and innovation.

To summarise, I think I have made it clear that science, research and innovation are vital to this country's future economic growth. But we have to operate in a financially constrained environment.

I want to lay down a challenge to the science and business communities today. That we come together, work together and plan a future together that makes the most of this country's competitive advantages in financially difficult circumstances for the benefit of us all.

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

Following recent high profile emergencies such as the swine flu pandemic and the Icelandic volcanic ash eruptions, 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 will examine four case studies: (i) the swine flu pandemic in 2009, (ii) the Icelandic volcanic ash eruptions in 2010, and the potential emergency situations that (iii) solar storms and (iv) cyber attacks could cause. In relation to these case studies, the Committee sought views on the following:

1. What are the potential hazards and risks and how were they identified? How prepared is/was the Government for the emergency?
2. How does/did the Government use scientific advice and evidence to identify, prepare for and react to an emergency?
3. What are the obstacles to obtaining reliable, timely scientific advice and evidence to inform policy decisions in emergencies? Has the Government sufficient powers and resources to overcome the obstacles? For case studies (i) and (ii) was there sufficient and timely scientific evidence to inform policy decisions?
4. How effective is the strategic coordination between Government departments, public bodies, private bodies, sources of scientific advice and the research base in preparing for and reacting to emergencies?
5. How important is international coordination and how could it be strengthened?

The deadline for written submissions was 14 September 2010. It is expected that the written evidence received will be on the Committee's website towards the end of October.

The Committee plan to take oral evidence on the case studies at sessions in the autumn. The first sessions will be announced in October.

ORAL EVIDENCE

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

Setting the scene

On 22 July, the Committee took evidence on *Setting the scene* 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 had a further evidence session on 27 July when it took evidence from Lord Rees, President of the Royal Society.

The UK Space Agency

The Committee agreed on 27 July 2010 to examine the role of the UK Space Agency. The Agency was officially launched on 23 March 2010, replacing the British National Space Centre and is responsible for all strategic decisions on the UK civil space programme and provides a clear, single voice for UK space ambitions.
The terms of reference covered:

1. What progress has been made in setting up the UK Space Agency?
2. How does the UK Space Agency work with other bodies (national and international) on space issues?
3. Is the UK Space Agency more effective at coordinating space policy than its predecessor, the British National Space Centre?
4. What should the UK Space Agency's priorities be for the next five years?
5. Is the UK Space Agency adequately funded?

The deadline for written submissions from interested parties was the end of August. The written evidence received is available at the Committee's website.

On 8 September 2010, the Committee took oral evidence on *The UK Space Agency* from Dr David Williams, Acting Chief Executive, UK Space Agency, Andy Green, CEO of Logica & Co-Chair of the Space Leadership Council, and Richard Peckham, UK Business Development Director, Astrium Limited and Chairman, UKSpace.

After the oral evidence session the Chair of the Committee issued the following statement:

Members of the Committee found the [oral evidence] session very useful and valuable. We are not at this stage producing a report but the Committee will follow the progress of the Agency, watch the concerns raised by the wider community, and track the financial resources provided to it by the Comprehensive Spending Review. The Committee is agreed on the importance of Space both to the UK economy but also the potential it has for encouraging young people to seek careers in science and engineering. I expect that the Agency and Space is a subject that the Committee may return to later in this Parliament.

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). Due to the approaching general election the Committee had to complete its work in March 2010 before two reviews that UEA itself had set up reported (the *Independent Climate Change E-mails Review* headed by Sir Muir Russell and the *International Panel set up by the University of East Anglia to examine the research of the Climatic Research Unit* headed by Lord Oxburgh). The reviews reported in July and April 2010 respectively and published their conclusions and recommendations.

The new Science and Technology Committee decided to take oral evidence from Sir Muir Russell and Lord Oxburgh examining how they responded to the former Committee's recommendations in its report and how they went about their respective reviews.

On 8 September 2010, the Committee took evidence on *The Reviews into the Climatic Research Unit's E-mails* from Lord Oxburgh. The Committee will hold a further evidence session in October when it will take evidence from Sir Muir Russell.

REPORTS

At this early stage in the Parliament the Committee has yet to agree any Reports.

GOVERNMENT RESPONSES

The Legacy Report: Government Response to the Committee's Ninth Report of Session 2009–10

On 27 July 2010, the Committee published the Government's Response to the former Committee's Legacy Report, HC 370.

Government Response to the Science and Technology Committee report 'Evidence Check 2: Homeopathy'

On 26 July 2010, the Government published its Response to the former Committee's Report on 'Evidence Check 2: Homeopathy' as a Command Paper (Cm 7914).

Government Response to the House of Commons Science & Technology Select Committee Report: "The Impact of Spending Cuts on Science and Scientific Research"

On 30 July 2010, the Government published its Response to the former Committee's Report on 'The Impact of Spending Cuts on Science and Scientific Research' as a Command Paper (Cm 7927).

As of September 2010 Government responses to three of its predecessor Committee's Reports of Session 2009-10, are outstanding:

- *The Regulation of Geoengineering,* Fifth Report (HC 221), published 18 March 2010
- *Bioengineering,* Seventh Report (HC 220), published 25 March 2010
- *The disclosure of climate data from the Climatic Research Unit at the University of East Anglia,* Eighth Report (HC 387-I), published 31 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.

