Autumn 2008

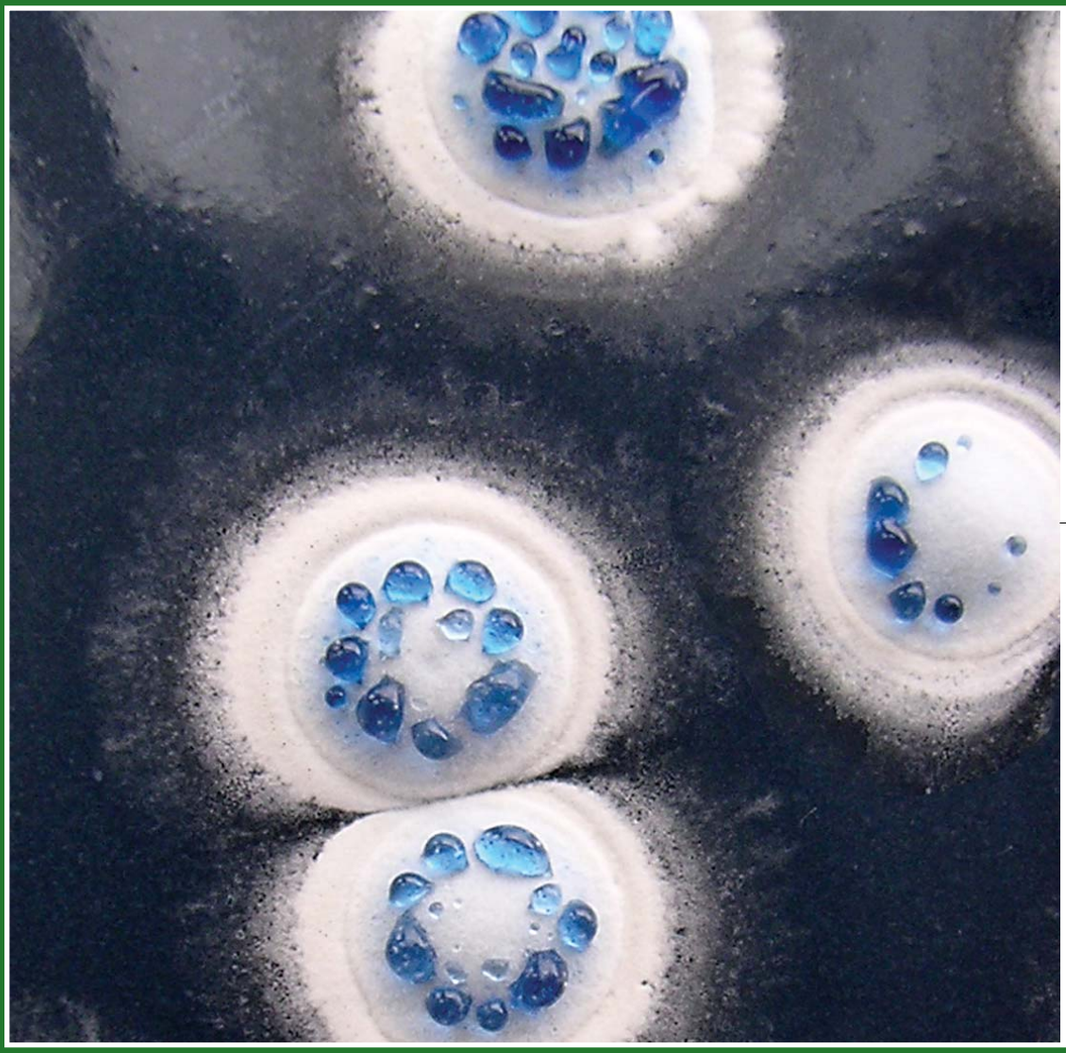
SCIENCE IN PARLIAMENT

Visions for Science

Alcohol Control

Allergies, Autism and ME

Defence Science



Actinobacteria producing droplets of antibiotic

SCIENCE IN PARLIAMENT

The Journal of the Parliamentary and Scientific Committee.

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

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

The Parliamentary and Scientific Committee

In the survey of P&SC membership, published last June, 55% of members regarded this Journal as high value to them. Whilst its content was praised, many members commented that the Journal looks old fashioned, lacks colour and that the layout and font style could be improved. Beginning in the New Year, we will carry out the changes that our membership have requested, and this will be the last edition published in the 'old' format.

When the Large Hadron Collider (LHC) was switched on at CERN on 10 September, scientists involved in this £5 billion project were jubilant. Sadly, their hopes were dashed just a few days later when a 'quench' occurred, and some of its supercooled magnets overheated. This announcement will come as no surprise to those who have visited CERN and seen the size and complexity of the LHC. It would be ironic if the £2 million Zeplin project, housed at the bottom of Boulby mine in Cleveland, provided the answers on 'dark matter' first.

There was an interesting exchange on BBC's Newsnight on 10 September between particle physicist Prof Brian Cox of Manchester University, who was defending the cost of the CERN project, and former Chief Science Adviser to HM Government, Prof Sir David King, who is now a champion of climate change research. Scientists are concerned now that the cost of supporting large research programmes is severely reducing the money available for responsive mode bids to the Research Councils.

The Institute of Physics publishes the Visions series of 'briefing papers for policy makers'. The latest is on 'T-rays' (number 22 in the series). There has been an explosion of interest recently in terahertz radiation, which has enabled a new type of security scanner to be brought into use. These strip search the body, revealing any metallic objects that a person may be carrying, such as guns or knives, and we should be concerned that the operator is using the 'modesty devices' provided with the controls.

Rhenium, hafnium, indium, rhodium and tantalum are almost unheard of metals, soaring in value presently. Rhenium, for example, is now twelve times its 2006 price. Their future availability will limit the growth of the electronics industry.

Dr Brian Iddon MP
Chairman, Editorial Board
Science in Parliament

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Front cover: Colonies of *Streptomyces coelicolor* A3(2) producing droplets of the blue-pigmented antibiotic actinorhodin. The droplets sit on the surface of the colonies due to the hydrophobic nature of the aerial hyphae and spores. The production of antibiotics and the developmental cycle of *S. coelicolor* is complex. *Photograph courtesy Dr Paul A. Hoskisson*

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OPINION

Science in Schools

Lord Lewis of Newnham

A point of concern within the science community is the fall in student numbers taking science at schools and universities. During the last decade, the A level entry has risen by one third, whilst there has been a fall in physics and chemistry students of approximately 20 per cent. There are a variety of factors that contribute to this, and this has been the subject of valuable reports from select committees in both Houses, as well as studies by professional bodies.

Government has responded in part; it has made progress in dealing with recruitment and the training of teachers in science, but there are still problems, particularly the retention of staff, with about 50 per cent leaving after five years. A point raised in the reports was the content of the courses, and the form of the examinations. As a result, syllabi and examinations have undergone significant changes for both GCSE and A level courses and new types of course have been introduced.

In 1990, with the introduction of the National Curriculum, it became compulsory to study science up to 16 years of age. This led to the introduction of the double award in science. This provides a very good basic course for an overall coverage of science. For the maintained sector, the number of entries for chemistry and physics at GCSE is around 23-30,000 whilst for the independent sector it is 13-14,000. For the double science course, the maintained sector number is of the order of 500,000 whilst the independent sector figures are about 26,000.

Although there is some question about the reliability of the interpretation, it has been estimated that the chances of attaining an A or B level in chemistry is increased by 76 per cent for pupils who take the separate science courses. If this is correct, then it is clear that taking the separate science courses is a better pathway to attain an A level qualification of the appropriate standard for entry to read chemistry at university. It is significant to note that the Government has recently agreed that from 2008 any pupil with at least level 6 at key stage 3 will be allowed to study triple science at GCSE.

The reduction in numbers of students taking A levels in chemistry and physics has also been reflected in the decrease in the numbers of graduates in these subjects. In chemistry the fall in graduate numbers between 1994 and 2005 is 41 per cent, whilst the corresponding figure for physics is 11 per cent. This has serious implications for the country's scientific work force.

The Government has modified the pre-university courses in a variety of ways, leading to new structures for A level courses. Thus starting in 2008 there have been major changes in the conventional A level courses, with the introduction of an A* grade, an optional project which will be equivalent to half an A level, and a change in the content of the modules. However, a point of concern is the removal of the practical examinations for assessment of practical courses in school.

A new qualification, the Diploma, has also been introduced. The Diploma encourages collaboration between schools, FE colleges and industry, and introduces a 'vocational' flavour to the courses. There are five subject areas included in the 2008 entry of which Engineering and Information Technology are the most directly applicable to sciences courses. Recently the Government has announced three new Diplomas, termed 'academic' – in science, languages, and humanities.

The course in Engineering is academically demanding and does encourage a partnership between employers, schools and colleges. The Diploma will be offered at three different levels: levels one and two will be comparable to GCSE and level three equivalent to three and a half A levels.

With the potential entry to the Diploma programme at GCSE level, this could involve students committing themselves to a specific area of study at 14, and limiting the general breadth of their educational experience. This situation may not have general public appeal, and appear as a step back in secondary education. A further problem could be the travel involved between the centres that will be particularly difficult for rural schools.

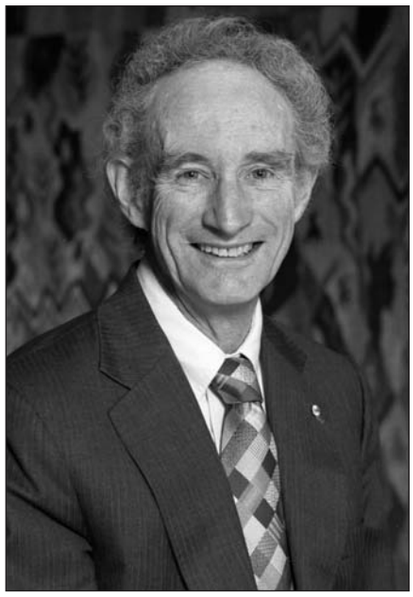
Finally, another new course is the 'Cambridge Pre-U', which also commences in 2008. The aim of this examination is to revert to the more traditional A level course, with no modular component, but a single set of examinations at the end of the two-year course. The course will involve the study of three principal subjects, and two further projects, each with half the weighting of a principal subject. As the name implies, this course has been designed with university entry in mind, and involves a top grade above A*; this has proved to be very popular with the independent school sector.

It is of concern that all these modifications will apply to the 2008 entries, and the monitoring of these courses will be important. It will be interesting to see how they affect the intake to chemistry and physics courses and reduce the criticisms of the examinations and the alleged fall in standards.

OPINION

Science in the UK: doing well, could do better

Lord May of Oxford OM



As I write this, the Beijing Summer Olympics are about to begin. If past performances are a guide, the daily presentation of cumulative medal totals will give the impression that the USA dominates, although China might challenge. But this impression confuses a country's sheer size with its athletic proficiencies. A medal count (scoring 3 for gold, 2 for silver, 1 for bronze) scaled against population size would not have put the USA – or the UK – in the top dozen in the past three Summer Olympics.

There is a different story, however, when it comes to ranking nations by their contributions to scientific understanding of how the natural world works. Here the USA and the UK are comfortably in the top ten, along with a collection of smaller countries (mainly Anglo or Scandinavian, and led by Switzerland and Israel). Of the most cited 1% of papers in Science, Medicine and Engineering over the past two decades, the USA produced 32.5% and the UK 8.8%. With the USA population five times that of the UK, we significantly outperform on this basis (and on others, such as major scientific prizes similarly rescaled).

Another interesting measure of scientific performance is the ratio of output (such as citations or papers) in relation to the inputs (in particular, the money spent on basic research some 3-4 years earlier). The UK has topped this league table for the past two decades, partly because its research is excellent and partly because our expenditure – as a fraction of GDP – has been among the lowest in the comparison set (which is essentially the OECD countries); as the funding for scientific research has increased during the Major and Blair Governments, the UK's lead in this 'efficiency measure' has narrowed, but persisted.

What explains this excellence? I think it derives partly from Britain's 'fast track' education system, which typically delivers young people to the frontiers of research at a younger age than prevails in the more rigidly structured systems of many other countries, combined with a willingness to set these people free to pursue their own agendas, rather than entrain them in hierarchies of academic deference and servitude to their elders. The inspired management of the MRC's Laboratory of Molecular Biology at Cambridge over the past half-century is an iconic example.

The newly established European Research Council, ERC, aims to emulate soccer's Champions' League, exemplifying and disseminating 'best practice' in managing the scientific research enterprise. I think it has got off to a good start with its first awards to help establish some 300 outstanding young investigators. Significantly, British Institutions are home to a disproportionate 20% of these awards. On the other hand, the nationality of the successful 300 tends more to reflect country sizes, with Germany providing the most; roughly half the awards in the UK are to non-British researchers. I believe all this suggests the ERC is indeed achieving its aims.

It is thus ironic that some of the recent changes in the UK are arguably carrying us backward, towards the bureaucratic rigidities that other countries are striving to escape. I see this unfortunate – and fairly easily reversible (at least in principle!) – trend as an unintended consequence of good things that have happened. These good things include a remarkable increase in the number of people going on to tertiary education in the UK, accompanied by a notable increase in faculty positions and other research opportunities, and a steady increase in funding, in real terms, for research in science, medicine and engineering. Unfortunately, however, student numbers have increased faster than faculty positions, whilst the money available for research has increased slower than the number of researchers chasing it. Thus, although these three increases are all good for the UK in general, the lives of research faculty have become less agreeable: more students per researcher, and tougher competition for research grants (exacerbated by including faculty salaries within 'full economic

costs', which has effectively reduced funds available for the research itself).

The Research Assessment Exercise, RAE, very sensibly introduced as a mechanism for the appropriately competitive distribution of universities' indirect infrastructure costs – which are every bit as real and important as the direct costs of research – has become more bureaucratically burdensome with each iteration. The RAE currently under way, in putatively 'simplified' form, has some bizarre features. The restriction that at most four papers may be submitted, intended to counter the charge of 'salami-slicing' (for which there is no shred of evidence), is silly enough. But the new restriction that no two members of the same department can submit the same (jointly authored) paper is surreal. Imagine the discussion between Watson and Crick, had today's RAE been around then!

Apart from anything else, the sheer cost of the exercise in administrative salaries – both centrally and in individual universities – and faculty time, when the outcome at the overall level of the University has a better than 95% correlation with the University's total value of competitively gathered research money, should be kept in view.

If the RAE is to be continued as a separate enterprise, at very least the process should be made truly simpler. Panels of people recognised for their research excellence and judgment, unimpeded by others added 'for balance', should look at no more than one side of A4 per submitted researcher. Too many officials worry about such a process being 'elitist'. But of course it should be: 'democratically elitist' in the memorable phrase coined by the first Head of the Office of Science and Technology, Sir William Stewart, recognising that elite performance in science has everything to do with demonstrated excellence and nothing to do with unearned privilege.

Beginning as a chemical engineer, later a theoretical physicist, finally transmogrified to ecologist and epidemiologist, I have spent a lucky and enjoyable life in science. When I started, the world of science was much smaller, with the global population of scientists a few percent of today's. The science community's growth is good; humanity's growing numbers and impacts need ever more understanding of natural processes, from molecules to ecosystems. But the growing scale of the enterprise, nationally and internationally, creates new problems. Then and now, Britain has been a leader, both in advancing the frontiers of knowledge and in how we go about doing it. Today it is hugely important that we think a bit more about the latter.

Intellectual Property - the Challenges for the UK Intellectual Property Office

Ian Fletcher

Chief Executive and Comptroller General of The UK Intellectual Property Office

It is a great privilege and responsibility to lead the UK Intellectual Property Office (UK-IPO) at a time when Intellectual Property (IP) is more important than it has ever been. It is easy for IP to be seen as a specialist subject, remote from the reality of business. Nothing could be further from the truth: IP is an essential part of the UK's economic infrastructure; the work done by the UK-IPO in policy, delivery and maintenance of Intellectual Property Rights (IPRs), and awareness raising, is fundamentally an economic, business-focused task, albeit in a technical and legal form.

For the UK to be making best use of all its IP there must be effective systems and frameworks for formal IPR, ie patents, trade marks, designs

and copyrights. There is also a significant role too for less formal kinds of protection of IP – trade secrets, know-how, forms of tacit knowledge and organisational culture and 'memory' all form intellectual 'property' or assets of an informal or intangible sort, which add value to individual companies, and provide the foundation for continued economic growth.

Frameworks, in themselves, are not sufficient to deliver success. It is also necessary for organisations to know how to recognise and develop IP assets, and to understand and utilize the formal and informal protection and exploitation possibilities.

One of the conclusions that the UK-IPO has drawn from its own review of its strategy has been that we do not yet have enough understanding of the economic connection between the formal and informal IP systems and the value which firms and individuals derive from their intellectual assets or their IP. We do not have the evidence we need in order to draw robust conclusions about how near the UK is to making best use of its IP nor, as a result, about the most effective measures to help bring this about. We have assumed that IP rights directly promote economic development and have never sought to prove this assumption. We must question this assumption if we are to meet the challenges of increasing globalisation and help UK businesses compete.

In planning for the future it is important that the UK-IPO does not lose sight of the strength of its achievements in delivering high quality services to our existing customers. The UK-IPO is fortunate in having been able to attract and retain people who are both able and highly motivated. We have an excellent reputation for the quality of the IP rights that we deliver. We have also been able to respond better than most other intellectual property offices to growing pressures on the IP system, in particular to an increase in applications for patents.

Many of the world's largest patent granting offices are carrying significant backlogs of applications. Increasing backlogs are economically significant for the UK. It is in the UK's interest for innovative companies, UK universities and research institutions, and individual inventors to have access to an effective patenting system which provides legal certainty for all by granting patents with a high presumption of validity in a reasonably short period of time. The UK-IPO is at the forefront of efforts to address these backlogs and to make the global patent system more fit for purpose.