HOUSE OF LORDS SCIENCE AND TECHNOLOGY SELECT COMMITTEE

The members of the Committee in the new Parliament for session 2010-11 (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 subject matter of the second will be decided later in the year.

A call for evidence was published on 28 July 2010 with a deadline for submissions of 8 October. The Committee held a seminar as part of the obesity case study on 19 October and began taking oral evidence in November. The evidence sessions will run through to May 2011. The Committee is due to report in the Summer.

Letter to the Rt Hon David Willetts MP, Minister for Universities and Science, BIS, about research funding cuts and the ability of the UK to continue to recruit and retain the very best brains

Following evidence given to the Science and Technology Committee on 13 July 2010 by David Willetts MP, Minister of State for Universities and Science, the Committee wrote to six leading research universities in the UK to ask them whether they could provide examples of any difficulties that they had encountered in recruiting and retaining high-quality researchers and their expectation of the effects of reductions in funding.

In the light of the responses from the universities, the Committee wrote to Mr Willetts on 22 September, setting out its concern that, in a world of global talent mobility, a worsening differential in funding between the UK and other countries, whether real or perceived, would put at risk the ability of the UK to continue to recruit and retain the very best brains.

Evidence session with the Rt Hon David Willetts MP

The Select Committee held a one-off evidence session with David Willetts MP on 11 October 2010. To follow up on the Committee's letter to the Minister on funding cuts, the Committee asked the Minister what assessment had been made of the potential impact of cuts in research funding on the ability to attract and retain high-priority researchers in the UK. The Committee also asked what assessment had been made of the impact of cuts on the following areas: the UK's position as a preferred partner for international collaboration in science; the future provision of skilled engineers; the industrial science base and the mobility of peripatetic global companies; and on the regions. The transcript for the session is available on the Committee's website.

Government Procurement and innovation

The Select Committee is conducting a short inquiry into the use of Government procurement to stimulate innovation within industry. A Call for Evidence was published on 22 October 2010 with a deadline for submissions of Monday 13 December. Further information is available on the Committee's website.

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 by the end of the year.

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 Committee held a one-off evidence session with representatives from CoRWM, Lord Hunt, 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. It is anticipated that the report will be debated by the House during the current session, following receipt of the Government's response.

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.

Summary of Letter from Damian Green MP of 26 October to The Rt Hon the Lord Jenkin of Roding, in response to his letter of 7 October to the Home Secretary regarding the Government's proposal to introduce annual limits on the number of non-European Economic Area (EEA) economic migrants admitted to live and work in the UK.

1) Immigration has enriched our culture and strengthened the economy.
2) Importance of competition for world class talent and expertise is recognised.
3) UK is open for business.
4) However, immigration has been too high and must be controlled.
5) Immigration has put pressure on jobs, housing and public services.
6) Annual migration of hundreds of thousands to be reduced to tens of thousands.
7) Focus will be on the brightest and best, including top scientists and engineers.
8) No need to admit migrant workers to do jobs that residents are capable of.
9) Cross-Government actions will up-skill residents to reduce need for migrants.
10) No details available or final decision made yet on how the limits will operate.
11) Annual limit is just one of several measures to be applied.
12) Larger routes for students and family members will be looked at later.

HOUSE OF COMMONS LIBRARY SCIENCE AND ENVIRONMENT SECTION

A Research Paper produced for Members of Parliament is summarised opposite. Papers can be accessed at http://www.parliament.uk/parliamentary_publications_and_archives/research_papers.cfm

This 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

The Section made various contributions to "Key issues for the New Parliament" which was prepared by the House of Commons Library Research Service. Those contributions appear under the heading "Environment and infrastructure" and can be accessed online at http://www.parliament.uk/business/publications/research/key-issues-for-the-new-parliament/ .

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

Sustainable Livestock and Public Bodies (Sustainable Food) Bills

Research Paper 10/71

The Bills are Private Member Bills introduced by Robert Flello MP and Joan Walley MP respectively. The Sustainable Livestock Bill aims to reduce the environmental impacts of livestock production in the UK. It also aims to amend the way agricultural subsidies are used to make them more environmentally friendly. It includes a duty to give consideration to supporting sustainable practices and consumption through public procurement of livestock produce.

The Public Bodies (Sustainable Food) Bill would go further on public procurement and create a duty on the Secretary of State to prepare a Code for Sustainable Food to promote the procurement of healthy and sustainable food by public bodies. This could be made compulsory if uptake was not extensive enough.

Energy Security and Green Economy Bill

SN/SC/5559

An Energy Security and Green Economy Bill 2010-11 was included in the Queen's Speech. DECC says that the purpose of the Bill is to provide a "step change" in the provision of energy efficiency measures to homes and businesses. It also intends to put in place a framework to deliver secure, low carbon energy supplies and fair competition in the energy markets. The main element of the Bill is given as "Implementation of a 'Green deal' to deliver energy efficiency to homes and business – delivering a framework including potential incentives to energy suppliers and households that will transform the provision of energy efficiency in the UK by enabling a 'pay as you save' approach."