Another area where we face challenges is copyright. Copyright, which exists in literary works such as musical recordings, film, photographs, software and other elements of creative endeavour, underpins the business models which drive the creative sectors in the UK economy. Two million people are employed in creative jobs and the sectors contribute £60 billion a year – 7.3% – to UK economy. Over the past decade the creative sector has grown at twice the rate of the economy as a whole and is well placed for continued growth as demand for content grows around the world.

Copyright rules are broadly set at EU level, building on an underlying corpus of international conventions that date back to the middle of the 19th century, and further refined within the EU in recent years.

The digital age has brought about huge technological changes that have altered consumer behaviour and challenged the current copyright framework. Creators, rights-holders, businesses, users and consumers, and the legal framework itself are all in dynamic tension. This reflects the fact that rapid technological change means that the options available to creators, to businesses looking to derive value from creative effort, and to users, are continuing to evolve very rapidly, as is user behaviour in respect of any given technology. The consequence is that, whilst the fundamental principles of copyright remain sound, their application in the digital age means that in certain areas the legal framework may be out of step with the technology and behavioural changes.

Where these changes result in significant shifts in the balance between the various stakeholder groups, then we will need to work with colleagues across government to assess whether action is needed to redress the balance.

We have already started to do more to help combat growing IP crime including strengthening our resources by bringing in police officers with specific expertise in intelligence and proceeds of crime and assets recovery. We are actively involved in a number of other initiatives to help deliver further improvements including a pilot campaign, led by enforcement agencies, which will bring together rights holders, creative industries, and Government bodies and will start to develop ideas to combat counterfeiting and piracy in the lead up to the 2012 Olympics.

The increasingly global nature of counterfeiting and piracy means we must also work across national boundaries to ensure IPRs are enforced around the world. Helping developing countries build their capacity to enforce IPR legislation is essential if we are to reduce global counterfeiting and piracy. We have therefore been working in partnership with governments in some of the major emerging economies including China and Brazil on this issue.

This is just a taste of what we are doing and the challenges that we are facing. It is, to say the least, an interesting and exciting time to be the head of the UK-IPO.

Alcohol Sales (Regulation of Prices and Promotion) Bill

Sally Keeble MP

Some of the strongest arguments for greater legislative controls on the retailing of alcohol came from the industry itself.

During the discussion around the introduction of powers to establish alcohol disorder zones the pubs and clubs lobby argued strongly that they were not the prime culprits in the increase in drink related crime. They argued that greater regulation of the on-licence trade wouldn't touch the big problem of the sale of large quantities of cut-price alcohol through the off-licence trade.

Where was the justice, they asked, in penalising a pub for selling a pint of beer to someone who came into the bar already drunk on cut-price superstrength lager bought in the local supermarket and drunk at home.

They had a point. In one of the more spectacular and tragic consequences of the ready supply of cheap alcohol, last December a young woman was brutally killed by a gang of drunken youths. One of the youths, aged only 15 admitted that before the killing he had drunk two litres of cider, a bottle of extra strong beer and 'quite a lot of' peach schnapps.

At today's prices, that amount of alcohol would have cost him, buying at our major supermarkets, just £1.42 for two litres of superstrength cider, 33p for the beer, and just £1 for his share of the £5.99 bottle of schnapps – so a total of under £3 for at least 20 units of alcohol – twice the level even for a binge drinker. The boy probably could not have afforded to drink that much in a pub or club.

This killing was a dramatic headline. Behind it are more sobering statistics in crime, health and education, demonstrating the big price that public services have to pay for our alcohol consumption.

Alcohol is a factor in 50 per cent of street crimes, 33 per cent of burglaries and 30 per cent of sexual crimes. One in ten assault victims treated in UK casualty departments has been injured in a fight involving glasses and bottles. An estimated 14,380 road casualties in 2006 were as a result of drink driving.

The impact on the NHS is huge. Almost 70 per cent of admissions to casualty wards between midnight and 5 am on weekends are alcohol related. Both men and women are 13 times more likely to contract liver disease if they binge, and liver disease is now appearing in people as young as 25 according to the British Medical Association. Death rates in the UK due to acute intoxification have doubled in the last 20 years for both men and women.

For schools, binge drinking causes a problem, with 62 per cent of 16 to 17 year olds reporting that they binge drink at least once a week. The National Association of Headteachers is concerned about the impact on children's education.

The figures also show that the increase is particularly in binge drinking which now affects 23 per cent of men and nine per cent of women. Compared with other European countries, we drink less frequently, but drink more at a sitting. UK drinkers consume an average 6.3 units of alcohol on a single occasion, compared with the European average of 5.1 units.

Managing these problems is a challenge for the whole industry, and the Alcohol Sales (regulation of prices and promotion) Bill sets out proposals for some modest controls on both the on- and off-licence trade but more especially the latter.

The most substantial proposal, of setting a minimum price for a unit of alcohol, is something that could only be done by legislation. Retailers agreeing a minimum price among themselves would be open to accusations of price fixing. A retailer going it alone could be committing commercial suicide, given the importance of alcohol sales for both supermarkets and convenience stores.

Although the debate about a minimum price has focused on the impact on the retail trade, it would also affect the on-trade. It would mean an end to special offers and happy hours, especially important since the breakdown of the industry's voluntary code.

In addition to price, availability has been seen as one of the major factors in the increase in problem drinking, which is why the bill included proposals on promotion of alcoholic drinks in shops whose primary purpose is not the sale of alcohol. This would mean that both supermarkets and convenience stores would have to stock and promote their alcoholic drinks only on specified and clearly labelled shelves. It would prevent the pepper potting of alcohol throughout shops, or the linking of certain foods with alcohol, and also the stacking of piles of cut price alcohol in front of the tills just before the bank holiday weekend.

Also in the bill are proposals for labelling, and the establishment of an industry council to recommend to the Government the minimum unit price, and the detailed regulations on the promotion of alcohol.

Already major health, education and law and order agencies favour the introduction of greater regulation of the retailing of alcohol, and have supported some of the detailed measures in the Alcohol Sales Bill. The big challenge it would seem for the industry is to work with these powerful public interest groups to ensure that any legislation coming out of the Government's current review are effective in rolling back the tide of binge drinking.

The Alcohol Sales (Regulation of Prices and Promotion) Bill was introduced by Sally Keeble MP in the House of Commons on 10th June under the ten-minute rule.

How can we tackle our drinking culture?

David Poley

Chief Executive, The Portman Group

The stark implications of some people's destructive relationship with alcohol surround us. The Department of Health estimates that the heaviest drinking 7% of the population account for one-third of all the alcohol drunk in the UK, an incredible amount. The harmful consequences of their drinking are placing an immense strain on our public services. Alarmingly, the number of alcohol-related hospital admissions in England is heading rapidly towards one million annually. It is clear we urgently need to cut the excesses of the significant minority of the population whose drinking is out of control.

The Portman Group, as the dedicated social responsibility organisation for UK drinks producers, is at the forefront of the industry's efforts in this area. We work with drinks producers to raise their standards of social responsibility. Our Code of Practice on the Naming, Packaging and Promotion of Alcoholic Drinks sets minimum standards for all drinks producers in the UK. The Code, for example, prevents drinks producers from undertaking marketing that appeals particularly to under-18s or encourages excessive drinking. A recent report by management consultants, KPMG, acknowledged that our Code and its accompanying independent complaints process have led to an improvement in standards of alcohol marketing. Despite this, we remain vigilant to prevent irresponsible examples of marketing from slipping through the net.

Our work is funded by nine of the largest drinks companies, together manufacturing over 60% of the alcohol sold in the UK. These companies are anxious to inform and educate the consumers of their products. For example, they unit label their drinks and promote extensively the alcohol information website, drinkaware.co.uk, which they helped to establish. They also have collectively committed to providing over £2 million a year in funding for the Drinkaware Trust, an exciting charitable initiative that brings together industry, health professionals and the alcohol voluntary sector and which aims positively to change the drinking culture through education.

Without doubt, other sectors of the industry must also raise their game to tackle excessive and under-age drinking. There should be no hiding place for retailers who flout the law by selling alcohol to under-age customers or to people who are drunk. Furthermore, the Government is currently examining mechanisms for restricting irresponsible promotions.

At the same time, police forces should be doing more to enforce current alcohol laws. Some appear reluctant to tackle drunken revellers, perhaps for fear of being branded as 'fun police'. This lax approach is epitomised in London where the number of people prosecuted for being drunk and disorderly has fallen by a third over the last decade. Another worrying indicator is that only 34 under-18s have been prosecuted for attempting to buy alcohol in England and Wales since 2004.

Some politicians and health campaigners argue that alcohol misuse should be tackled by raising prices, for example through the introduction of minimum pricing, but the evidence in support of this is patchy. The Government has commissioned the University of Sheffield to review the impact of price and promotions on alcohol-related harm. Their emerging findings are that although increasing prices will reduce the nation's overall consumption, the impact is likely to be greater on responsible drinkers than on those whose behaviour most needs modifying.

The behaviour of friends, colleagues and families is significant in reinforcing social norms. Research, commissioned by the Advertising Association, has found that the vast majority of heavy drinkers think their friends binge drink, compared to fewer than half of those questioned who drink in moderation. Similarly, peer influence extends to the work environment with 65 per cent of binge drinkers considering that most or all of their colleagues drink heavily with only 34 per cent of moderate drinkers sharing this view.

Regrettably, drunkenness is glamourised in certain sections of the media. Images of inebriated celebrities in some newspapers create the impression that getting drunk is a reflection of social success. Portrayals of alcohol misuse are also prevalent in television programming. These are often condoning, and occasionally encouraging, of such behaviour. Strict advertising rules ensure that drinks producers show and encourage only responsible drinking but unfortunately the wider media are not bound by the same principles.

Achieving social change will be extremely difficult but is not impossible. The analogy with drink-driving is telling because it demonstrates how social attitudes to alcohol can be influenced. Thirty years ago, drink-driving was prevalent until hard-hitting educational campaigns combined with robust enforcement of the law changed the culture. Consequently, the number of people killed per year in drink-drive accidents has fallen by two thirds.

A similar approach can make drunkenness socially unacceptable. The Government's Know Your Limits campaign and the work of the Drinkaware Trust will be pivotal in changing attitudes and behaviour. Additionally, many of the largest drinks companies have their own dedicated marketing campaigns to challenge people's attitudes to alcohol. Better education alone, of course, will not succeed. But if this is accompanied by effective law enforcement, improved industry standards and more people accepting responsibility for their drinking, we can make a difference.

Alcohol and the Liver

Mark Thursz

Professor of Hepatology, Imperial College London

Data from the Office for National Statistics shows that liver disease has risen to fifth place in the list of causes of mortality in the United Kingdom. However, unlike the top four causes which include coronary artery disease, cerebrovascular disease, respiratory disease and cancer, liver disease mortality is rising rather than falling. In the majority of liver related deaths alcohol is either the primary cause or a major contributory factor. The reason for the increasing mortality from alcoholic liver disease is clear; we as a society are consuming more alcohol. However, the relationship between alcohol consumption and liver disease is not straightforward; not everyone who consumes excessive amounts of alcohol will develop significant liver disease. It is estimated that only 10-15% of alcoholics will develop alcoholic hepatitis and/or cirrhosis (Mann 2003). The risk of developing alcoholic liver disease is related to the blood alcohol concentration and the duration of raised blood alcohol concentration. These parameters are determined by the pattern of drinking (daily versus binge) and total alcohol consumption (quantity and frequency). There are large inter-individual variations in the rate of alcohol elimination (Li 2001) which indicate that blood alcohol concentrations and risk of developing alcoholic liver disease are influenced by genetic variation in the alcohol metabolising enzymes.

Patterns of alcohol consumption affect the risk of developing liver disease. The term 'binge drinking', currently beloved and misused by the media, is formally defined as consumption of 5 or more units (50g) of alcohol in 2 hours in males and 4 or more units (40g) in 2 hours in females. Binge drinking is undoubtedly a marker of an alcohol use disorder and may be associated with violent behaviour, risky sexual behaviour and emergency hospital admissions. However, it is frequent heavy drinking which results in alcoholic liver disease rather than binge drinking. Nevertheless early binge drinking in teenagers may progress to frequent heavy drinking and subsequently to alcoholic liver disease.

The amount of alcohol required to induce liver disease is controversial. There is some evidence to support the concept of a threshold level of alcohol consumption at around 30g/day (Kamper-Jorgensen 2004). Above this level, the risk of developing significant liver disease rises in proportion to consumption levels; an individual who consumes 50g/day increases the risk of cirrhosis 5 times above the population average and in someone who consumes 100g/day the risk increases to 25 times the population average.

The liver is the main site for alcohol metabolism and therefore the main focus of alcohol induced damage. Alcohol is converted to acetaldehyde primarily by the enzyme alcohol dehydrogenase. Acetaldehyde is a highly reactive molecule which binds to cellular proteins, inhibits protein functions and incites an immune response. When alcohol is present in excess, alcohol is metabolised to acetaldehyde through two additional pathways; the cytochrome P450 oxidation pathway and the catalase pathway. Metabolism through either of these pathways generates excess amounts of oxygen-derived free radicals which injure the liver cells by damage to cell membranes, proteins and DNA. Cell damage activates immune and inflammatory responses which, in turn, stimulate wound healing processes resulting in the deposition of fibrous scar tissue within the liver. Accumulation of fibrous tissue eventually results in cirrhosis where islands of normal liver cells are surrounded by bands of scar tissue. Further cell damage may then lead to liver failure or liver cancer. Acetaldehyde is metabolised by the enzyme acetaldehyde dehydrogenase to produce acetate which is used as an energy source within the cell. The excess calories generated by alcohol consumption are converted to triglycerides and stored as lipid droplets in liver cells which is relatively benign for the liver.

There are a number of ways in which people who drink to excess may present to medical services. Blood tests performed either in acknowledgement of an alcohol use disorder or for other medical indications may reveal derangements in the liver biochemical tests. Evaluation by a specialist at this stage will exclude other causes of liver disease and determine the extent of liver damage. Control of alcohol consumption at any stage of the disease will improve the prognosis and if alcohol is withdrawn prior to the development of cirrhosis the liver will return to normal. There is therefore a valid argument to use liver biochemical tests to screen for liver disease as interventions to control alcohol abuse are highly effective (Crawford 2004).

Alcoholic hepatitis is a more dramatic presentation of alcoholic liver disease where there is an overwhelming inflammatory response to alcohol induced cell damage and the patient is often deeply jaundiced. The mortality rate from alcoholic hepatitis is greater than 20% but with care in specialist hepatology units the outcomes may be substantially improved.

The third presentation of alcoholic liver disease is with the complications of cirrhosis. Scar tissue in the liver interrupts the normal blood flow from the intestines through the liver and back to the heart causing an increase in pressure in the blood vessels in the abdomen known as portal hypertension. With portal hypertension there may be an accumulation of fluid in the abdominal cavity, known as ascites, which causes abdominal distension. A second consequence of portal hypertension is dilated veins in the lower oesophagus (oesophageal varices) where blood flow from the intestine finds an alternative route back to the heart. Oesophageal varices may rupture and bleed profusely with a mortality rate of 20% associated with each hospital admission. Cirrhosis may also present with hepatic encephalopathy, a cause of confusion and coma resulting from liver failure, where toxins absorbed by the gut are not removed by the liver. Whilst alcoholic liver disease is also a cause of liver cancer, it is not particularly common for patients to present with this condition.

In addition to being a direct cause of liver injury alcohol is now recognised as a major contributory factor in other causes of liver disease. The prognoses of hepatitis C virus infection, hepatitis B virus infection and haemochromatosis are all worse in

patients who consume excess alcohol. It should be noted, however, that liver disease is not the only physical consequence of excess alcohol consumption. Alcohol causes a range of neurological disorders, ranging from peripheral neuropathy to dementia. Chronic pancreatitis, muscle damage and cardiac damage are caused by alcohol and may develop independently or coexist with liver damage.

In conclusion it is important to recognise the range of diseases to which alcohol contributes and the extent of morbidity and mortality attributable to this recreational drug. It is estimated that £2.9 billion a year of NHS resources are spent on alcohol related disorders but these statistics hide a much greater burden of social and emotional costs (Royal College of Physicians 2001). Effective action to control alcohol consumption is therefore urgently required.

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Health equity in a generation? Time to address the social determinants of health

Professor Sir Michael Marmot and Dr Sharon Friel

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Health inequity and its social causes

Our children have dramatically different life chances depending on where they were born. In Japan or Sweden they can expect to live more than 80 years; in Brazil, 72 years; India, 63 years; and in one of several African countries, fewer than 50 years. And within countries, the differences in life chances are dramatic and are seen worldwide. The poorest of the poor have high levels of illness and premature mortality. But poor health is not confined to those worst off. In countries at all levels of income, health and illness follow a social gradient: the lower the socioeconomic position, the worse the health.

The Commission on Social Determinants of Health, set up by the World Health Organisation to marshal the evidence on what can be done to promote health equity and to foster a global movement to achieve it, is a global collaboration of policy-makers, researchers, and civil society led by Commissioners with a unique blend of political, academic, and advocacy experience. Importantly, the focus of attention embraces countries at all levels of income and development: the global South and North.

The Commission takes a holistic view of social determinants of health. The poor health of the poor, the social gradient in health within countries, and the marked health inequities between countries are caused by the unequal distribution of power, income, goods, and services, globally and nationally, the consequent unfairness in the immediate, visible circumstances of people's lives – their access to health care, schools, and education, their conditions of work and leisure, their homes, communities, towns, or cities – and their chances of leading a flourishing life. This unequal distribution of health-damaging experiences is not in any sense a 'natural' phenomenon but is the result of a toxic combination of poor social policies and programmes, unfair economic arrangements, and bad politics. Together, the structural determinants and conditions of daily life constitute the social determinants of health and are responsible for a major part of health inequities between and within countries.