DECC said that the legislation "may" also include measures to: regulate the carbon emissions from coal-fired power stations; reform energy markets to deliver security of supply and ensure fair competition; put in place a framework to guide the development of a smart grid that will revolutionise the management of supply and demand for electricity; require energy companies to provide more information on energy bills in order to empower consumers and to ensure fair access to energy supplies; ensure that North Sea infrastructure is available to all companies to ease the exploitation of smaller and more difficult oil and gas fields; create a Green Investment Bank to support investment in low carbon projects to transform the economy.

This note sets out the measures in the Bill alongside what was said about these areas in the main election manifestos, the formal Coalition Government agreement and the March 2010 Conservative green paper Rebuilding Security: Conservative energy policy for an uncertain world. It also highlights comment on the proposals. In the July 2010 Draft Structural Reform Plan, DECC suggests that the Bill will be introduced in December 2010.

Coalition policy on Nuclear Power

SN/SC/5667

This note sets out the Coalition Government's policy about new nuclear build and associated issues.

The Conservative Party agreed with and supported the previous Labour administration's policy and development of new nuclear build, while the Liberal Democrats would prefer new generation to be renewable rather than nuclear. The Coalition Government has agreed that it will take forward the new nuclear build policy which it has stressed will be subject to normal planning arrangements for large infrastructure projects and without public subsidy. A Liberal Democrat spokesperson will speak in Parliament about new nuclear issues but its members will not vote on them so that an issue of confidence will not arise. This gives the Coalition the certainty it needs to develop new nuclear build.

It appears that the Coalition does intend to place a floor under the carbon price. However, the timetable is not clear and it may not happen until new plant comes online in about 10 years time. This would push up the price of allowances for polluting and incentivise investment in low-carbon generators which includes renewable, clean coal and nuclear power. It, therefore, cannot be considered a 'subsidy' solely for nuclear."

Major Infrastructure Planning
SN/SC/5041

The Planning Act 2008 provided for a new Infrastructure Planning Commission (IPC) to decide applications for major infrastructure applications of national importance. That would replace the current method of decisions being taken by the Secretary of State following a public inquiry. The IPC would make its decisions on the basis of National Policy Statements on various aspects of energy, transport, waste and water. The main provisions of the Act came into force in March 2010, when the Infrastructure Planning Commission (IPC) was opened to receive applications.

The Decentralisation and Localism Bill in the Queen's Speech would "Abolish the Infrastructure Planning Commission and replace it with an efficient and democratically accountable system that provides a fast-track process for major infrastructure projects." The Coalition Government intends to continue the development of National Policy Statements . In July 2010 DCLG published a draft Structural Reform Plan under which the IPC would be abolished in April 2012.

Housing Targets and Planning
SN/SC/3741

This note describes how the planning system produces targets for housebuilding in each area. Governments tried to use the planning system to stimulate housebuilding between about 1993 and 2010. Local planning authorities were heavily pressured to set aside enough land for housebuilding so that the Government's targets could be met. The system operating under the last Labour Government included the setting of development targets at a regional level.

The Decentralisation and Localism Bill 2010-11 in the Queen's Speech would "abolish Regional Spatial Strategies; [and] return decision-making powers on housing and planning to local councils." Regional Strategies were formally revoked on 6 July 2010 but on 10 November 2010 the High Court ruled that the revocation was unlawful. The Government stated that the Court case did not really change the position. In effect, planning authorities could use the Government's intentions as a reason for not following the Regional Spatial Strategies until the Decentralisation Bill became law.

Bovine TB and Badgers
SN/SC/3751

This note sets out recent developments in the policy on badger control. The previous Government decided in 2008 not to introduce a badger cull as part of bovine TB control measures in the light of the findings of the UK Randomised Badger Culling Trial published in 2007. This concluded that a reactive cull of badgers resulted in significant increases in Bovine TB and a proactive cull, whilst controlling TB in the cull area, contributed to an increase in TB in surrounding areas and would not be cost effective. Not all agreed. Sir David King, the Chief Scientific Adviser at the time, reviewed the findings and concluded that a proactive cull would be cost effective.

Since the election the Coalition Government has indicated that a badger cull will be introduced as part of control measures. It announced a consultation in September 2010, which set out its proposals. These include introducing proactive culls over 150km^2 areas where farmers would be licensed to control badgers by shooting. Farmers would have to bear the costs of any culls. The consultation also included proposals on TB monitoring in cattle and biosecurity.

Food Security – UK Policy
SN/SC/4985

Food security for the UK in peacetime has only recently been a subject of concern. British Governments have resisted the view that food security concerns should be met by increased subsidy for domestic – or indeed European – agriculture. Instead they have argued for freer international trade. Until 2008, the Labour Government justified financial support for farming as a means of obtaining environmental objectives.

Even before the election in 2010, however, increasing concern over food security has encouraged renewed emphasis upon domestic food production. Several reports have argued that food security problems would return unless appropriate action was taken. The Russian ban on wheat exports as a result of a drought in 2010 has raised concerns again. The Pakistan floods in 2010 are likely to create serious food supply problems in that area. Both events are probably caused by climate change.

The Coalition Government appears to be following roughly the same policy as the Labour Government on this topic.