A new approach to development

Health and health equity may not be the aim of all social policies but they

will be a fundamental result. Economic growth is without question important, as it gives countries the opportunity to provide resources to invest in improvement of the lives of their population. But growth by itself, without appropriate social policies to ensure reasonable fairness in the way its benefits are distributed, brings little benefit to health equity.

Traditionally, society has looked to the health sector to deal with its concerns about health and disease. Certainly, maldistribution of health care – not delivering care to those who most need it – is one social determinant of health. But the high burden of illness responsible for appalling premature loss of life arises in large part because of the immediate and structural conditions in which people are born, grow, live, work, and age.

Action on the social determinants of health must involve the whole of government, civil society and local communities, business and international agencies. Policies and programmes must embrace all the key sectors of society not just the health sector. That said the minister of health and the supporting ministry are critical to global change. They can champion a social determinants of health approach at the highest level of society, they can demonstrate effectiveness through good practice, and they can support other ministries in creating policies that promote health equity.

Closing the health gap in a generation

The Commission calls for closing the health gap in a generation. Dramatic improvements in health, globally and within countries, have occurred in the last 30 years. The knowledge exists to make a huge difference to people's life chances and hence to provide marked improvements in health equity, but action must start now.

The Commission's analysis leads to three principles of action:

1. Improve the conditions of daily life – the circumstances in which people are born, grow, live, work, and age.
2. Tackle the inequitable distribution of power, money, and resources – the structural drivers of those conditions of daily life – globally, nationally, and locally.
3. Measure the problem, evaluate action, expand the knowledge base, develop a workforce that is trained in the social determinants of health, and raise public awareness about the social determinants of health.

These three principles of action are embodied in the three overarching recommendations (Box 1). The Commission's recommendations have to be seen in light of its global reach. Inequities in health embrace the plight of people living on a dollar a day in rural Africa, urban dwellers in shanty towns in low and middle income countries and the social gradient in health in high income countries. One set of specific recommendations will not apply to each of these particular settings; the general principles will.

This article is based on the Commission on Social Determinants of Health's Final Report, August 2008 (www.who.int/social_determinants/en/)

Box 1: The Commission's Overarching Recommendations

1. Improve Daily Living Conditions

Improve the well-being of girls and women and the circumstances in which their children are born, put major emphasis on early child development and education for girls and boys, improve living and working conditions and create social protection policy supportive of all, and create conditions for a flourishing older life. Policies to achieve these goals will involve civil society, governments, and global institutions.

2. Tackle the Inequitable Distribution of Power, Money, and Resources

In order to address health inequities, and inequitable conditions of daily living, it is necessary to address inequities – such as those between men and women – in the way society is organised. This requires a strong public sector that is committed, capable, and adequately financed. To achieve that requires more than strengthened government – it requires strengthened governance: legitimacy, space, and support for civil society, for an accountable private sector, and for people across society to agree public interests and reinvest in the value of collective action. In a globalised world, the need for governance dedicated to equity applies equally from the community level to global institutions.

3. Measure and Understand the Problem and Assess the Impact of Action

Acknowledging that there is a problem, and ensuring that health inequity is measured – within countries and globally – is a vital platform for action. National governments and international organisations, supported by WHO, should set up national and global health equity surveillance systems for routine monitoring of health inequity and the social determinants of health, and should evaluate the health equity impact of policy and action. Creating the organisational space and capacity to act effectively on health inequity requires investment in training of policy-makers and health practitioners and public understanding of social determinants of health. It also requires a stronger focus on social determinants in public health research.

Antibiotics: where does the future lie?

As we mark the anniversary of the discovery of penicillin, what are the prospects for new drugs to fight infectious diseases?

Professor Sir David Hopwood FRS

Emeritus Professor of Genetics, University of East Anglia and Emeritus Fellow, John Innes Centre, Norwich

By common consent, Alexander Fleming's discovery of penicillin made by the mould that contaminated one of his culture dishes 80 years ago was one of the most important medical landmarks of the 20th century. Its development into a wonder drug by Howard Florey and Ernst Chain at Oxford in the early 1940s revolutionised the treatment of bacterial infections caused by staphylococci and streptococci and saved countless lives. Numerically, though, the major producers of antibiotics are a group of soil microbes that shot to fame from relative obscurity after the 1943 discovery of streptomycin by Selman Waksman's group at Rutgers University in New Jersey. Streptomycin was the first effective treatment for tuberculosis. It is made by *Streptomyces griseus*, the type species of a large genus within the actinomycetes, later shown to be true bacteria rather than being, as earlier supposed based on their fungus-like growth, a group intermediate between fungi and bacteria (or even actual fungi).

Penicillin and streptomycin ushered in the antibiotic era that transformed the management of infectious disease. Their discovery was followed by the finding of many further antibacterial drugs. One was another fungal product, cephalosporin, discovered at Oxford by Edward Abraham, another member of Florey's department. It falls into the same chemical class as penicillin, and chemical derivatives of these two molecules over subsequent decades account for about half the current market in antibiotics. The rest is made up of many actinomycete products, mostly discovered in the 1950s and 1960s in a period named retrospectively as the 'Golden Age' of antibiotic discovery. They include antibacterials such as the tetracyclines, erythromycin, kanamycin and vancomycin. The antifungal agents candicidin and amphotericin were also found, as well as anticancer drugs like doxorubicin and bleomycin.

The Golden Age of antibiotic discovery was followed by decades in which far fewer useful natural products were discovered (Figure 1), although the antiparasitic compound avermectin was a big success for the treatment of worm and warble fly infestations of livestock, and with a human application to prevent river blindness, caused by a microscopic worm, in Sub-Saharan Africa. It was joined by important immunosuppressant drugs for controlling organ transplant rejection such as cyclosporin from a fungus and tacrolimus from an actinomycete.

Needs for new antibiotics

With so many successes, why could we possibly need new antibiotics? The most urgent need stems from the rise of acquired antibiotic resistance. Almost as soon as antibiotics were introduced into medicine the bacteria fought back. They have evolved over countless millions of years to survive the insults of their environments, and they could readily combat the threat posed by clinically used antibiotics. The huge numbers that bacterial populations achieve in a small space and in a short time help them mutate to survive, though the main source of medically important resistance is not fresh mutations but genes conferring drug resistance transferred into them by mating with non-pathogenic relatives. The ultimate source of resistance to many antibiotics is almost certainly the antibiotic-producing organisms themselves, since they need to have genes for protection against suicide by their own antibiotics.

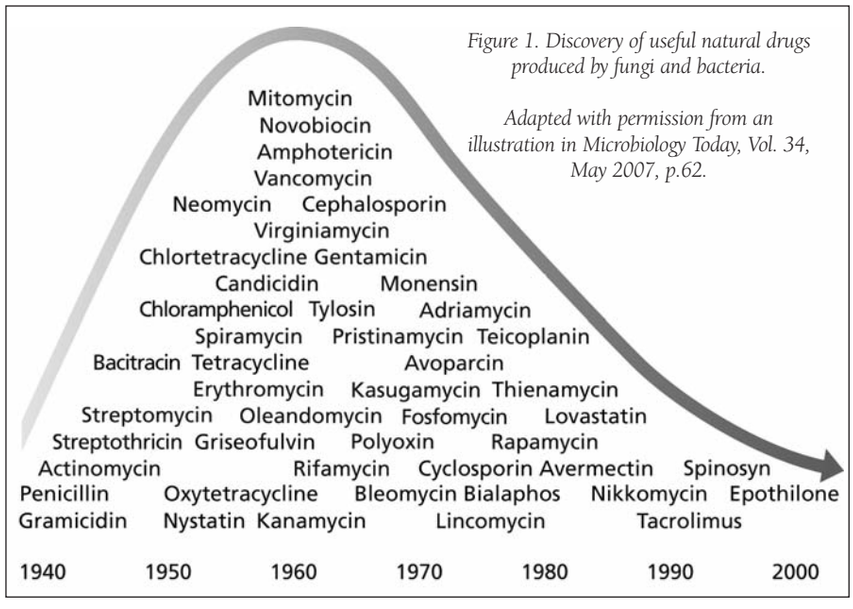

Figure 1. Discovery of useful natural drugs produced by fungi and bacteria.

Adapted with permission from an illustration in Microbiology Today, Vol. 34, May 2007, p.62.

The most famous resistant pathogen is MRSA – methicillin-resistant *Staphylococcus aureus* – responsible for much hospital-acquired infection. Others include vancomycin-resistant *Enterococcus* after abdominal surgery, and multi-drug-resistant *Mycobacterium tuberculosis*. *Clostridium difficile* is also a much talked about threat, ironically in patients whose antibiotic treatment has cleared their gut of beneficial bacteria that keep *'C. dif.'* at bay in healthy people. Another growing problem is resistant respiratory pathogens, especially in immuno-compromised patients. There is no doubt that antibiotic over-use and misuse have greatly exacerbated the problem of acquired resistance, but at some level it is an inevitable consequence even of sensible antibiotic use itself.

New antibiotics through genetic engineering

How are we going to find new treatments if the supply of naturally produced antibiotics has been exhausted? One answer was been to go back to the roots of the pharmaceutical industry before the antibiotic era and use synthetic chemistry to make new drugs. This endeavour, aided by modern developments in robotic synthesis – combinatorial chemistry – was heavily backed by the big drug companies in the 1990s as they closed their natural product discovery efforts. The companies also backed the idea of sequencing the genomes of the pathogens in order to discover genes encoding proteins that are found in them but not in humans and which could therefore provide potential new targets for compounds that should not damage human cells. Unfortunately the approach has had negligible success, mainly because the synthetic compounds tend not to make good drugs and the new targets were not as susceptible as those already refined in nature during the process of natural selection.

A more promising approach is to harness the enzymes that microbes have evolved to make complex molecules that interact specifically with cellular targets, but in new ways. This is the field of combinatorial biosynthesis of 'unnatural natural products', so called because the compounds are made by microbes, and so are 'natural', but not by those found in the wild, hence 'unnatural'. It builds on knowledge about the genetics of the actinomycetes that has developed over the decades since the mid-1950s, reaching an advanced enough stage for the rational genetic manipulation of antibiotic biosynthesis around 1990.

The first example of making a hybrid antibiotic in this way capitalised on the natural colours of the antibiotics: some of the genes for a blue antibiotic were introduced into a strain making a brown compound, whereupon a purple hybrid was produced. This demonstration of hybrid antibiotic production was academic, but as knowledge accumulated about how the complex biochemical pathways that make natural products are 'programmed', the field has burgeoned.

Many such compounds consist of a skeleton made from a long carbon chain, decorated and folded in characteristic ways, and are made on protein templates in which a linear arrangement of enzyme sites forms an 'assembly line'. The final structure of the product depends on the number, properties and arrangement of these sites, the equivalent of workstations along the assembly line, which are determined directly by the DNA sequence of the genes encoding the proteins and so can be read just by DNA sequencing, now that many of the rules have been worked out. Since the changes introduced at each workstation along the protein assembly line are nearly all independent of one another, the number of possible combinations is enormous. The trick is to alter the programming in predictable ways, guided by prior knowledge of structure-activity relationships of the compounds. In this way it is possible to do complex 'chemistry by genetics'. It is still relatively early days, but some of the first products are in clinical trials.

Back to nature?

Meanwhile, the idea that nature's bounty was exhausted during the Golden Age has been challenged. The sequencing of several complete *Streptomyces* genomes since the turn of the Millennium has revealed that these organisms must be capable of producing much greater numbers of interesting natural products than are found by traditional screening procedures. Expression of the genes is tightly regulated, presumably because many of them encode products that are useful to the organisms under special conditions that they encounter only sporadically. Isolated examples of waking up these sleeping genes in the laboratory are now being published. We need sustained investment in the fundamental microbiology required to understand the natural roles of the compounds, and their regulation, in order to find general, and therefore commercially attractive, methods to reveal the full potential of the organisms to make useful compounds.

Commercial caveats

The development of antibacterial agents suffers from problems not encountered in launching other classes of drugs. Anti-cancer medicines, for example, always have side effects, often serious, but they make it to the clinic because their benefits are deemed to outweigh their drawbacks. Not so with antibiotics. They must be devoid of side effects, in all members of the population, and this is an almost impossible ideal: hardly any of the antibiotics that have saved millions of lives since the 1940s would have been launched in the current regulatory climate. So companies are reluctant to spend hundreds of millions of pounds on clinical trials that are likely to fail on the grounds of, perhaps rather small, drawbacks. Added to this, a successful antibiotic might be taken for only a week and the patient recovers. Moreover, the expectation is that antibiotics will be inexpensive compared with anti-cancer drugs, even of marginal benefit, or treatments for chronic conditions that large numbers of the population will take for years on end. If the pharmaceutical industry is to be persuaded back to the task of combating the danger of medicine entering a scary 'post-antibiotic' era, some of these commercial caveats must be urgently addressed.

Strengthening UK Medical Science

Mrs Mary Manning
Executive Director, Academy of Medical Sciences

A new Academy for the 21st Century

Ten years ago the UK health community saw the birth of a new institution: the Academy of Medical Sciences. The creation of a new academy on the eve of the 21st century was a bold move, and not without controversy. The establishment of a national medical institution had been hotly debated for the previous thirty years, and some older organisations were wary of a new body claiming such high aspirations – to play a pivotal role in shaping the national agenda in biomedical science and healthcare. But, ten years on, the Academy has forged a unique and valuable position at the intersection of medical science, healthcare and policymaking.

Our seminal 2003 report *'Strengthening Clinical Research'* represented a turning point for both the Academy and the medical science community. The report catalysed a series of important step-changes in UK health research – from the formation of the UK Clinical Research Collaboration, to the recent £1.3 billion Government investment in the sector through OSCHR (the Office for the Strategic Coordination of Health Research). Our work on the use of patient data in research, training pathways for doctors and medical researchers and human embryos have all had significant impacts on national policy; we expect recent studies on 'Brain science, addiction and drugs' and the 'science of ageing' to do the same. Similarly, our direct support for clinical researchers and our prestigious mentoring programme continue to attract investment from the Department of Health, Health Foundation and Wellcome Trust amongst others, with overseas organisations now looking to emulate our success.

Issues of medical science and healthcare continue to be at the forefront of national policymaking – how to tackle dementia, addiction and obesity, how to prevent disease and promote healthy living, how to ensure that the UK's excellence in research translates into real health and wealth benefits for citizens. There are huge public expectations around what science and health can, and should, deliver. The need for an Academy of Medical Sciences to provide expert and independent advice has never been greater.

Our origins and Fellowship

The origins of the Academy lie in a committee chaired by Sir Michael Atiyah OM FRS, past President of the Royal Society. A distinguished mathematician, Sir Michael was well placed to provide an independent overview of the different perspectives and competing aspirations of the bodies represented on his committee: the medical royal colleges, the British Medical Association, Deans of medical schools, leading clinicians and university researchers. The ultimate goal identified by the committee was to create an institution that could represent the *whole* biomedical community, from 'bench to bedside', and so provide national leadership to a sector that had become increasingly fragmented. In 2008, the Academy's primary objective – to promote advances in medical science and ensure these are converted quickly into health benefits – remains true to this original mission.

Since our inception in 1998 we have established a Fellowship of over 900 leading medical scientists from hospitals and general practice, academia, industry and public service. Fellows are elected on the basis of sustained and outstanding contributions to medical science, including clinical and non-clinical research, veterinary medicine, dentistry, nursing, medical law, health economics, social sciences and bioethics. Our Fellowship is a national resource, outside the framework of Government, with the expertise and authority to deal with policy issues in healthcare in their wide scientific and social context.

Areas of work

In addition to our work on medical science policy and academic medical careers, the Academy has developed an innovative FORUM with industry, consisting of an active network of scientists from industrial companies and academia. FORUM member organisations are drawn from the pharmaceutical, biotechnology, medical engineering and health product sectors, with representation from commercial companies, trade organisations, research councils and other major research sponsors. Previous FORUM work has tackled safer medicines, pharmaceutical drug discovery, clinical trials and children, and personalised healthcare. Future work will examine the clinical uses of advances in medical imaging, and how the revolution in genetics, particularly the advent of the personalised genome, will impact on prevention, diagnosis and treatment of disease.

The Academy's 2006-2010 Strategic Plan added a new facet to the Academy's core objectives: to contribute to developments and improvements in global health. This represented an important re-focusing of Academy effort, recognising that our Fellows' expertise should in some way be put to work to alleviate the health burden of the developing world. We have now begun to mobilise the expertise within our Fellowship through activities looking at global mental health research, diagnostics of relevance to low- and middle-income countries and how the socio-economic benefits of research in developing countries can be evaluated. The Academy also participates in a small number of global multilateral initiatives, most significantly the African Science Academies Development Initiative, a scheme supported by the Bill and Melinda Gates Foundation to strengthen African academies' ability to inform government policymaking and public discourse with independent, evidence-based advice.

Our future

To have grown so fast and achieved so much in our first ten years is due to the outstanding commitment of the Officers and Fellows of the Academy, the hard working staff, and the support of many good friends, among them the Wellcome Trust, Royal Society, Medical Research Council and British Academy (in whose London headquarters the Academy is currently housed). The Academy is run by a small secretariat of 16 people. The size of the administration and our modest funding have inevitably played a role in shaping the Academy agenda, challenging us to focus on issues where we can really make a difference. But we continue to punch well above our weight and the ambitions of our early years have certainly not diminished. We now stand on the cusp of an exciting new phase in the Academy's lifespan: in our 10th year, we have acquired our own home at 41 Portland Place, London.