Fluoridation
SN/SC/5689

This note sets out the positions of various groups regarding the effects of fluoridation of drinking water and the Government's position. It is not a scientific critique. Information on legislation relating to fluoridation can be found in another note, SN/SC/3135.

Marine Litter: 'Continents' of Rubbish
SN/SC/5622

Marine litter comes from many sources including waste discarded from ships, sanitary products from sewerage outflows and litter left on beaches. Some of the most problematic marine litter is made of plastic as it has a very slow rate of decomposition, leading to a gradual build up in the environment. A plastic bottle can remain intact for up to 450 years. A large amount of plastic is accumulating in large areas of the sea. These areas have been dubbed 'great garbage patches' or 'plastic continents'.

Marine litter is a major environmental issue with significant implications for the marine environment and coastal communities. It leads to large economic losses. The long term environmental impacts of marine plastic pollution are unknown. There are concerns that it may lead to chemical contaminants entering the food chain, although more research is required.

British Summer Time
SN/SC/3796

This note provides an overview of the pros and cons of British Summer Time and the altering of clocks, as well as details of attempts to change clock times in the UK.

In general, much of the evidence would seem to suggest that changing UK time to give an extra hour of daylight in the evening, rather than the morning, may provide a range of benefits. However, a trial would be required to provide more definitive information on the likely impact of such a change.

PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY (POST)

RECENT POST PUBLICATIONS

Space Weather
July 2010 *POSTnote 361*

Space weather can affect space- and ground-based technological systems and cause harm to human health. Monitoring space weather is crucial in order to understand and mitigate its impacts. International collaboration, stimulated by the approaching peak in solar activity, has a key role to play in this area given the global nature of space weather.

Resilience of UK Infrastructure
October 2010 *POSTnote 362*

National infrastructure, such as transport, energy, water supplies and communications, is essential to the UK. Investment is needed to protect it from existing natural hazards and any effects of future climate change. This briefing outlines efforts to improve the resilience of infrastructure to these risks. Vulnerability due to the interdependence of different infrastructure components, where failure of one may lead to failure of others, is also discussed.

Sea Level Rise
October 2010 *POSTnote 363*

Global mean sea levels are projected to rise over the next century. Around the UK this would exacerbate problems of coastal flooding and erosion. This POSTnote summarises the causes of sea level rise, and the uncertainties in, and the consequences for, UK climate change adaptation.

Drug Pricing
October 2010 *POSTnote 364*

The government intends to reform the way in which drugs purchased by the NHS are priced. It aims to ensure that drug costs more fully reflect clinical benefit and to improve patient access to new treatments. This note outlines current pricing policy and examines other options to evaluate drug pricing, including "value-based" pricing.

Electric Vehicles
October 2010 *POSTnote 365*

There is increasing interest in using Electric vehicles (EVs) for road transport. The technology is developing rapidly, driven in part by EU regulation of car emissions. This POSTnote examines issues surrounding large scale deployment of EVs in the UK, and discusses the extent to which EVs could reduce carbon emissions.

FORMATION OF THE NEW POST BOARD

The process of assembling the new POST Board after the 2010 general election is nearing completion. This requires Commons and Lords select committees that nominate some members as representatives to meet and make their nominations, followed by nomination of 'conventional' members by the party whips. Adam Afriyie, MP for Windsor, is chair-designate. Full details of the new Board will be given in the next issue of *Science in Parliament*.

CURRENT WORK

Biological Sciences – Deception Detection Technologies, Indoor Air Pollution, Biofortification.

Environment and Energy – Biodiversity Credits/Habitat Banking, Future Electricity Transmission, Climate Change Adaptation in sub-Saharan Africa, Environmental Limits (long report).

Physical sciences and IT – Solar Technologies, Rare Earth Metals, Technologies for Clean Water.

CONFERENCES AND SEMINARS

Science in the New Parliament

On 26th October, POST hosted an interactive exhibition in collaboration with seven of the leading organisations that fund scientific research in the UK: the Arts and Humanities Research Council (AHRC); the Biotechnology and Biological Sciences Research Council (BBSRC); the Economic and Social Research Council (ESRC); the Engineering and Physical Sciences Research Council (EPSRC); the Medical Research Council (MRC); the Natural Environment Research Council (NERC); the Science and Technology Facilities Council (STFC); and Research Councils UK (RCUK).

Science cuts across almost all areas of public policy and experts from numerous disciplines were on hand to discuss the latest research with

parliamentarians. This reception provided the opportunity to experience the hands-on exhibits and to learn more about the science involved from leading researchers. Three short presentations from a distinguished panel, which included the Science Minister, David Willetts MP, chaired by Adam Afriyie MP, chair-designate of the POST Board, highlighted the value of science in economic recovery and in providing high quality evidence upon which to make policy.

STAFF, FELLOWS AND INTERNS AT POST

Staff

A new Energy Adviser, Dr Stephen Allen, started at POST in September, following the move of Dr Michael O'Brien from POST to take up the position of specialist with the Energy and Climate Change Committee.

Conventional Fellows

Edvard Glücksman, Oxford University, Natural Environment Research Council Fellowship

Dr Gareth Owen, Kings College London, Wellcome Trust Bioethics Fellowship

David Philips, University of Bristol, Engineering and Physical Sciences Research Council Fellowship

Special 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.