The building at 41 Portland Place will be familiar to many as the home of the Novartis (formerly Ciba) Foundation for over 60 years. When funding ran out for the Foundation early this year, the Foundation Trustees proposed a merger with the Academy and transferred their assets to us. This represented a most generous gift of over £4 million. The Foundation will long be remembered as a centre for international co-operation and excellence in biomedical science. Building on this heritage, the Academy's vision is to create an independent, professional headquarters that properly reflects the prestige and influence of the Academy. The new building will promote our public face and provide a welcoming space to the medical science community from around the UK and the wider world. Our plans to refurbish and develop 41 Portland Place are supported by an ambitious £5 million fundraising programme, to be launched at our 10th birthday celebrations in November.

In the next ten years we will continue to do the things we do well: maintaining a Fellowship that represents the cream of UK medical science; influencing policy on issues of medical science and healthcare; working at the interface between industry and academia; and supporting careers in biomedical sciences through policy, mentoring and direct grants schemes. There are also several areas of activity we are seeking to grow: our work in global health and international affairs, celebrating scientific excellence and innovation, and engaging patients and the public. We look forward to implementing these plans from within our new headquarters, so creating an enduring home that will serve the Academy, the Fellows, and the UK health community, for many years to come.

Officers of the Academy:

President: Sir John Bell FRS PMedSci

Vice-President: Sir Michael Rutter CBE FRS FMedSci

Vice-President: Professor Ron Laskey FRS FMedSci

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Animal Research – the Role of a Professional Inspectorate

Dr Judy MacArthur Clark CBE MRCVS
Chief Inspector, Animals Scientific Procedures Inspectorate

The latest statistics on the use of animals in research in the UK were released by the Home Office in July. The raw figures show that regulated procedures rose by 6% in 2007, continuing the upward trend seen since 2000. However, the annual total is still only about half what it was 30 years ago.

The main area where animal research is increasing lies in the use of fish and genetically modified mice which now account for nearly half of all procedures. Genetic modification is a very powerful tool that enables scientists to find out the function of genes and to create better animal models of diseases. It may actually reduce the number of 'higher' species used, such as monkeys (currently 0.1% of procedures), because mice with human genes may better mimic specific aspects of human diseases. It is also important to recognise that animal research is a small, but necessary, part of the total UK research effort which is increasing at a much greater pace.

Many think it is the responsibility of the Animals Scientific Procedures Inspectorate (ASPI) to reduce the numbers of animals used in research. However, it's a bit more complicated than that. There is no mechanism under the Animals (Scientific Procedures) Act 1986 to reduce overall numbers or to meet numerical targets. Instead, the regulatory controls aim to ensure that animals are used only when there is no alternative, that the fewest number of animals consistent with the scientific objectives are used, and that any harm caused is minimised. These principles are known as the '3Rs' of animal research – *Replacement, Reduction and Refinement* – first articulated in the late 1950s by British scientists William Russell and Rex Burch.

All Inspectors are professionally qualified, either medically or as veterinarians, and all have extensive relevant experience when they enter the Inspectorate having worked previously in areas such as biomedical research, clinical practice and animal welfare. With such a rich and diverse background, I believe we are ideally placed to ensure that a suitable balance is achieved between any compromise to animal welfare and potential scientific benefits.

On the benefit side, the use of animals in research continues to contribute greatly to medical advances, including the development of improved anaesthetics, antibiotics, vaccines, a wide range of other modern medicines, and surgical advances such as open heart surgery, joint replacements and organ transplants. In addition, animals are used in other areas of research unconnected with healthcare but where their use is still justified. We should also remember that animals, as well as humans, have benefited.

However, there is still much unmet medical need – just starting at A we face life-threatening and debilitating conditions such as Alzheimer's disease, AIDS, atherosclerosis and arthritis. Whilst many alternatives to animals have been developed for significant elements of modern research programmes, there remain many examples of really important research where the use of animals is absolutely necessary to achieve the objectives.

Under the 1986 Act, a regulated procedure is any scientific procedure that has the potential to cause pain, suffering, distress or lasting harm to a protected animal. In the UK, protected animals include all vertebrate animals and one species of octopus and central to the application of the Act is the principle of the '3Rs'. Hence all applicants for project licences must show they have taken steps to avoid using animals wherever possible (Replacement), to use the minimum number of animals (Reduction) and to refine their procedures to minimise the impact on the animals (Refinement). Therefore, whilst on the welfare side it cannot be denied that animals may suffer in some research, a main role for the Inspector is to make sure that any suffering is minimised as much as possible.

So, what does ASPI actually do? When the annual statistics were released earlier this year, we also published our annual report detailing many aspects of our work during 2007. The 28 inspectors carried out over 2,400 visits to scientific establishments, primarily to check for compliance and to ensure the 3Rs are being effectively applied. The majority of visits were unannounced. They also provided advice on over 3,200 applications for personal and project licences as well as over 6,550 amendments.

Under the rigorous controls of the 1986 Act, an important part of the Inspectorate's work lies in the triple

licensing system: research must generally take place in research institutes or companies which have appropriate animal accommodation and veterinary facilities, and have gained a **certificate of designation;** procedures must be part of an approved programme which has been given a **project licence**; and procedures must be carried out by people with sufficient training, skills and experience as shown in their **personal licence.**

It is clear then that, in addition to visiting establishments, much of ASPI's work is in assessing licence applications. However we are concerned that the way the licensing system has been administered in the past may have, for a variety of reasons, become more bureaucratic than may be necessary. A remarkable feature of ASPI is the day to day contact we have with our stakeholders as part of our role as regulators. And the range of those stakeholders is immense – including internationally renowned scientists performing research which may literally change the world, veterinarians and animal care staff who devotedly care for animals on a daily basis, and representatives of animal welfare and protection bodies who are passionate in their concern for animals. Working with these stakeholders, we are actively seeking ways to improve the licensing process without compromising animal welfare. We have already made good progress but we are conscious that applicants, particularly for project licences, still find preparing their applications challenging. We believe this is largely due to difficulties in achieving the right level of detail in the information which we require to properly assess the application. So there is need for better communication at many levels.

On the other hand, many stakeholders also want to be reassured that any measures to reduce bureaucracy will not compromise animal welfare. Unnecessary red tape may threaten the competitiveness of UK research but equally it is the rigour of the regulatory system which assures public confidence. So there is much to be done in achieving the right balance whilst meeting the challenge of better regulation.

A further big challenge is to ensure consistency in our recommendations. All Inspectors are professionally qualified which is important because we are working in very complex fields. However, as professionals, we exercise judgment in formulating our advice and this may lead to apparent inconsistency. In reality, this inconsistency is often not real since the circumstances surrounding a particular recommendation may explain why it differs from an apparently similar situation elsewhere.

Nevertheless, we recognise the need to demonstrate consistency wherever appropriate but without creating a set of inflexible rules. A solution lies in teamwork so we are performing thematic reviews of specific areas of work, often in association with stakeholders, to ensure our advice is both consistent and of a high standard. We are also prioritising our resources to focus particularly in areas of higher risk such as those involving substantial suffering or sensitive species, such as dogs, cats and non-human primates. In addition, we make use of joint visits, meetings and assessments to enable Inspectors to benefit from each other's specialist knowledge and to share best practices.

The Inspectorate is also involved in a number of special projects, sometimes providing advice to the Animal Procedures Committee (APC), our statutory independent advisory committee. The range of these special projects is very wide, from advice on the acquisition and use of primates to the training of licensees; from guidance on ethical review processes within establishments to retrospective review of licences. We have recently offered advice to the APC on improving the welfare and refining the use of genetically altered rodents and advice to stakeholders on the pitfalls that may arise when building new facilities or renovating existing buildings. And, importantly, we support our colleagues in the policy section of the Animals Scientific Procedures Division (ASPD) in advising ministers and responding to parliamentary questions and external enquiries, particularly with respect to operational and technical issues.

The Inspectorate also plays a central role in advising on the current revision of European Directive 86/609/EEC on the Protection of Animals used for Experimental and other Scientific Purposes. The main aims of the revision are to achieve an improvement across Europe in the welfare of animals undergoing scientific procedures and to promote a level playing field throughout Europe for researchers using animals. The Commission has sought advice from a number of experts and has undertaken a public consultation. The Inspectorate plays an important role in an Inter-Departmental Group, convened by the Home Office, which co-ordinates the UK Government's views on the revision of the Directive. This group also works closely with a wide range of UK stakeholders to determine and understand views and align them wherever possible.

The Commission had originally intended a rapid revision of the Directive but we now realise we may have to wait several years before a new version is finally agreed. At that point, it may be necessary to seek changes to the UK legislation in order to transpose and implement the new Directive.

In conclusion therefore, it can be seen that the role of ASPI, whilst primarily advisory, is fundamental to the effective operation of the UK regulatory system to protect animals used in research. Many initiatives are under way to improve the efficiency of the system through better regulation. In addition, the European dimension means that we are likely to see some significant changes to our regulatory system in the coming years. Whilst many of these changes may lead to improvements in animal welfare, the major benefit for UK research, both in academia and industry, has to be in achieving a more level playing field for research across Europe.

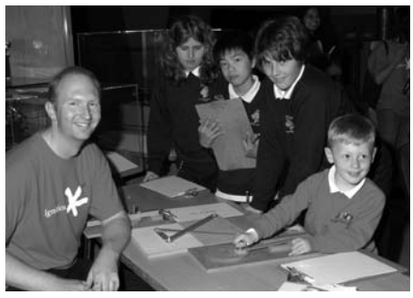
East Midlands invests in STEM education

Phil Hope, Minister for the East Midlands, describes how a focus on science, technology, engineering and maths (STEM) is taking hold in the region.

The future prosperity of the East Midlands and its ability to compete on the global stage relies heavily on a strong supply of talented individuals going into science, technology, engineering and mathematics (STEM) careers. East Midlands Development Agency (emda) together with major regional organisations have set out a vision for more coherent, effective STEM education, reaching out to all learners and offering better support to educators.

Andrew Morgan, emda's Skills and Communities Director, is looking to the future: "The UK produces just 25,000 STEM graduates each year, compared to over 2 million in China and India. This is why we need to take action now to inspire the next generation of scientists, engineers, technologists and mathematicians. Our STEM initiative, which we launched in early 2008, marks a £6m investment over three years in a range of projects - including Ignition*, the STEM Student Journalist scheme, 'Lab in a Lorry,' and a Space Academy – to help achieve this goal."

Emda's initiative is in response to the recommendations of both The STEM Programme Report 2006 published by the then DTI and DfES, and 'The Race to the Top – A review of Government's Science and Innovation Policies' undertaken by Lord Sainsbury in 2007. The latter looks into how the UK is competing against the emerging economies and advocates both collaboration across education and business, and a widening of STEM literacy in the UK population.



Chris Bishop, one of the 3M ambassadors with students from the Ivanhoe School in Ashby and Sam Houghton (5), Britain's youngest patent-holder for his double-headed broom.

An integral part of emda's investment programme is the East Midlands STEM Partnership, which is the voice for science, technology, engineering and mathematics (STEM) education in the region. Bringing together all those involved in STEM – delivery organisations, businesses and educators at all levels, the Partnership supports the challenge to get more young people interested in STEM subjects and into the industries that need them.

Several of the region's leading businesses are already involved in education and skills work. 3M Health Care Limited, Rolls-Royce and Siemens understand the commercial benefits from proactive involvement, and through the STEM Partnership more companies will find it easier to join in this skills drive.

Ignition* is a further example of how the emda funding is being applied. The three-year programme aims to transform the region's achievements in STEM subjects by inspiring the next generation of enquiring minds. At a recent workshop at Leicestershire's Snibston Discovery Park, which showcased the talent for invention and creativity of 11-14 year olds, 3M Health Care Limited science and technology staff shared their expertise with the students and put their curiosity to the test.

Chris Bishop, Senior Project Engineer from 3M Health Care Limited, attended the event as a mentor: "Working with children on STEM

activities has been exceptionally rewarding in many ways. It has challenged me to think about how I communicate information at a level appropriate to my audience. It has given me the opportunity to share my own interest and enthusiasm for STEM subjects and try to foster those same feelings in the next generation. It has provided constant surprises in the shape of children's genuinely novel and innovative solutions to a brief. All this, and it's been great fun too."

By getting involved with local schools, colleges and universities, businesses are also helping with specific projects. For example, the 'Lab in a Lorry' has already visited 6,500 students in the region and is currently recruiting for more volunteers to support activities with budding scientists and engineers. Companies such as AstraZeneca are supporting the STEM Student Journalist project by encouraging summer placement students to create news reports on their work experience.

Taking the long view by resourcing science, technology, engineering and maths promotion over the next three years is a bold step on the part of emda. I am in no doubt as to the significance of the STEM skills agenda, not least at a time of ever greater global competition. The East Midlands will be judged on its ability to innovate and to reflect better the skills and competences that employers need. Calls for greater efforts to work together and share good practice are essential and the emerging East Midlands STEM Partnership is helping to mobilise these skills.

For more information on all these activities, visit www.emstempartnership.org.uk or call 0115 984 7021.

Sciencewise Expert Resource Centre

An interview with Lord Winston by Karen Gooch

Leading scientist and broadcaster Lord Robert Winston has recently taken on yet another role – that of 'ambassador' and 'champion' of the recently launched Sciencewise-ERC.

The aim of the Sciencewise Expert Resource Centre for Public Dialogue in Science and Innovation, funded by DIUS, is to help policy makers engage and talk with the public about challenging and often controversial science and technology issues.

Lord Winston, who was recently appointed the first Professor of Science and Society at Imperial College, will act as the centre's figurehead to get the message across to politicians, the public and the scientific community.

"We have to recognise that the science people like me do is not owned by us, it is owned by society and therefore we have a duty to demonstrate our responsibilities as good citizens and ensure we listen and respond to public concerns about the technology we are proposing" Lord Winston said in an interview for Science in Parliament.

"As a champion, my role is not to be part of their executive (Sciencewise-ERC) or execute policy, I think that is for Sciencewise. My role is to ensure that when it is engaged on something it gets an appropriate profile.

"We want to have more involvement with the public and people who have little influence in our society, for example people from ethnic backgrounds and people who have not had a higher education, who should have a say in what we are on about.

"Sciencewise is a valuable resource for developing two-way conversation with the public, and, most importantly, will help to build greater confidence and trust between Government, scientists and society as a whole."

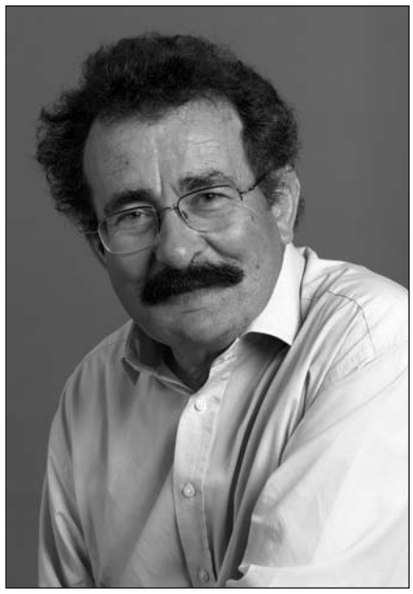
Lord Winston is especially well placed, as he acknowledges, to spearhead the work of Sciencewise-ERC. His high profile encompasses Parliament, where he sits on the Labour benches in the House of Lords, the academic world – as Emeritus Professor of Fertility Studies at Imperial College he is currently leading a research programme in the Institute of Reproductive and Developmental Biology on improvements in transgenic technology in animal models. As a broadcaster, he is able to spread the message to a wide audience about new developments in science and technology.

This autumn his new television series 'SuperDoctors', examined the problems raised by cutting edge technologies and the implications on people's daily lives. The three-part series on BBC 1 followed other highly successful television programmes by Lord Winston, including *Superhuman, Child of our Time, Human Instinct*, and the BAFTA award-winner *The Human Body.*

This background gives Lord Winston a unique insight into communicating with all strands and sections of society, and he is especially enthusiastic about the role public dialogue can play in formulating policy.

Funding public dialogue programmes to enable policy makers to learn more about public perceptions is an important focus of the Sciencewise-ERC, which also offers a virtual knowledge hub and offline support services, including 'Drop in for Dialogue' sessions throughout government.

"Dialogue sessions are much better than referenda, as they allow you to pick up on nuances and also enable far more detailed scientific explanation than is possible in, for example, public opinion poll questions" Lord Winston explains.



The Embryology Bill, currently going through Parliament, is an example of how policy can be formulated and even significantly altered, after public dialogue input. The Human Fertilisation and Embryology Authority took on board the public views expressed at Public Dialogue sessions, funded by Sciencewise-ERC, when deciding in principle to licence hybrid and chimera embryo research last September.

"The feedback persuaded HFEA to be a lot more permissive with their interpretation and advice as to how the bill would go. Whether the bill would have been presented in that format is difficult to know, of course, but certainly dialogue seems to have had a considerable impact in alerting the Government not to be too rigid in the new legislation."

On the day I met Lord Winston, who is internationally acclaimed for his long and highly successful research career in reproductive medicine, the IVF pioneer was particularly exercised about abortion amendments to the Embryology Bill, which he condemned as "quite cynical and I think rather disreputable".

He pointed out that the anti-abortion campaigners should be aiming their fire at primary legislation on abortion, not the Embryology Bill.

In the long term, Lord Winston is confident that negative headlines about scientific research, in particular

that on hybrid embryos which panders to fears about 'Frankenstein' creations, is little more than 'hysteria' on the part of some sections of the media.

"The British people are not stupid – unfortunately our media leaders would think that they are sometimes.

"Frankenstein's monster was something alive, and there is no possible interpretation you can argue that is being done in this case" he asserts, referring to hybrid embryo research. "It is just not helpful. Dialogue needs truthful evidence and information which is verifiable."