INTERNATIONAL ACTIVITIES

Lectures and Presentations

The summer period has been a busy time for POST with inbound and outbound missions.

Remarkable has been the increase in requests for POST to present to inbound missions from China, which are occurring on an almost monthly basis. While keen to learn about POST's specific functions, delegations to date have requested briefings on topics ranging from water management, through forestry to the interchange of scientific expertise between government and parliament, academia and the private sector.

In August, the Director made a presentation to the final meeting of the 2010 intake of French government, research institute and private sector scientists on the annual study courses organised by the Institut des Hautes Etudes pour la Science et la Technologie (www.ihest.fr). Meeting at the Saline Royale, Franche Comté, the 40+ participants were keen to learn about the development of UK stem cell research policy and regulation.

In September, the Director made a keynote presentation at the latest in a series of regional parliamentary dialogues organised by the Science Policy Division of UNESCO (www.unesco.org/science/psd/programme.shtml). Hosted by the Syrian Parliament, parliamentary and scientific delegates came from across the Middle East and North Africa to Damascus for a two-day discussion on developing the interface between science and technology and parliaments.

In October, the Director made a presentation on "Science and Diplomacy" to the 2010 Science and Technology in Society Forum in Kyoto – and also attended an associated reception at the British Embassy in Tokyo to mark the 350th anniversary of the Royal Society, along with Sir John Beddington, government Chief Scientific Adviser and Sir Paul Nurse, president-elect of the Royal Society.

POST AFRICAN PARLIAMENTS PROGRAMME

Activities continue to focus on the Parliament of Uganda.

- Exchange visits between all 17 MP-scientist pairs involved in Uganda's second "MP-scientist pairing week" have taken place. http://www.monitor.co.ug/OpEd/Commentary/-/689364/949108/-/a0b655z/-/index.html

- A seminar was held on tree planting hosted by the Ugandan Parliament's Committee on Natural Resources - "Is Pine the right tree for Uganda" on 17th June 2010.

- A Ugandan parliamentary "science café" was held on 22nd June 2010 to discuss the impact of oil discovery on the environment. A panel of 3 experts handled the topic and Betty Kituyi (Uganda Science Café) facilitated the discussion.

- A training workshop for Ugandan parliamentary staff was held from 21st-23rd June 2010 on Scientific Writing Skills with a focus on climate science. Dr Michael O'Brien (POST science advisor) advised on Climate Science while Kris Anderson of Oxford University ran training on writing skills.. Materials from the writing skills part of this workshop have been developed into a downloadable module which is now available on the INASP website (http://www.inasp.info/)

- The first Ugandan parliamentary internship has been advertised, to start before the end of 2010, and the topic of technologies for clean water has been selected.

- POST was successful in its application for a third "Commonwealth Professional Fellowship" provided by the Commonwealth Fellowship Commission. A parliamentary researcher from Uganda will spend 2 months at POST (November/December 2010).

SCIENCE DIRECTORY

DIRECTORY INDEX

IT, Internet, Telecommunications, Computing and Electronics
EPSRC
Institution of Civil Engineers
Institution of Engineering and Technology
National Physical Laboratory
STFC

Intellectual Property
ABPI
The Chartered Institute of Patent Attorneys
C-Tech Innovation
Eli Lilly and Company Ltd
NESTA

Large-Scale Research Facilities
C-Tech Innovation
The Food and Environment Research Agency
Institute of Physics
London Metropolitan Polymer Centre
National Physical Laboratory
Natural History Museum
STFC

Lasers
Institute of Physics
National Physical Laboratory
STFC

Manufacturing
ABPI
AMSI
EPSRC
Institution of Chemical Engineers
London Metropolitan Polymer Centre
National Physical Laboratory
Semta

Materials
C-Tech Innovation
Institution of Chemical Engineers
London Metropolitan Polymer Centre
National Physical Laboratory
Royal Society of Chemistry
Semta
STFC

Medical and Biomedical Research
ABPI
Academy of Medical Sciences
Biochemical Society
British Pharmacological Society
British Society for Antimicrobial Chemotherapy
CABI
Eli Lilly and Company Ltd
HFEA
Medical Research Council
Merck Sharp & Dohme
Plymouth Marine Sciences Partnership
Royal Institution
Society of Biology
UFAW

Motor Vehicles
London Metropolitan Polymer Centre

Oceanography
AMSI
National Physical Laboratory
Natural Environment Research Council
Plymouth Marine Sciences Partnership

Oil
C-Tech Innovation
Institution of Chemical Engineers
LGC

Particle Physics
Institute of Physics
STFC

Patents
The Chartered Institute of Patent Attorneys
NESTA

Pharmaceuticals
ABPI
British Pharmacological Society
British Society for Antimicrobial Chemotherapy
C-Tech Innovation
Eli Lilly and Company Ltd
Institution of Chemical Engineers
LGC
Merck Sharp & Dohme
PHARMAQ Ltd
Royal Society of Chemistry
Semta
Society of Biology

Physical Sciences
Cavendish Laboratory
C-Tech Innovation
EPSRC
Institute of Physics
London Metropolitan Polymer Centre
National Physical Laboratory