On a more positive note, he cites the vast amounts of responsible newspaper coverage of the issue, ranging from features to articles in science columns.

Looking back, Lord Winston pinpoints the moment he believes science attracted criticism and became something to be suspicious of: "The watershed in history of all this for me was the development of nuclear weapons. In the 1930's the then government decided what we were doing with the nuclear programme was so powerful it had to be kept secret – even from some members of the Cabinet.

"A lot of scientists showed their misgivings, and a lot wanted to come off it (the programme). Until that time, it was assumed that science was good. In the last two to three decades there was then the notion, articulated by C P Snow, that of the two cultures, science was hard edged and threatening, while the arts were touchy feely and cuddly."

Lord Winston wants to dispel that viewpoint: "In my view science and the arts are the same thing, expressions of the same part of human aspiration generally."

It is a message he aims to share with as wide an audience as he possibly can.

BOOK REVIEW

An Appeal to Reason: A Cool Look at Global Warming

By Nigel Lawson

Duckworth Overlook £9.99, pp149

After his tremendous career on the Financial Times, as Secretary of State for Energy and as Chancellor of the Exchequer, Nigel Lawson is now bringing his perspectives of journalism, economics, energy policy and politics to the issues of climate change. His book is a strongly argued, but unbalanced attack both on scientific research into climate change and on the plans of governments to moderate global warming by reducing carbon emissions. The heart of his case is a disbelief in the scientific predictions about the natural and human consequences associated with the rise in atmospheric temperatures over this century of about 4°C. Nor is he convinced about the policies proposed to deal with these effects.

These policies as well as the scientific, economic and administrative procedures being used are broadly similar to those that environmental scientists, campaigners and governments developed over the past 50 years to deal with urban smog, acid rain, lead in petrol, asbestos, stratospheric ozone depletion and water pollution, etc. With the progress that has been made towards these environmental objectives the international community is confident that they will be able to deal with the more complex problems of long term climate change caused by human activities.

The book seriously understates these problems, based on a selective review of scientific observations of the natural world. These changes are more substantial and have been occurring more rapidly than any others since about 10,000 years ago when huge ice sheets covering Britain were melting along the Thames. The largest temperature rise of 3°C in the last 50 years has been on the Antarctic peninsula, where recently large ice sheets the size of Wales and at least 20,000 years old broke away and initiated further slippage – 'the cork popping out of the bottle'.

Economists are more gloomy about forecasting than meteorologists – as I have learnt from Professor Lord Desai. So it is not surprising that Lord Lawson doubts whether it is possible to predict how climatic changes will develop and whether there is anything we can usefully do to arrest them. The evidence so far about predictions and about whether political responses are possible does not support this pessimism.

Arrhenius' nineteenth century predictions have been confirmed by the steady rise of CO_2 concentration (which will nearly double the pre-industrial levels in the next 20-30 years), and by satellite measurements of the reduced out-going radiation and lower temperatures in the stratosphere.

However Lord Lawson is quite correct to point out the difficulty in predicting the rise in temperature in the lower atmosphere and near the surface, though Arrhenius' estimate of 5°C may be only a slight overestimate. But as an economist living in a glass house he should not throw stones at the methodology of incremental improvements in modelling, which he unjustifiably ridicules by appealing to the philosopher Sir Karl Popper.

This approach (explained by Popper's student Lakatos) is proving successful in the continual reduction of the uncertainty of climate science, as John Mitchell successfully showed in the 1990's when the effects of industrial aerosols were introduced into the Hadley Centre climate model.

Although the book criticises the use of climate data and its interpretation by the Intergovernmental Panel on Climate Change, and by Al Gore in his movie, it actually agrees with the official conclusion that the average temperature over each century was always at least 0.8°C lower than its present value; in other words we really have a warmer climate now.

More controversially the book does not accept the usual explanations about the trend of the global average yearly temperature in the past 50 years. One should recall that until the 1990's, it was generally assumed that global warming would not be detectable until about 2010-2020 because of the natural climate fluctuations that can last over many years and even decades. However when the annual global temperature rose sharply in the late 1990's, many climate scientists regarded this trend as clear evidence that human activities were already causing significant global warming, and indeed at a more rapid rate than had been expected. But since 1998, as the book makes clear, this average temperature, which covers both land and sea areas, has not risen further, which has confused engineers and others making long term policies and investment decisions.

In fact over the period 1998-2008 the average surface temperature of the ocean has decreased. Nevertheless, because of the underlying green house effect, the temperature over all the land areas has continued to rise, currently (according to NASA) at the rate of about 0.15°C per decade.

In other words natural or man-made climate trends cannot be understood without considering the chaotic variations, lasting over many years, both in the temperature over the surface of the oceans and to a lesser extent over the land areas. Since global climate models describe these broad features, they are valid for predicting global temperatures over periods of decades and centuries.

The greatest dangers associated with climate change will be extreme weather events and changing processes in the atmosphere and ocean, and on the land. But Lord Lawson is sceptical and underplays the danger of future climate change by describing it as simply a slow rise in temperature (which he does accept).

The critique developed in the economics chapters of the book are based on this optimistic assumption. He urges governments to disregard the economic analysis and scientific reviews of Lord Stern which concluded that a modest (about 1-2% of GDP), but urgent, increase in public and private investment is needed to accelerate both energy conservation measures and market-driven low carbon technologies.

When it comes to an analysis of the non-governmental financial structures to enable the market to promote these measures, he calls the market-based, but government supported system of carbon credits, cap and trade, and the Clean Development Mechanism (CDM) a 'scam'.

Having rejected these incentive arrangements, Lord Lawson gives a surprising endorsement to the socialist (or Treasury?) solution of a carbon tax, which most politicians and statesmen such as Mr Blair and Senator Bingaman regard as a step too far. The only exception is the environmentally committed government of British Columbia. We shall see.

In rejecting the need for urgent action on mitigation, he insists that the immediate priority should be to invest in adaptation measures in developing countries where natural hazards and concentrations of populations lead to enormous loss of life, even in the present climate. In the opinion of legislators from developed and developing countries when they met recently to put their case to the G8 and other world leaders, adaptation is vital. But as they observe the growing impacts of climate change in their countries, they are convinced that mitigation is also essential.

The final chapter on bold 'geo-engineering' solutions to reduce global warming and its effects takes a cautious view; but some local projects may be an essential policy tool for example by stimulating the hydrological cycle in desert/mountain areas.

Perhaps the most provocative aspect of the book is the title which implies that better science and policy only needs a better level of the economics-style of reasoning. This is too modest – we need more boldness, openness, inventiveness, humanity, sensitivity, investment and also reasoning, provided it is applied with some humility and with some understanding of its differing cultural overtones.

Lord Hunt of Chesterton
Professor of Climate Modelling, University College London

LETTER TO THE EDITOR

Dear Sir,

As the Foreign and Commonwealth Office finalises the transfer of the Science and Innovation Network (SIN) to DIUS whilst continuing to invest heavily in climate change programmes, it is becoming increasingly evident here in Brazil that such climate change objectives cannot be achieved without a sound, science-based foreign policy and a clear strategy on international research collaboration. Indeed, scientific collaboration is at the heart of what the Brazilians regard as their strategy for engaging the UK in discussions on climate change: from agreements to launch joint satellites (including Amazonia 1, a deforestation monitoring satellite currently being designed by both countries) to discussions on joint data analysis and meteorological modelling, excellence in science constitutes an essential part of what Brazil wants out of a partnership with the UK. In this context SIN was in an ideal position to shape international research collaboration on the basis of specific foreign policy objectives, which was essential given the influence that UK science exerts on external stakeholders. We can only hope that the appointment of a Chief Scientific Advisor within the Department repairs some of the damage that may have been caused by the transfer of such a vital tool for foreign policy-making.

Yours sincerely,
Damian Popolo
Vice-Consul, Science and Innovation
British Consulate General, Sao Paulo (Brazil)

20 Years of the Parliamentary Office of Science and Technology (POST)

Part 2: the Past 10 Years and the Future

Next year marks the 20th anniversary of POST's services to the UK Parliament. In the last issue of Science in Parliament, Dr Michael Clark, former MP and Chair of POST, and its first Director, Prof Michael Norton, looked at the Office's origin and early experiences. In this second article, the current Chair, Dr Ashok Kumar MP, and the Director, Prof David Cope, examine the Office's experiences since 1998 and offer some thoughts on future directions.
Prof Cope became POST's Director in 1998.

Expansion and Extension

Although of course, POST is strictly a non-political organisation, the election of the Labour government in 1997 had a considerable influence on it. At one level, this came through the succession of MP Chairs appointed by the Government Whips to lead POST's Board in determining its work programme – first, Dr Ian Gibson, from 1997-2001; then Dr Phyllis Starkey, from 2001-2005 and from 2005 to the present, Dr Ashok Kumar.

More significant, however, was the emphasis placed by government on the role of science and innovation in stimulating the UK economy. This encouraged a strong sense of the positive contribution of the entire 'science enterprise' and of the urgency to develop policies to maximise the benefit. It is fair to say that there is little political disagreement on such aims, as was shown last year when the Conservative Party published its task force report on science, technology, engineering and mathematics, with the task force being chaired by POST Board member, Ian Taylor MP[1].

Coincidental, but also influential, was a whole series of national and international circumstances where science and technology issues came to the forefront of media and political attention. The first was the BSE/CJD 'crisis', followed in short order by the huge controversy over genetically-modified foods. The latter, in particular, encapsulated some of the basic principles of POST's work on technology assessment, for the Office had examined the subject as early as 1994 – and had also worked with external partners, such as the Science Museum, in organising the UK's first national 'consensus conference' – a structured public consultation process. POST was therefore very well placed to provide the type of detailed, impartial, analysis described by Dr Clark and Prof Norton in the first article, when the subject rocketed to the top of the political agenda in early 1999[2]. Foot and Mouth Disease followed in 2001, while the entire period of the last decade has seen enduring issues, such as stem cell research, concerns over the potential impacts of information technology developments, especially in relation to privacy and, above all, the entire subject of climate change, constantly the subjects of public and political debate.

It is no accident therefore that demands for the Office's services expanded dramatically in the past ten years, nor that both Houses, in 2001, decided that POST should be established as a permanent bicameral institution, instead of being on a quinquennial renewal basis. Demand for increased services was met, early in the decade, by an expansion in staffing, so that POST now operates with three teams, each of two advisers, in the fields of Biological Sciences and Health; Physical Sciences and IT and Environment and Energy. To help to disseminate the increased output, a special Publications, Media and Events Manager position was also established.

POST Fellowships

A key contribution to the Office's increased output has also been the expansion in the number of short-term (usually three month) fellowships at POST. These enable doctoral students (and occasionally post-docs) to work alongside the permanent staff. Usually fellows produce one of POST's famous 'POSTnotes' but they may additionally or solely be based with a select committee, assisting it in a relevant inquiry. In 2008, the Biotechnology and Biological Sciences Research Council became the latest research council to sponsor POST fellows, while support also comes from learned societies such as the Institute of Physics and Royal Society of Chemistry and other external organisations such as the Wellcome Trust and the National Endowment for Science, Technology and the Arts.

As Chair and Director, we would like to put on record our gratitude to all our fellowship sponsors. As a result of this support, POST now has an 'alumni network' of over 50 such former fellows, most of whom retain strong links with the Office and often continue collaboration with it in various ways.

POST's Work with Select Committees

From its earliest days, the Office had worked in various ways in assisting parliamentary committees in both Houses, but the expansion in numbers of both permanent staff and fellows has enabled this contribution to shift

up a gear over the past decade. Assistance can range from informal briefings given to committee members prior to their beginning an inquiry through to substantial pieces of research conducted at the suggestion of a committee.

The origins of POST's longest, largest, and in many ways, most influential piece of work in its 20 year history arose in this latter way. In 2002, the House of Commons Defence Committee published a report on *Defence and Security in the UK*[3]. In the course of its inquiry, the Committee received evidence suggesting that sabotage attacks at UK civil nuclear facilities could have very serious consequences. The committee felt it was not itself technically qualified to assess the validity of such claims and requested POST to 'pick up the ball'. So began a two year investigation that culminated in the publication of POST's longest report[4] and a continuing relationship with the government Office of Civil Nuclear Security. POST will most likely be re-examining developments in this field in the near future.

It was also in collaboration with select committees that POST, in the last decade, pioneered the use of online consultations by the UK Parliament. The first consultation was on the career experiences of female scientists, for the House of Lords Science and Technology Committee. This was followed by a general public consultation organised for the Culture, Media and Sport Committee, while POST, on its own initiative, conducted another, which had over 600 participants, on inland flooding, after the disastrous occurrences of 2000-01. Such online consultations are now quite regularly used in committee inquiries, where appropriate.

POST looks forward to strengthening and extending its work with parliamentary committees in the future. The timescales of committee work, with inquiries usually originating at quite short notice, does not always mesh well with the longer term work planning horizon of POST. However, the Office always tries to reschedule its programme to accommodate interesting committee requests, as it did most recently, when POST's Environment and Energy team leader was seconded for a period to assist the work of the Draft Marine Bill Committee.

POST and the Wider World of Technology Assessment

Two significant features of the past decade have set the work of POST in a wider context. The first has been the remarkable expansion of parliamentary technology assessment units across Europe, with the latest being established in July 2007 at the Swedish Parliament. There are now 18 such offices, from Finland to Greece, and movements afoot in some of the newer member countries of the EU. Many of these Parliaments have sent delegations to investigate POST's working methods before establishing their own offices. All have been welcome, although eyebrows were raised when the Norwegian Parliament requested that we receive a delegation of 18 members – the Office had to make a special request to increase its entertainment budget to be able to offer them dinner. All 18 offices collaborate in various ways, including joint projects, through the European Parliamentary Technology Assessment network. Next year, to mesh with POST's 20th anniversary, it will also hold the presidency of the network.

Delegations also came to POST from wider afield than Europe – especially through approaches to POST by organisations such as the Commonwealth Parliamentary Association and the Inter-Parliamentary Union. This coincided with a growing interest in 'science for development'. In 2001, POST's Board agreed that a continuing theme of its work should be examination of UK interests in development matters. The resultant output served only to increase the interest in POST's work from parliaments and research institutes in developing countries, especially Africa. In response, last year, with support from organisations such as the Gatsby Charitable Trust and the Association of Commonwealth Universities, POST began a special project to assist such parliaments to enhance their science and technology assessment capacities. One POST staff member has been on a part-time secondment to initiate the project, which will run for the next two years.

Closer to home, awareness of, and interest in, the work of POST from within the UK has considerably expanded in the past decade. Dr Clark and Prof Norton, in their first article, noted that one of Parliament's original objectives was that POST should, through its work, help to raise the credibility of the parliamentary process as a whole. It is very gratifying that so many higher education institutions systematically refer their students to POST publications, while POST always welcomes the requests that the Office regularly receives from Members for multiple copies of POSTnotes to distribute to constituents.

20 More Years

There is no indication that the growing role of science and technology that POST has covered over the past twenty years will slacken in its pace in the future. POST regularly conducts internal 'horizon-scanning' exercises to identify emerging issues – something that the House of Commons Public Administration Select Committee last year suggested that it should explore more formally[5] – a message received with alacrity by POST's Board. Immediately after every general election, POST publishes a special briefing on the science and technology issues that it anticipates might receive parliamentary attention during the forthcoming Parliament. Soon after the return of Parliament from the 2008 summer recess, POST will collaborate with the Government Office of Science to look at that Office's Foresight and Horizon-Scanning Programmes and ways in which they can reinforce their parliamentary relevance. POST looks forward to ensuring that on the issues of the future – be they 'human enhancement', the problems of securing energy needs while protecting the environment, or the seemingly limitless applications of information technology – the UK Parliament can draw on analysis that is – timely, independent, comprehensive and comprehensible.

Notes

1 Ian Taylor, Conservative Party Science, Technology, Engineering and Mathematics Task-force, ***Science in Parliament***, **64**, 1, Spring, 2007, p1.

2 POST report, ***Genetically Modified Foods - Benefits and Risks, Regulation and Public Acceptance***, 1998

3 House of Commons Defence Committee, Sixth Report, Session 2001-2, ***Defence and Security in the UK***, HC 518-I, 24 July 2002

4 POST report 222, ***Assessing the Risk of Terrorist Attacks on Nuclear Facilities***, July 2004

5 House of Commons Public Administration Select Committee, Second Report, Session 2006-7, ***Governing the Future***, HC 123-I, 6 March 2007

EMERGENT HUMAN DISEASES: ALLERGIES - AUTISM - MYALGIC ENCEPHALOMYELITIS (ME)

MEETING OF THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE ON TUESDAY 17TH JUNE 2008

Professor the Baroness Finlay of Llandaff, Chairman, HoL S&T Committee Inquiry into Allergy

Simon Baron-Cohen Autism Research Centre, Department of Psychiatry, University of Cambridge

Peter Spencer Chief Executive, Action for M.E.

Allergies

There seems little doubt that allergies have increased in recent years. It seems that this is not merely greater awareness or previous misdiagnosis but a true increase in the prevalence of allergies, in particular anaphylactic reactions.

The Inquiry

The House of Lords Select Committee on Science and Technology was tasked to investigate this. In setting up the enquiry and looking at the three previous reports in the last five years, from the Royal College of Physicians, the House of Commons Health Committee and the Department of Health, it seemed that lack of provision of allergy services had been of major concern. But, it was clear from our enquiry that little had been achieved and the shortfalls in clinical services remained unaddressed.

As the inquiry developed, it became shockingly apparent just how severely allergic diseases could impair people's quality of life and how, despite our track record of high quality research in the field, allergy services in the UK lag far behind those of other European countries through a severe shortage of allergy specialists.

During our inquiry we heard of children with allergies who sleep poorly by night and are bullied at school by day, and whose hay fever impairs their performance in summer exams. We learnt that the workplace environment can cause or so exacerbate allergic symptoms that some adults are forced to give up work, yet there is no clear guidance about what to do next or how to control their symptoms. And we heard of the increasing problem of fatal anaphylaxis, particularly through insect stings and food allergies.

Allergic mechanisms

Allergy underlies a wide spectrum of conditions. With anaphylaxis, most commonly caused by nuts or bee stings, there is a very rapid onset of swelling of the tongue and respiratory passages leading to collapse, and even to cardiac arrest and death. Less acute reactions result in a severe local reaction to contact with various allergenic substances. Some reactions take a little longer for onset and include severe skin rashes. Other more chronic reactions include contact dermatitis, eczema and food allergy responses of the skin and the gut, and delayed hypersensitivity reactions to drugs. Unfortunately some people believe that they are allergic to various external agents but extensive investigations show that this is not the case; these are better described by the broad term 'idiopathic environmental intolerance'.

The allergic mechanism is principally mediated through IgE antibodies which cause the release of histamine leading to anaphylaxis. In the more chronic reactions immune cells (T cells) are activated by the allergen and cause the release of cytokines, chemokines and other inflammatory markers. Some tests marketed commercially depend on the detection of IgG antibodies, which simply show that the person has been exposed at some time to a substance, but do not indicate that they have a true allergic response, nor do they indicate that the substance is harming the person's

health. The broad range of presentations means that accurate diagnosis, which depends in large part on very careful history taking, is absolutely key to management in the long-term.

During our enquiry, we learnt of people who spend time and money on treatments for which there is no benefit and we also learnt of many people whose true allergy goes untreated or mismanaged because of the lack of accurate specialist diagnosis. Some of the rare allergies, such as allergies to anesthetic, sometimes require specialist investigation which is only undertaken in one or two centres in the UK.

The size of the problem

Our committee also found we could not quantify the problem, the full health cost of allergies or the economic burden to society because the reporting systems in the NHS do not code specifically for allergy per se. Yet data from 2004-05 suggests that 3 million people consult their GP, at a cost of around £211-311million per annum, generating about 72.6 million prescriptions at a cost of almost a billion pounds – or 11% of the annual drugs budget.

We also learnt that there are at least 70,000 acute hospital admissions for asthma and 3,000 for anaphylaxis each year, costing in the region of £56-83 million in secondary care alone. And there are hidden costs; some patients believe they are allergic to drugs such as penicillin and so are always prescribed more expensive alternatives, when in fact they do not have a true allergy and have never been properly tested for the allergy.

Services in Europe

The committee found that allergy services in the rest of Europe are much more developed than in the UK, despite our history of excellence in basic cellular science around allergy. We therefore made our key recommendations around clustering allergy services together to create centres of excellence. We want those services that already are involved in treating allergy and have an interest in allergy to come together in a grouping, led by a full time allergist, to create a centre. Such a centre would be able to provide education to primary and secondary care in their region, lead on research and also provide a resource to patients. Skin testing and complex allergy testing could be undertaken to ensure accurate diagnosis and a management plan evolved with the patient that could be monitored back in primary care. Where allergy is severe or life threatening and where patients have complex allergic disease, they need to have access to a centre of excellence.

Recommendations

We also made recommendations around the need to look at the way that those handling food are trained, because of the danger of nut and other allergen contamination in food. The whole peanut allergy story is currently being researched and it is worth noting that in Israel and Africa where children are weaned on peanut based preparations, they seem to have a lower incidence of peanut allergy than in this country. Here, the Department of Health advises pregnant women and lactating women to avoid peanuts; this advice is subject to review although our committee felt the advice should be withdrawn pending the review.

Children with hayfever can drop up to a grade in major exams which occur during the hayfever season. However these children rarely get extra time in exams and sometimes are seated in an exam hall near a window, exposing them to higher levels of pollen than may be present in other parts of the exam hall. School teachers may not be adequately trained to deal with anaphylaxis. If a child with a dangerous nut allergy has forgotten to bring their Epipen to school, and is exposed to nuts, the school does not have a generic adrenalin single-dose pen available to give as emergency first aid. When anaphylaxis occurs time is of the essence.

In Europe immunotherapy is available and widely used for managing some allergic disease, but many of these immunotherapy products are not licensed in the UK and therefore have not been put before NICE for appraisal. Until they are licensed here, patients in Europe will have a range of treatments available to them that do not exist in this country.

Atmospheric pollution, particularly diesel exhaust particles contribute to allergy; those living close to areas of high diesel fumes seem at greater risk of developing allergies, as well as at risk of poor lung development as they grow up.

The future

Many theories have been advanced as to why allergies are on the increase, from the 'hygiene hypothesis' through a range of other proposed explanations. However none of them is clearly proven and it seems that the causes of allergy are probably multi-factorial. Without good ongoing epidemiological research, we will never unscramble who is most at risk let alone what can be done to change the trend of an increasing number of allergies manifest in our society.

The House of Lords report has been universally welcomed by patient groups and clinicians alike and has triggered the formation of co-ordinated working groups to try to improve allergy services across the UK. With the Government's backing, a small number of changes and a small amount of money could dramatically improve the service to patients.

Autism Spectrum Conditions

Simon Baron-Cohen

Autism is a *spectrum* condition, meaning that it is manifested to varying degrees of severity. At one extreme, a person may have no social skills, no language, and major learning difficulties. At the other extreme, the individual may have average or even above average IQ, precocious vocabulary (though a lack of interest in small-talk or chatting), and odd social skills (being one-sided or extremely self-centred). The former

would receive a diagnosis of *classic autism*. The latter would receive a diagnosis of *Asperger Syndrome* (AS). Both of these are subgroups on the autistic spectrum. Both also share a strong preference for routines and repetition, and 'obsessional' interest in highly specific topics. Up to 1% of the population are somewhere on the autistic spectrum.

Psychological aspects

The *empathising-systemising (E-S)* theory proposes that there are empathising deficits in autism, whilst systemising is either intact or superior. *Empathy* involves imagining another person's thoughts and feelings, and having an appropriate emotional reaction to those feelings. Children and adults with AS show their empathising deficits on age-appropriate tests of emotion recognition, theory of mind, and spontaneous empathy.

Theory of mind (ToM) is the ability to attribute mental states to oneself or others and is regarded as the cognitive component of empathy. Emotion recognition is sometimes regarded as part of ToM because emotions are mental states. Often emotion-recognition deficits only appear if 'complex' emotions are tested, though in some individuals with autism the deficit is evident even when 'basic' emotions are tested. This deficit can make sense of the difficulties in social and communicative development, and in imagining others' minds.

Systemising is the drive to analyse a system in terms of underlying rules, in order to understand and predict its behaviour. People with autism spectrum conditions show precocious understanding of systems, relative to their mental age, on tests of intuitive physics or questionnaires assessing how interested a person is in different types of systems (maps, train timetables, machines, syntax, etc). The unusually strong repetitive behaviour, the strong desire for routines, and the 'need for sameness', can be seen as the result of a strong drive to systemise. Systemising also requires excellent attention to detail, and people with autism and AS are faster on visual search tasks. Strong systemising can therefore explain the strengths that people with autism and AS have.

Neurological aspects

Anatomical abnormalities have been identified in different brain regions in autism. These are not found in every case, and there are inconsistencies between studies, such that sometimes overgrowth is found, and sometimes undergrowth. The brain regions that have been reported to be atypical include the cerebellum, corpus callosum, hippocampus, and the amygdala.

Epilepsy also occurs in a proportion of individuals with autism spectrum conditions, though the exact rate is no longer clear. Although in classic autism it is well established that one third of cases develop epilepsy by adolescence, in the Asperger subgroup these rates may be much lower and have not been systematically studied. In terms of neuropathology, the number of Purkinje cells in the cerebellar cortex is abnormally low. Abnormalities have also been reported in the density of packing of neurons in the hippocampus, amygdala, and other parts of the limbic system. Abnormalities have also been found in the functioning of the amygdala, the orbito- and medial-frontal cortex. These atypical patterns of neural activity arise in relation to the empathising deficits.

Using MRI volumetric analysis, or measures of head circumference, some reports suggest the autistic brain involves transient postnatal macroencephaly. For example, neonates later diagnosed with autism have normal head circumference, but by 2-4 years of age 90% of these have MRI-based brain volumes larger than average. This may reflect an enlargement of cerebellar and cerebral white and grey matter.

Genetic aspects

The sibling risk-rate for autism shows a five- to ten-fold increase over general population rates. It used to be said that the sibling recurrence rate was much higher than this (50-100-fold), but this was based on old epidemiological prevalence rates of autism being 4 per 10,000, whereas today we recognise that 1% of children have an autism spectrum condition. The sibling recurrence rate is 5-10%.

Regarding twin studies, when a narrow phenotype (definition) is considered, 60% of monozygotic (MZ) pairs are concordant for autism versus no dizygotic (DZ) pairs. When a broader phenotype is considered, 92% of MZ pairs are concordant as compared to 10% of DZ pairs. Molecular linkage genetic studies have led to a number of chromosomal regions being implicated, such as 2q, 7q, and 15q. Loci on the X chromosome have also been implicated in autism, which may explain the sex ratio (markedly biased towards males), though these obviously cannot account for cases of male-to-male transmission.

Early diagnosis and intervention

The earliest that classic autism has been reliably diagnosed is 18 months of age. This has been shown using a screening instrument (the CHAT, or Checklist for Autism in Toddlers) which tests for the absence of 'joint attention' behaviours such as pointing and gaze following, and the absence of pretend play, all of which are normally present by this age. Population-based studies show that the CHAT has excellent specificity (children who fail on this test have a 83.3% chance of developing autism or a related pervasive developmental disorder), but low sensitivity (it only detects 2 out of every 5 cases, mostly missing the Asperger subgroup). Revisions of the CHAT are under way to improve the instrument further. Asperger Syndrome can be reliably diagnosed by age 5 years. This has been shown using a screening instrument called the CAST (Childhood Asperger Screening Test).

The most effective interventions for children on the autistic spectrum are special education, such as social skills teaching, and Applied Behavioural Analysis (ABA), where appropriate skills and behaviours are taught through principles of reinforcement. The key ingredients for effective early intervention are that the methods are highly structured, intensive, and individualised. Appropriate cognitive interventions are also beneficial for teenagers and adults.

Medical treatments are not usual. Indeed, there are ethical issues

surrounding the notion of trying to 'cure' autism. Although some aspects of the condition do require help (eg the empathy difficulties), other aspects may not (eg the systemising talents).

The cost of autism spectrum conditions

Knapp and Jarbrink in 2007 calculated that autism costs the UK £28 billion per annum, with the cost per individual with autism being £2.9 million over their life time. Such estimates include the impact on families that can be major.

Putting intervention on a rational basis

For many years, 'treatment' in autism has proceeded on the basis of an approach that has been tried and tested but without any real rationale for why it should be effective. Newer interventions, in contrast, are designed to harness individuals' areas of strength and their natural interests as a means for building new skills. Two examples of these are: (a) teaching emotion-recognition via computers using the *Mindreading* DVD educational software; and (b) teaching emotion-recognition by presenting emotional expressions on toy vehicles using the *Transporters* animation. In the case of the *Mindreading* DVD (www.jkp.com/mindreading), the individual's natural interest in lawful, predictable computers and in information being systematically organised renders the domain of emotions easier to learn about. In the case of the *Transporters* animation (www.transporters.tv), the child's natural interest in the mechanical, predictable motion of vehicles means they are attending to the film, thereby enabling implicit learning of emotions since these are grafted onto the vehicles (See Figure). In this way, the domain of emotions is separated from their usual context (real-time social interaction). Rather than expecting the child with autism to join the social world, with all its attendant unpredictability, social information is taken to the child's safer world of computers or mechanical vehicles. Such methods of intervention are rational in that they are based on cognitive theory (in this case hyper-systemising).

Some useful links

The National Autistic Society is the main charity in the UK for families with a child on the autistic spectrum: www.nas.org

The Autism Research Centre, Cambridge University, contains a searchable database of publications and screening instruments: www.autismresearchcentre.com

As interventions are scientifically evaluated, the results of such studies are summarised at www.researchautism.net

Further Reading

Autism and Asperger Syndrome: *The Facts* (Simon Baron-Cohen, 2008, Oxford University Press.

Figure: Screen shots from The Transporters (www.transporters.tv)

M.E. (Myalgic Encephalomyelitis) – A Research orphan for too long!

Peter Spencer

Introduction

Almost everything about M.E. is contentious – even the name. It is a complex and invisible illness which stigmatises people and completely destroys the quality of their lives. We know little about the epidemiology, aetiology and pathogenesis. With an estimated 250,000 people in Britain directly affected – around one million including loved ones and carers – it affects much larger numbers than is generally realised.

M.E. is believed to be the greatest single cause of long-term absence from school for children. Overall the social and economic costs of M.E. to the country have been estimated at £6.4 billion per annum. Successive reports over the past 20 years – including most recently the Gibson Inquiry – have strongly recommended that the Government funds much more research. This raises hopes that are not then realised. Why is it so difficult to achieve what is obviously so necessary?

What M.E. does to people

M.E. has a devastating impact on people. Its symptoms include overwhelming exhaustion and malaise, cognitive difficulties and poor concentration ('brain fog'), joint pain, muscle pain, sleep disturbance, digestive problems, sensitivity to light

and a whole range of other painful and distressing problems.

The most severely affected become housebound and often bedbound for years. A recent survey by Action for M.E. showed that 77% of those who were in employment lose their jobs. A fortunate minority of those somehow struggle back to a level of health that enables them to work. A much more typical example however is Sue, a former university lecturer. Sue was a very active sportswoman and mountaineer before she was struck down by M.E. at the age of 26. She tried hard for years to resume her academic career. Eventually at the age of 42 she reluctantly accepted medical retirement. The life which was so full of promise has been taken away from her.

In addition to severe health and financial problems, patients encounter extraordinary levels of ignorance, scepticism and rejection. The stigma affects the behaviour of friends, close family and all too often health and social care professionals.

Epidemiology

Information on incidence and prevalence is still fragmentary and contradictory. But there is ample evidence that M.E. is not a new illness. Florence Nightingale and Charles Darwin both had symptoms which would probably give rise to a diagnosis of M.E. today. What we have here then is not so much an emergent disease as a disease about which there is at last emergent recognition and awareness.

So what can we say with any degree of confidence about M.E.? This is a really tough question because there is no explicit diagnostic test and no biological marker for the disease. Early studies into prevalence were extrapolations from studies which were recognised to be too small. Comparisons were hampered by different definitions. Nevertheless a number of studies seemed to point towards a population prevalence in the region of 0.4%. This has become the provisional figure in the UK until better data are available. Several large scale studies in the USA indicate a figure of around 0.4%, except for one which claims a significantly higher rate but was based on a much broader definition that clearly includes other conditions in which chronic fatigue is a factor. We also know that this is not a disease confined to the developed world. Studies in Nigeria, India and Brazil suggest that M.E. is present in those countries with a prevalence up to around 0.6%.

Large scale international studies into the epidemiology are important because they will reveal vital clues that will help us to target research into disease mechanisms more intelligently. There is evidence of genetic predisposition and some variations in incidence related to ethnicity. We also know that a large proportion of cases are precipitated by a viral attack from infections such as glandular fever, viral meningitis, viral hepatitis etc. A general hypothesis held by many in the field is that in some people infection produces a persistent abnormality of the immune system and that immune mediators cause central and peripheral neural dysfunction. But not all viruses trigger M.E. and epidemiology studies which capture precipitating factors therefore open up ways of understanding how the immune system malfunctions in a person with M.E.

In addition to global studies, we also need to understand the national epidemiology of the illness. This will produce more reliable figures for incidence and will also identify specific environmental and other risk factors. One such study taking place through the M.E. Observatory is funded by the Big Lottery Fund. The research objectives are to pilot a national disease register for M.E. and conduct epidemiology studies in London, Hull and East Anglia.

The wider research agenda

The Chief Medical Officer published a report in 2002 which set out a compelling case for making M.E. a high priority within the NHS and emphasised the urgency for research. The MRC responded by drafting a preliminary research strategy which emphasised the need for epidemiology to shape the research agenda, and issued a notice indicating special interest in this area and inviting research proposals. It also placed a priority on treatments and assessment of treatments rather than focusing on the disease mechanisms.

From 2004 the MRC co-funded with the NHS two large scale trials. PACE is assessing the merits of 'pacing' (energy management) and involves 600 people attending hospital outpatients across seven centres in the UK. FINE is a nurse-led rehabilitation programme for 360 patients in their own homes in the Manchester area. The MRC has since funded several much smaller studies into risk factors. However the expectations raised by announcements in 2003 have not been met and this has not been for lack of submissions. The question therefore is why this resulted in such a pedestrian and deeply disappointing outcome?

The MRC argues that competition for research funds is fierce and points out that the overall success rate of applications is only 20%. Assessment criteria are tough. Evaluating the merits of research proposals is challenging in an organisation which has not dealt with such complexity. Perhaps the weight given to the track record of research applicants handicaps newcomers into the field and tends to perpetuate research enquiry along the lines of earlier approaches. The position today is that there is widespread disappointment amongst patients about how little research into M.E. has been funded by the Government since 2003, especially the lack of research into the most severely affected, children and disease mechanisms.

A research summit workshop co-sponsored in November 2006 by the MRC and Action for M.E identified barriers to success including:

- No one discipline owns the illness and can treat it alone – it is an orphan and it is heterogeneous
- Insufficient inter-disciplinary collaboration in research
- Insufficient funding for pilot work
- Discouragement of potential researchers from becoming involved

Professor Stephen Holgate is considering the possibility of the MRC setting up a national research workshop to re-energise the whole UK national programme of research into M.E./Chronic Fatigue Syndrome.