Physics
Cavendish Laboratory
C-Tech Innovation
Institute of Physics
National Physical Laboratory
STFC

Pollution and Waste
ABPI
AMSI
C-Tech Innovation
Institution of Chemical Engineers
Institution of Civil Engineers
London Metropolitan Polymer Centre
National Physical Laboratory
Natural Environment Research Council
Plymouth Marine Sciences Partnership

Psychology
British Psychological Society

Public Policy
Biochemical Society
The British Ecological Society
British Nutrition Foundation
British Society for Antimicrobial Chemotherapy
Economic and Social Research Council
Engineering UK
The Food and Environment Research Agency
HFEA
Institution of Civil Engineers
Institution of Chemical Engineers
NESTA
Prospect
Royal Society of Chemistry
Society of Biology

Public Understanding of Science
Academy of Medical Sciences
Biochemical Society
The British Ecological Society British Nutrition Foundation
British Science Association
British Society for Antimicrobial Chemotherapy
Clifton Scientific Trust
EPSRC
Engineering UK
The Food and Environment Research Agency
HFEA
Institute of Physics
Institution of Chemical Engineers
Institution of Engineering and Technology
Medical Research Council
Natural History Museum
NESTA
Plymouth Marine Sciences Partnership
Prospect
Research Councils UK
The Royal Academy of Engineering
Royal Institution
The Royal Society
Royal Society of Chemistry
STFC
Society of Biology

Quality Management
LGC
National Physical Laboratory

Radiation Hazards
Health Protection Agency
LGC

Retail
Marks and Spencer

Science Policy
ABPI
Academy of Medical Sciences
Biochemical Society
The British Ecological Society
British Nutrition Foundation
British Pharmacological Society
British Science Association
CABI
Clifton Scientific Trust
Economic and Social Research Council
Eli Lilly and Company Ltd
EPSRC
Engineering UK
The Food and Environment Research Agency
HFEA
Institute of Physics
Institution of Chemical Engineers
Institution of Civil Engineers
LGC
Medical Research Council
NESTA
National Physical Laboratory
Plymouth Marine Sciences Partnership
Prospect
Research Councils UK
The Royal Academy of Engineering
Royal Institution
The Royal Society
Royal Society of Chemistry
Semta
STFC
Society of Biology
UFAW

Sensors and Transducers
AMSI
C-Tech Innovation
Institute of Measurement and Control
STFC

SSSIs
Kew Gardens
Natural England

Statistics
EPSRC
Engineering UK
Royal Statistical Society

Surface Science
C-Tech Innovation
STFC

Sustainability
The British Ecological Society
CABI
C-Tech Innovation
EPSRC
The Food and Environment Research Agency
Institution of Chemical Engineers
Institution of Civil Engineers
The Linnean Society of London
London Metropolitan Polymer Centre
Natural England
Plymouth Marine Sciences Partnership
Royal Society of Chemistry
Society of Biology

Technology Transfer
AIRTO
CABI
C-Tech Innovation
The Food and Environment Research Agency
Institute of Measurement and Control
LGC
London Metropolitan Polymer Centre
NESTA
National Physical Laboratory
Research Councils UK
Royal Society of Chemistry
STFC

Tropical Medicine
Health Protection Agency
Natural History Museum
Society for General Microbiology
Society for Applied Microbiology

Viruses
ABPI
Health Protection Agency
Society for General Microbiology
Society for Applied Microbiology

Water
AMSI
C-Tech Innovation
Institute of Measurement and Control
Institution of Chemical Engineers
Institution of Civil Engineers
LGC
Plymouth Marine Sciences Partnership
Royal Society of Chemistry
Society for General Microbiology
Society for Applied Microbiology
Society of Biology

Wildlife
The British Ecological Society
The Food and Environment Research Agency
The Linnean Society of London
Natural England
Natural History Museum
Society of Biology
UFAW

Research Councils UK

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

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

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

Arts and Humanities Research Council

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Each year the AHRC provides approximately £105 million from the Government to support 700 research awards and around 1,350 postgraduate awards in the arts and humanities, from archaeology and English literature to dance and design. Awards are made after a rigorous peer review process, so that only applications of the highest quality are funded. The quality and range of research supported by this investment of public funds not only provides social and cultural benefits but also contributes to the economic success of the UK.

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

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.

EPSRC's investment in high quality basic, strategic and applied research and training promotes future economic and societal impact in the UK.

Medical Research Council

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Website: www.mrc.ac.uk

For almost 100 years the Medical Research Council (MRC) has improved the health of people in the UK and around the world by supporting the highest quality science.

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

Natural Environment Research Council

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

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

British Antarctic Survey, British Geological Survey, Centre for Ecology and Hydrology, 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.

The Association for Science Education

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The Association for Science Education (ASE) is the largest subject association in the UK for teachers, technicians and others interested in science education. Working closely with the science professional bodies, industry and business, ASE provides a UK network bringing together individuals and organisations to share good ideas, tackle challenges in science teaching, develop resources and foster high quality continuing professional development.

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

Contact: Professor Richard Brook OBE FREng
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E-mail: airto@campden.co.uk
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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

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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

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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

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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

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

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Websites: www.nutrition.org.uk
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.