The niche role of charities in research

Action for M.E. acts as a catalyst for research. Last year we received 21 research funding applications. We are about to announce our selections. The budget is modest at £80K but will enable the selected teams to develop their proposals into more robust propositions for mainstream funding by the MRC, NHS or other funders. We also aspire to attract high calibre researchers into the field by funding research fellowships and PhD Scholarships. Most importantly we shall continue to represent the patient voice at the heart of this crucial element of government decision making.

Conclusions

M.E. is a horrible illness which wrecks the lives of far too many people. Its stigma adds to the immense difficulties faced by patients. Many endure years of acute physical pain, financial deprivation and institutionalised injustice.

A major contributory factor is scientific ignorance. This must now be addressed as a national priority by deciding who in Government should lead and then holding them publicly accountable for delivering a re-invigorated and more robust research programme. This should be centred upon the best interests of patients and recognise the need to keep them routinely informed of progress.

During discussion the following points were raised:

The increased rates of autism could be attributed to growth of services and greater awareness, but this lacks scientific proof. It was suggested in the MMR debate that vaccines, or something in them, was toxic, although autism in Japan continued to rise even when MMR was withdrawn. In Denmark half the population who had received the vaccine showed no difference in rates of autism from the other half who had not. There is no scientific way of testing what the increase is due to. It is better therefore to point to mundane factors that every small town in Britain now has a child development centre capable of diagnosing autism, whereas 40 years ago you had to go to a specialist centre.

For allergies there is the hygiene hypothesis, where East German children had a much lower incidence of allergies living in a much more polluted environment before the wall came down. After re-unification the East German rates went up. Proximity to motorway junctions, exposure to diesel fumes and the packaging of food products may have also have some effect. There have been major changes in diet and children today may be junk food babies. For M.E. it is difficult to obtain a reliable diagnostic test for this disease although it may result from failure to recover from a viral attack. Further training of General Practitioners is required.

There is not such a vocal lobby group for vaccine damage in the UK as the cause of autism (which arose from the work of Dr Andrew Wakefield) as there is in the US. Environmental factors should not be ruled out and the genetic evidence does not indicate 100% heritability. Until evidence for an environmental factor is very strong we should be cautious about attributing blame, which is likely to be multi-factorial. The current rates of recorded autism may be much closer to the true rate due to better diagnosis, although this was disputed. The possible role in autism of mercury preservative in vaccines given to young children was dismissed.

There is a genetic component to allergies, but unpicking that from other factors may be very complex. You can't change your genes which have been fixed, although your genetic expression may be altered by environmental factors. Families with the eczema-asthma group of allergies exist, but may grow out of it. Research requires distinction to be made between the things that you can and cannot change. Autism is not 100% genetic as gene-environment interactions occur which can result in genetic predisposition being enhanced by unknown environmental factors which switch genes on and off.

The 'Not Invented Here Syndrome' may result in less attention being paid to scientific research done elsewhere. Access to population databases is important for multifactorial interpretation although access suffers from restrictions due to confidentiality issues that prevent their use in fundamental research into disease controlling factors. Community healthcare has been developed at the expense of the creation of centres of excellence with regulatory hurdles restricting scientific research.

Graham Love
CEO QinetiQ Group plc

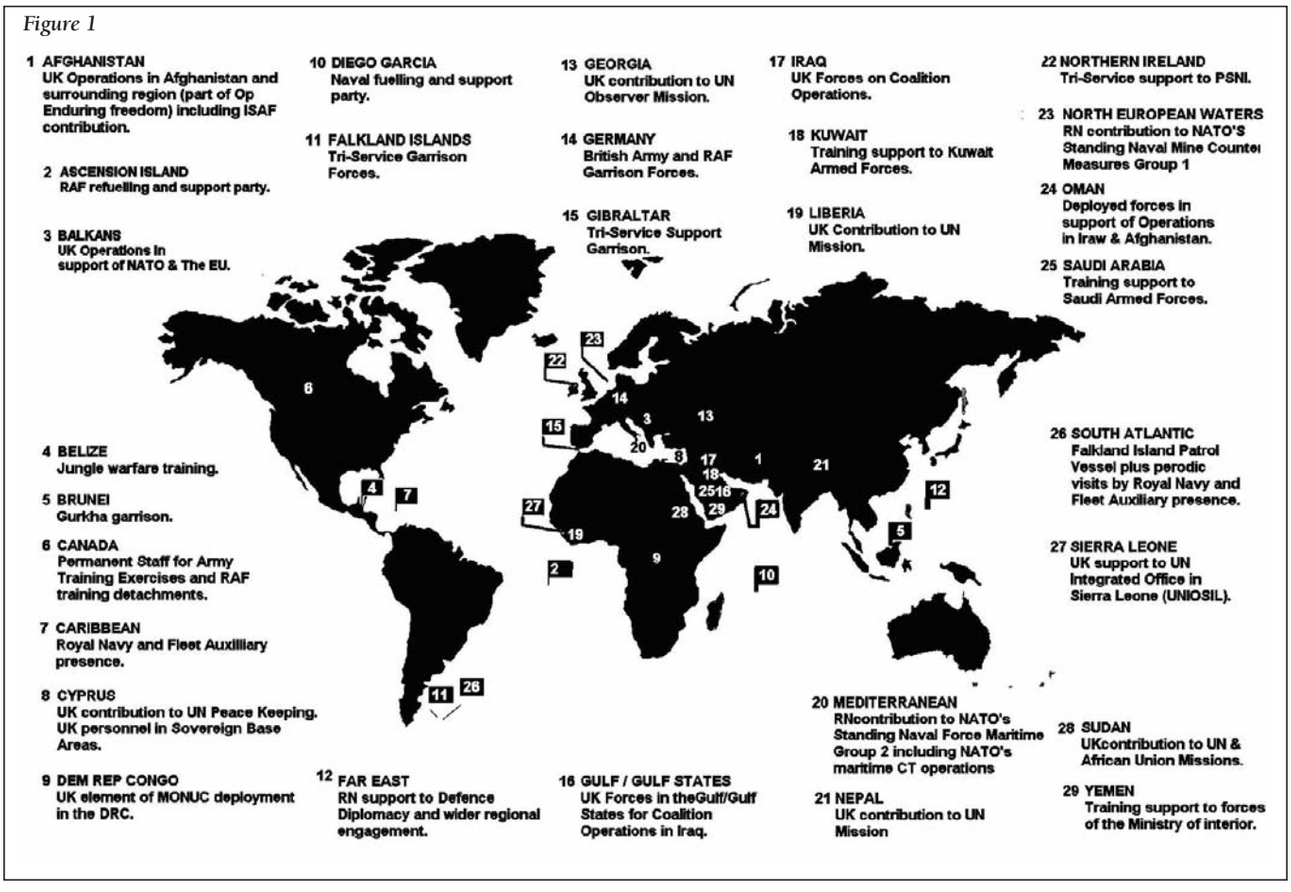
Andrew Sleigh
Group Chief Technology Officer

Defence Science – Maintaining a Cutting Edge

"Today the UK faces adversaries whose tactics change rapidly and employ ever more varied advanced and innovative technologies. This demands rapid evolution in our response, both tactically and in the technologies we deploy to combat the threats.[1]"

The MOD Defence Technology Strategy captures the importance of defence science and innovation to maintaining a cutting edge, of providing the UK Armed Services with the capabilities they need to conduct a wide range of operations and deployments across the world. Figure 1 illustrates the extent of commitments by the UK Armed Services in 2007 across the globe and highlights their need for a breadth of capabilities to deploy in very physically and operationally different theatres[2]. Defence science is a key enabler in underpinning the versatility demanded of our troops and preparing them to meet the challenges of future conflicts. Alongside the unpredictable

Figure 1



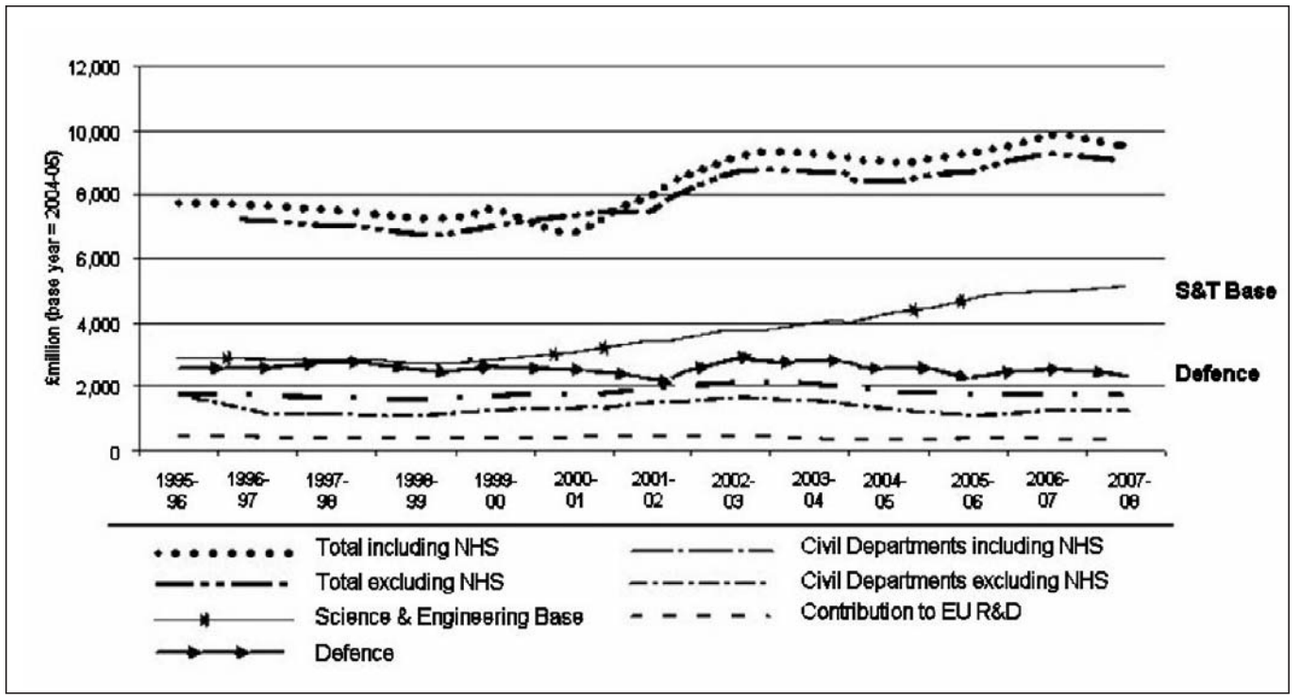


Figure 2: Government funded Science Engineering & Technology in real terms

nature of warfare, the demands on budgets and the declining career attraction to young people are some of the issues currently challenging UK defence science.

By the very nature of its business the MOD is an early adopter and user of cutting-edge technology. Ambitious early adopter customers encourage pull-through of science and innovation to meet the advanced needs of modern warfare. It is not surprising then that defence science and innovation in leading western nations has resulted in many advances in civilian life including satellite navigation, weather forecasting, mobile phones, flat-screen televisions, microwave ovens and ultrasound baby scans.

Recent work has demonstrated the strong correlation between the level of national defence investment in R&D and the quality of equipment or years of military advantage [3]. Due to historic investment the UK has a favourable position relative to the front runner, the USA. However, while the USA is preserving its leading position through a decade of increased spending on defence science, the UK and other European countries are eroding their positions of advantage. The expanding economies of China and India are increasing their R&D spend in line with GDP growth and will be on par with European quality of military equipment by 2020.

Defence science in the USA is seen to deliver both security and economic benefit and the USA makes extensive use of defence science to pump prime industry into a position of global competitiveness. Comparison of US and UK Government funding of science and innovation indicates that a far higher proportion of US Government expenditure is mission driven and therefore conducted in industry, in contrast with the UK. Mission driven research delivers outputs with a higher level of technology readiness and closer to market. Over the last decade UK Government-funded science and technology has increased in real terms, Figure 2, while that for defence has been declining [4]. The UK is investing more strongly in investigator-led science which is characterised as 'blue skies' and further from market than mission-driven science.

Cutting edge science relies heavily on a skilled workforce, particularly in the fields of physical sciences and engineering. Yet these are the very subjects which have become increasingly unpopular with young people. As the Sainsbury Review highlighted there has been a 20-year decline in the number of students taking A-level physics which has not yet been reversed [5]. These statistics are of concern for a country that has set itself a goal of creating an 'Innovation Nation'. Like many UK organisations engaged in high technology business, QinetiQ has a very active STEM (Science Technology Engineering Mathematics) Outreach programme. The company engages with young people in a variety of STEM activities to give them an insight to the exciting and rewarding careers in science and engineering and to encourage them to consider careers in these fields.

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Defence Science in the UK has had a world changing impact on military capability, and on wealth creation in the wider economy. Looking back into the 20th Century, UK defence science developed RADAR, the jet engine, liquid crystal displays, advanced electronic materials and devices that underpin much of modern technology including mobile phones, thermal imaging, vertical take-off flight and carbon fibres. These examples, and there are many more, have had a profound impact on defence and many have opened huge new markets in civil technology.

This should not be a surprise. In defence, second-rate technology is never good enough, and the need to maintain combat edge makes defence an early adopter. So as well as stimulating innovation, defence often provides the early exploitation route for new technology as a 'sling-shot' to volume commercial application.

Defence science has also had substantial impact on recent military operations. For example, the Tornado fast jet combat aircraft is a classic case of how defence science has provided advanced and responsive capabilities through technology insertion. Tornado was conceived in the 1960s and introduced into service in the 1980s as a low level, all weather bomber in response to cold war operations. But as a result of the changes in the security landscape, a series of technology upgrades have been applied which have transformed this platform into one of the world's most effective close air support fighters. This has been possible through BAE Systems, QinetiQ and MOD working closely together to draw on advances in technology to meet operational needs responsively as they emerged.

Another example is the rapid development of the SWIMS (Shallow Water Influence Mine-Sweeping System) robotic boats to support the clearing of the Khor Abd Allah waterway in Operation TELIC to enable safe landings by the Royal Navy. This innovative capability drew directly on the outcomes from defence research into robotics and mine countermeasures. In its review of Rapid Procurement of Capability to Support Operations[1], the NAO said *"[MOD] has shown impressive ingenuity to deliver customised solutions to the warfighter, such as SWIMS. QinetiQ had been undertaking research on the use of remote controls and this technology was fitted to the boats to create remote controlled shallow water influence mine sweepers, reducing the risk of loss of life."*

Other examples include Electronic Warfare, where UK defence science has produced truly world beating products, a technology which is saving lives in current operations every day, battlefield robotics which are proving to be a vital capability to deal with roadside bombs, and hybrid electric drive for armour vehicles which will provide advances in range, greater flexibility in vehicle layout, improved options for protection and reduced logistics for supply of fuel.

Defence science will continue to have profound impact into the future. Long endurance (of many months) for unmanned air vehicles is becoming possible through solar power, exemplified by QinetiQ's Zephyr UAV which holds the world record for endurance of unmanned flight. Quantum technology will impact on searching large amounts of data, on development of more effective sensors, and on enhancing computer security. We will see novel technology applied to the soldier to improve protection, support co-operative engagement, reduce fratricide, and help build relationships with local peoples. More powerful architectures will make evolution of future equipment more agile and less costly. Smart materials will create new concepts in design and reduce operating costs.

In summary, defence science has always been a driver of military capability, and will remain vital to the Nation's defence and security needs. The platform of knowhow and demonstration systems that defence science funding creates has played a rather unsung role in ensuring our forces have the equipment they need; many of the responsive procurements draw directly from research, and could not otherwise have been achieved in time. One can argue that investing in defence science is an *antidote to uncertainty.* The UK can take considerable pride in the quality of its defence science, which is seen around the world as one of our most impressive assets. And because defence science invariably stretches the envelope of what is possible, it continues to drive innovative opportunities that create wealth across the economy.

Andrew Sleigh

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During discussion the following points were raised

How much of the research is self generated and how much from other sources? The majority of the work is funded by customer funds such as the Ministry of Defence. Unlike many other companies in this field we are not a manufacturer. QinetiQ has no involvement with biological warfare as that area is retained within government. We are partners with DSTL and there is opportunity for us to understand what they are doing and for us to contribute to work they undertake in the chemical and biological fields. This area is managed jointly by DSTL and the Ministry of Defence.

In the UK although Research Council funds have doubled, overall R&D expenditure including the Research Councils is still 0.7% of GDP. The conclusion therefore must be that defence R&D has dropped faster than the projection indicated. The

overall impression is that compared with US, we are not doing enough in this country and it is not clear what we should be doing. The US places more emphasis on mission-driven research and the term R&D is a very broad category. In the UK we draw more heavily on basic science in conjunction with universities, and this raises the question of how much defence science can the nation afford?

The expenditure on R&D takes several different forms from applied science with rapid returns to basic science which takes longer to generate an impact. Hence measures of expenditure do not provide a clear view of the overall benefit likely to be obtained. The presentation exhibited our strengths essentially in physics and engineering. However the whole point here is to get an advantage in conflict and to respond to the adversary doing different things. If Iraq teaches us anything it is that we have done very badly in anticipating the outcome. Who should be having the responsibility for a more sophisticated heart of research in defence and asking what is the nature of tomorrow's conflict? Have we got to relearn the lessons of Malaysia that we have forgotten? Whose responsibility is that? How is the world changing? Do you accomplish your goals by retooling a bomber? Or might you be better off by not dropping bombs?

The return of increased capability for expenditure in the UK is value for money when compared with the US, which shows lower rate of return overall for a much greater expenditure. It is not easy to understand the future, it may be possible to understand the risks. You do need to have somebody responsible for a no-holds-barred approach. However the approach should assume that you will not necessarily be able to foresee the outcomes and therefore need to build flexible architecture into the platforms that can adapt to the circumstances as they evolve. People in MoD are speaking that sort of language. Another strategy would be to invest in people skilled in social sciences.