BRITISH PHARMACOLOGICAL SOCIETY

Today's science, tomorrow's medicines

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

The British Psychological Society

The British Psychological Society

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

British Society for Antimicrobial Chemotherapy

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

CABI

www.cabi.org

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CABI is an international not for profit organization, specialising in scientific publishing, research and communication. Our mission is to improve peoples' lives worldwide by finding sustainable solutions to agricultural and environmental issues. Activities range from assisting national policy makers and informing worldwide research to supporting income poor farmers. We also house and manage the UK's National Collection of Fungus Cultures which we are exploring for potential new drugs, enzymes and nutraceuticals.

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 ...advantage through technology

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Innovation Management and Technology Development organisation offering an end-to-end innovation management service, able to assist at every step of the innovation journey. We work with SMEs, Blue Chips, Central, Regional and Local Government. Our activities include research and development, engineering design as well as a wide ranging innovation, business and technology consultancy. See www.ctechinnovation.com for more details.

Eli Lilly and Company Ltd

Lilly

Answers That Matter.

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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.

Health Protection Agency

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The Health Protection Agency is an independent UK organisation that protects the public from threats to their health from infectious diseases and environmental hazards.

The HPA identifies and responds to health hazards and emergencies caused by infectious disease, hazardous chemicals, poisons or radiation.

It gives advice to the public, provides data and information to government, and advises people working in healthcare. It also makes sure the nation is ready for future threats to health that could happen naturally, accidentally or deliberately.

Human Fertilisation and Embryology Authority

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

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.

IPEM 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 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 from 1871, the IET has 150,000 members in 127 countries with offices in Europe, North America and Asia-Pacific.

KEW GARDENS

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

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

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LGC

Setting standards in analytical science

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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 28 laboratories and centres across Europe and at sites in China, India and the US.

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

Marks & Spencer Plc

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

We have over 600 UK stores, employing over 75,000 people - 285 stores internationally in 40 territories.

We are one of the UK's leading retailers, with over 21 million people visiting our stores each week. We offer stylish, high quality, great value Clothing and Home products, as well as outstanding quality foods, responsibly sourced from around 2,000 suppliers globally.

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

NESTA Making Innovation Flourish

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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 the public services.

National Physical Laboratory

NPL National Physical Laboratory

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

Natural England

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Natural England has the responsibility to enhance biodiversity, landscape and wildlife in rural, urban, coastal and marine areas; promote access, recreation and public well-being, and contribute to the way natural resources are managed so that they can be enjoyed now and by future generations. In delivering these responsibilities, we work with a range of partners to continue to develop the broad evidence base we need to underpin both our operational decisions and our advice to government and others.

Natural History Museum

The Science of Nature

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

The Nutrition Society

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Founded in 1941, The Nutrition Society is the premier scientific and professional body dedicated to advance the scientific study of nutrition and its application to the maintenance of human and animal health.

Highly regarded by the scientific community, the Society is the largest learned society for nutrition in Europe. Membership is worldwide and is open to those with a genuine interest in the science of human or animal nutrition.

Principal activities include:

1. Publishing internationally renowned scientific learned journals
2. Promoting the education and training of nutritionists
3. Promoting the highest standards of professional competence and practice in nutrition
4. Disseminating scientific information through its publications and programme of scientific meetings

PHARMAQ Ltd

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

Plymouth Marine Sciences Partnership

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The Plymouth Marine Sciences Partnership comprises 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.

The Royal Institution

The Royal Institution of Great Britain

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www.rigb.org

The core activities of the Royal Institution centre around four main themes: science research, education, communication and heritage. It 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 building has recently undergone a £22 million refurbishment, and now features an extended museum, new social spaces and upgraded facilities in the historic lecture theatre.

The Royal Society

THE ROYAL SOCIETY
CELEBRATING 350 YEARS

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London SW1Y 5AG.
Tel: 020 7451 2502 Fax: 020 7930 2170
Email: peter.cotgreave@royalsociety.org
Website: www.royalsociety.org

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

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

The Royal Society of Chemistry

Contact: Dr Stephen Benn
Parliamentary Affairs
The Royal Society of Chemistry
Burlington House, Piccadilly, London W1J 0BA
Tel: 020 7437 8656 Fax: 020 7734 1227
E-mail: benns@rsc.org or parliament@rsc.org
Website: http://www.rsc.org
http://www.chemsoc.org

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

The Royal Statistical Society

Contact: Mr Andrew Garratt
Press and Public Affairs Officer
The Royal Statistical Society
12 Errol Sreet, London EC1Y 8LX.
Tel: +44 20 7614 3920
Fax: +44 20 7614 3905
E-mail: a.garratt@rss.org.uk
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
Watford
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 1809 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
9, Red Lion Court,
London EC4A 3EF
Tel: 020 7936 5900
E-mail: markdowns@societyofbiology.org
Website www.societyofbiology.org

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

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

SCIENCE DIARY

THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE

Contact: Secretariat
020 7222 7085:
parliamentaryandscientificcommittee@hotmail.co.uk
www.scienceinparliament.org.uk

Tuesday 16th November 17.30

HOW ENGINEERING PROVIDES BETTER HEALTHCARE

Boothroyd Room, Portcullis House
Professor Molly Stevens Professor of Biomedical Materials and Regenerative Medicine, Imperial College London
Professor Lionel Tarassenko FREng Director, Institute of Biomedical Engineering University of Oxford; Chair, RAE's "UK Focus for Biomedical Engineering"
Professor John Fisher FREng Director, Institute of Medical and Biomedical Engineering University of Leeds

The Royal Academy of Engineering (RAEng) has offered to provide financial support for this event.

Tuesday 7th December 17.30

SYNTHETIC BIOLOGY DIALOGUE: WHAT IS THE PUBLIC PERSPECTIVE?

Boothroyd Room, Portcullis House
Professor Robert Winston FMedSci House of Lords; Professor of Science and Society, Imperial College London
Dr Brian Johnson Chair of Public Dialogue Steering Group
Professor Douglas Kell BBSRC Chief Executive; The University of Manchester
Professor David Delpy EPSRC Chief Executive

Tuesday 1st February 2011 17.30

MEDICAL PHYSICS: FROM BLUE-SKIES TO BEDSIDE

Turning today's cutting-edge science into tomorrow's healthcare technology
Boothroyd Room, Portcullis House

The Institute of Physics and Engineering in Medicine (IPEM) has offered to provide financial support for this event.

Tuesday 15th February 2011 17.30

CAN THE ECONOMY SURVIVE WITHOUT A NATIONAL MEASUREMENT SYSTEM?

Boothroyd Room, Portcullis House

The importance of the National Measurement System (NMS) and of traceable measurement
The dependence of industry on the NMS for manufacture and innovation UK leadership in new technologies through the NMS

Organised with financial support from The Association for Instrumentation, Control, Automation & Laboratory Technology (GAMBICA)

THE ROYAL INSTITUTION

The Royal Institution has now re-opened following its £22 million refurbishment, including the new Time & Space restaurant, bar and café. See www.rigb.org or telephone 020 7409 2992 for full details and to book tickets.

THE ROYAL SOCIETY

Throughout 2010 the Royal Society is celebrating its 350th anniversary in a year-long celebration of the impact that science has had, and continues to have, on our lives. 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. In addition for its 350th celebrations the Society is teaming up with major cultural institutions in London as part of its Capital Science programme. Events, exhibitions and conferences are also being held in over 70 museums and galleries around the UK as part of the Royal Society's Local Heroes programme. For further details, please visit http://royalsociety.org/events/

THE ROYAL ACADEMY OF ENGINEERING

3 Carlton House Terrace, London SW1Y 5DG
www.raeng.org.uk/events or
events@raeng.org.uk
020 7766 0600

THE ROYAL SOCIETY OF CHEMISTRY

For details please contact Dr Stephen Benn
benns@rsc.org or phone 0207 440 3381

ROYAL SOCIETY OF EDINBURGH

22-26 George Street, Edinburgh EH2 2PQ.
Tel: 0131 240 5000 Fax: 0131 240 5024
events@royalsoced.org.uk
www.royalsoced.org.uk

BRITISH SCIENCE ASSOCIATION

Please visit
www.britishscienceassociation.org for events programme.

ROYAL PHARMACEUTICAL SOCIETY OF GREAT BRITAIN

Contact: events@rpsgb.org
www.rpsgb.org/events

THE LINNEAN SOCIETY OF LONDON

Burlington House
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Working collectively to advance UK science

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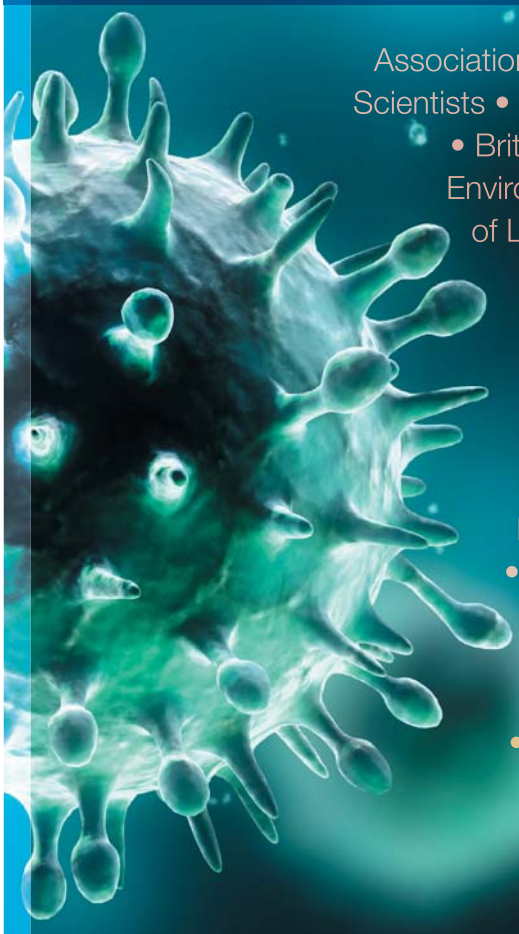
futuremorph.org

The Careers from Science project aims to raise young peoples' awareness of career opportunities available from studying Science, Technology, Engineering and Maths.

www.futuremorph.org

The Science Council is a membership organisation that brings together learned societies and professional bodies across science and its applications.



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