China in 2020 and the UK appear well positioned on the capability chart with an optimum return for the investment made compared with all other entries. Fundamental research investment in the UK Research Councils also bypasses the MoD. The model adopted in the UK depends on the relationship between the science base academics and the take up and build supply chain that makes things happen, as exemplified by QinetiQ. That is what matters and work at the University of Warwick is a good example of this arrangement.

The US spends approximately $600 billion on defence and a further $100 billion on homeland security and intelligence, much greater than anyone else, which puts them in a different league. There is no sign of any slowdown in this expenditure. In the UK we use our skills to take technology such as Global System for Mobile technology (GSM) for example back to the UK. Our defence science base also facilitates our interaction with the US in an effective way. This enables the UK to sit at the top table and access US development technology directly, especially because they know we have the knowledge to do it ourselves should we need to do so.

TOWARDS 2020 SCIENCE AND THE EUROPEAN SCIENCE INITIATIVE

MEETING OF THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE ON TUESDAY 15TH JULY

Towards 2020 Science

Professor Stephen Emmott
Head of Science, Microsoft

Science will be absolutely central – indeed critical – to understanding and addressing the most important challenges we face this century; indeed perhaps any century, not least because the scale of the challenges is so great this may be the last century we have to address them. Chief amongst them are:

1. possible rapid and highly non-linear climate change and loss of Earth's life support system,
2. pressures on the planet with a population of over 9 Billion people,
3. intractability of the prevention and eradication of a range diseases that prematurely kill millions of people every year,

4. the real risk of a sudden global pandemic that could kill hundreds of millions, possibly over a billion people.

These challenges potentially [probably] have profound implications for the continued availability and security of food and water, the displacement and movement of hundreds of millions of people, the means by which we will need to produce our energy requirements, and for our very future and the future of thousands of species with whom we share our planet.

Major advances in science have been made over the past fifty years in particular, in areas spanning biology (especially molecular biology and genetics), medicine, physics, astronomy and climatology. And yet, despite what are undeniably remarkable scientific achievements, our understanding of our climate system is far from adequate and – alarmingly – we are still not able to predict *accurately* the scale, nature and consequences of either climate change or resource (especially 'ecosystem services') loss over this century. We still cannot fully explain even the working of a eukaryotic cell, let alone how even 'simple' organisms such as the 1mm long *C.elegans* nematode worm works. And we are nowhere near an understanding of, for example, the brain, or the one thing standing between you and me and the cemetery – our immune system. Thus, predictive biology is almost unheard of, predictive medicine remains largely an aspiration, and millions of people continue to die prematurely of disease because our understanding of the functional aetiology of disease, and effective treatments, remains inadequate.

The primary reasons for this state of affairs are twofold: first is because they are complex natural systems – complexity being the problem. The second is because complex living things continue to resist revealing much by the reductionist approaches characterising current scientific methods used to study them. Third, the kinds of conceptual and technological tools currently available to scientists are therefore not sufficient. In short, significant barriers exist to fundamental scientific progress in precisely the areas in which advances are urgently required to address the enormous societal challenges we face.

I believe that breaking through these barriers requires – and urgently requires – a radical re-think in science. A re-think that would certainly represent a transformation of how science is done, and a transformation that would perhaps form the foundations of nothing less than a new scientific revolution, and 'new kinds' of science.

This is a non-trivial statement. Transformations in science are rare. Scientific revolutions are rarer still. Arguably there's only been one – '*The* Scientific Revolution' of the 17th century. What brought this one about, and what will bring about the one we now need, are three important things. First is the development of new 'conceptual' tools (eg, Copernicus' use of algebra enabling a precise, formal, testable theory of the heliocentric universe; Newton's calculus which underpinned formulation of the laws of physics, thermodynamics and the universe). Second are new 'technological' tools (eg, Kepler's mechanical model of the universe, Galileo's telescope). The third are new kinds of scientists: highly quantitative, computationally literate natural scientists who also have a *different way of thinking* about problems (call it creative imagination in scientific discovery) whose hands these tools are created by and/or get into. When the combination of these events occurred in the 17th century it created a *'new kind'* of natural philosophy: *Science*.

I believe that in order for science to fulfil its important role in understanding and addressing the challenges we face, we once again need radically new kinds of conceptual and technological tools, and new kinds of scientists who can create them and use them.

New Kinds of Conceptual tools

The conceptual tools of the 17th century enabled what I might term the 'Codification of Heaven' (a precise explanation of the solar system). The new kinds of conceptual tools we need now are those that enable the codification of *Nature*. That is, the precise, formal representation and accurate prediction (predictive models) of *dynamic processes* of complex natural systems – from biochemistry and cells, to *C.elegans*, sea urchins and the brain, to forest dynamics and the Biosphere.

By *codification* I mean literally turning knowledge into a coded representation, in terms of data or programs, that is mechanically executable and analysable. The overall task typically involves building mathematical models of natural phenomena – from biochemistry to biotic-abiotic coupling and feedback of the climate system. But it goes beyond that, turning models into coded representations that are useful to the broad scientific community. Codification is just beginning in the major fields of scientific knowledge. Codification has at least one basic scientific property: once obtained, it can be right or wrong, or 'not even wrong', but it is at least exactly reproducible and independently analysable. The general, hardest, problem in this area is going to be how to store, search, compare and analyse biological *processes*. A process, here, is intended as a dynamic interaction of multiple discrete components, eg the process of cell division.

This last example brings into focus the full meaning of codification: it is not, in general, just to represent scientific facts as *data*, but to represent scientific phenomena as dynamic *processes*. Martin H Fischer's aphorism emphasises the point: "Facts are not science, as the dictionary is not literature".

A considerable part of this effort will be underpinned by concepts adapted from computer science. Calculus, and its more modern derivatives, is the main way in which mathematics deals with dynamics, but it does so in a continuous fashion. In contrast, computer science deals predominantly with the interactively discrete *(reactive)*. In most kinds of complex systems, biology being the primary example, the discrete is both central and is also much harder to deal with; they not only behave but also affect, prescribe, cause, program and blueprint other behaviour. In short, the characteristics of computer science are also central to the dynamics of biological systems: concurrency, time dependence, cause-effect phenomenon and distributed control.

New kinds of technological tools

Hand in hand with new kinds of conceptual tools is the need for new kinds of technological tools – computational tools – for doing new science. Here I want to distinguish between *computation* and computers. Computers have played an important role in science for almost 50 years, and will continue to do so. However, I am emphasising something very different. It is a fundamentally important shift from *computers* supporting scientists to 'do' traditional science to computational methods transforming the *kind* of science possible. Such tools will include those to implement the new conceptual methods (eg, programming languages for modelling biology will form the foundation of tomorrow's 'systems biology'); computational tools integrating data, models and theory; computational tools for the development of complex dynamic models of complex natural systems and which will enable scientists to perform realistic experiments on a computer. These kinds of technological tools, combined with the new kinds of conceptual tools I briefly outlined, will transform how science is done and the kind of science that is possible, enabling new kinds of science.

New Kinds of Scientists

Critical to the realisation of the new kinds of science required will be new kinds of scientists. By 'new kinds' of scientists, I mean a generation of scientists who will not just work in highly inter-disciplinary, highly computational science, but who are themselves inter-disciplinary and highly computationally literate. But even over and above this, we need to be producing scientists who have a different way of thinking about currently intractable problems. There is an urgent need to re-emphasise the importance, and encourage the development of *creative imagination* to scientific discovery. Its importance is best emphasised by Einstein and Infeld (1937): "The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science". We have barely begun to produce such scientists, but it is at least starting to happen. In the UK, Oxford is leading the way on this front, primarily through its Life Sciences Interface Doctoral Training Centre. Elsewhere, the Weizmann Institute of Science in Israel also stands out. We need to do far, far more in creating the kinds of scientists we urgently need.

New kinds of Research Institutions

This brings me last, but not least, to the need for new kinds of research laboratories. We need more labs that attract, produce, develop, bring together and enable to flourish these new kinds of scientists, and that pioneer these new kinds of science. Such research labs are rare. Janelia Farm (Howard Hughes Medical Institute) is one of them. In uncharacteristically immodest fashion, I believe I can rightly claim that my own laboratory in Microsoft Research in Cambridge is another leading this transformation. I mention this not to boast, but to indicate how few of such labs exist and how much needs to be done – and done urgently – to lead a transformation of science that will break through barriers in important areas of science; an undertaking of profound importance if we are to tackle the profound challenges we face this century, as well as the unprecedented social, technological and economic benefits that achieving this would bring.

During discussion the following points were raised

No mention had been made of quantum computing as the decision had been taken to focus on natural complex systems in order to be able to learn how to build complex systems for future use. The development of quantum computers, if even possible, is seen as 40 years away into the future.

The question was raised: how can computing help to control a pandemic? By understanding the problem, modelling early stages, differentiate between pathogens, identify general principles and apply the outcome to 6.3 billion people. A computer model exists that accounts for every plane flight from every country that can be used to model how a disease could spread. This can be applied to both existing and potential pathogens and take account of rapid mutation in malaria for example.

One of the implications of the use of predictive modelling in molecular biology is that school education is heading in the wrong direction and has been doing so for 15 years. Much greater interaction is required between arts and sciences, in preference to interaction within these areas.

ROYAL SOCIETY OF CHEMISTRY PARLIAMENTARY LINKS DAY – TUESDAY 24TH JUNE 2008

Science and an Uncertain World

The Rt Hon John Denham MP

Professor Jim Feast, President, Royal Society of Chemistry, the organisers of Parliamentary Links Day, hosted by Dr Brian Iddon MP and Mr Mark Lancaster MP, welcomed a capacity audience, comprising some 200 plus invited participants from within and without Parliament, to Links Day in the Attlee Suite on Tuesday 24th June.

Parliamentary Links Day is thus the largest scientific event held annually at the Houses of Parliament and involves the active participation of sister societies including the Institute of Biology, Royal Academy of Engineering, Geological Society, Institute of Physics, the Royal Society and many other scientific organisations. The theme selected this year provided a timely opportunity to discuss ways in which science can contribute to solving global challenges involving crucial issues as diverse as food, water, energy, and climate change.

Professor Feast introduced the Rt Hon John Denham MP, Secretary of State for Innovation, Universities and Skills, who thanked the Royal Society of Chemistry for all their efforts in bringing professional scientists and engineers, with their unique relevance and importance to the economy, into closer engagement with members of both Houses and thereby improving mutual understanding of the parliamentary process.

Sir David King, Institute of Physics, Director, Smith School of Enterprise, University of Oxford, and former Chief Scientific Adviser to the Government and Head of the Government Office for Science, then described, with examples, how we have successfully managed to deal with apparently intractable environmental problems in the past by good science combined with decisive action, both nationally and internationally. This was an introduction to a description of the likely outcome of a 'business as usual' approach to the partly predictable risks posed by climate change. However, additional and poorly understood earth system science factors pose an additional risk of rapid and non-linear increases in temperature. A major behavioural change is required, combined with transformation of the power generation infrastructure to one which is decarbonised, and thus able to supply carbon-free electricity for transport by road and rail and to the domestic and industrial infrastructure alike.

Professor Rosemary Hails, Institute of Biology, called for a more holistic approach to the interlinked issues of climate change, energy, food and population growth with appropriate regulation using a flow chart procedure. This will enable advantage to be taken of new technologies, proportionate to the risks involved, where these are demonstrated to have an overall benefit to the environment.

Lord Krebs, Royal Society, introduced the issues surrounding policy versus science and the cultural gaps that may exist between independent scientists and government scientists and the need for an evidence-based policy. If the evidence is lacking then every effort should be made to obtain it before introducing policy changes. The established media continue to demonstrate their general lack of scientific understanding to the disadvantage of all concerned, in seeking to treat all scientific issues simplistically as either/or with equal weight being attributed to both sides of an argument, ignoring any vested interests involved, even when the scientific view may be 99.9% for and 0.1% against. This effectively stultifies all reasonable public debate of science policy issues concerning science and engineering by elevating the often very narrowly restricted views of a very small minority to the level of equal and opposite to peer reviewed

Lord Krebs

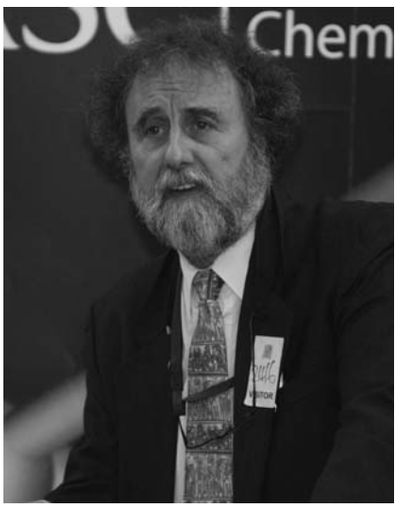
Professor Lynne Frostick and Lord Browne

science, thus indicating that the opportunity for a provocative discussion is often more important to the media than the underlying science.

Dr Bob Crawford, Royal Society of Chemistry, raised chemical science priorities, especially the global issue of sustainable water and the water poverty threshold with particular reference to Africa, pointing out the inadequate infrastructure and the high costs of provision of even minimal amounts of water for cooking. His examples were all drawn from areas of high population density which is particularly relevant to the increasingly urbanised African population living remotely from access to natural sources of fresh water.

Professor Lynne Frostick, Geological Society, referred to sea level rise, compounded by subsidence in south-east England and water expansion due to heating, leading to an uncertain future for 21% of the UK population that live within 30km of the current UK shoreline. Threats of flooding, as in Hull, jeopardise property, people and infrastructure such as the Dungeness Nuclear power station. She called for monitoring by earth observation satellites and creation of long term datasets to evaluate the changing situation of our coastal defences.

Lord Browne, Royal Academy of Engineering, claimed that engineers decide the future and went on to discuss six bad ideas that keep coming back and which had got us into serious difficulties in the past. These include subsidising energy in order to avoid making decisions related to future energy supply; the development of biofuels; the idea that we already have all the technologies that we are likely to need in the future; there is no further need for innovation; and sacrificing long term plans in short term decisions.



Professor Robert Watson

Professor Robert Watson, Chief Scientific Adviser DEFRA, raised local and global scale issues ranging from the destruction of mangrove swamps thereby placing coastal populations at risk from tsunami inundation, to biofuels and the vital role of agriculture in ensuring human health.

David Willetts MP, Shadow Secretary of State for Innovation, Universities and Skills, emphasised policy issues including better advice for young people wishing to take up science subjects at school; single science subject GCSEs available to all, to enable those wishing to take A level science, with a view to reading science at university; premium payments for engineering of 32% over arts subjects; development of better links between schools and universities. Serendipity is important in funding science as the outcomes of scientific research may be completely unpredictable. If only predictable science is funded we will miss innovative developments.

David Willetts MP

Phil Willis MP, Chair of the Commons Select Committee on Innovation, Universities, Science and Skills, in winding up the invited presentations, emphasised the need for serendipity, translation and basic research. He criticised the lack of funding for an enquiry into biosecurity in view of pathogens increasing with climate change, the need for strategic vision and our failure to capitalise on groundbreaking science. Policy issues were discussed especially the need for food policy involving scientists, politicians and the public. However public perception of politicians is unfortunately low while it is high for scientists, and uncertainties require scientists for their resolution.

One of the informative papers provided in the comprehensive briefing pack included notes on A Guide to Science in Parliament which is freely available to allcomers from the website of the Parliamentary & Scientific Committee, which can be found at: www.scienceinparliament.org.uk

Flood Prediction Strategy benefits from Science

Phil Evans

Met Office Chief Advisor to Government

Summer 2008 will be remembered as a damp squib. A continuing 'La Niña' in the Pacific again altered the flow of the jet stream to bring rain from the Atlantic that in a sunnier summer would have otherwise troubled Iceland. But while Northern Ireland and eastern Scotland have seen extensive flash flooding this year, nothing has quite matched summer 2007 for either the intensity or the cumulative impact of the rain that fell.

Then, the total June and July rainfall for England and Wales broke records going as far back as 1766. Flooding occurred on an unprecedented scale with events later described as the UK's largest peacetime emergency since World War II. An estimated £3bn was paid out by the insurance industry with a further £2bn worth of damage being shouldered by a combination of central government, local public bodies, businesses and private individuals.

This autumn Hilary Benn will set out the future for flood risk management in England and Wales, building on the lessons learnt by Sir Michael Pitt's year long review. One of the key recommendations he will be considering is a joint flood forecasting centre making best use of Met Office and Environment Agency expertise. This mirrors the solution to a previous lack of joined up working identified in France in the wake of devastating floods in 2002 and 2003.

This may have resonance across the UK given the impact of unusually intense rainfall on saturated ground and urban streets in towns as far apart as Boscastle, Sheffield and Kirkcaldy. The resulting surface water floods have often occurred well away from swollen rivers, with flash flooding exacerbated by overwhelmed drains and urban development. Flooding in Hull, which bore the brunt of damage to homes and property last summer, was caused not by the Humber bursting its banks, but by excess rain with nowhere to go.

Pitt praised the accuracy of the weather forecasts issued in the days before the worst of the floods, and with its 24 hour operational capability, the Met Office was identified in Sir Michael's report as the natural starting point for multi-agency assessment and response to severe weather impacts.

But he also acknowledged the scientific problems associated with pinpointing summer rainfall and matching those forecasts with hydrological warning models. In response the Met Office accelerated its ongoing research programme and this summer has successfully delivered extreme rainfall forecasts a further day in advance (up to three days from two) with probabilistic forecasting and pinpointing of storms within 30 square kilometres' accuracy. These are now being communicated as extreme rainfall alerts under the auspices of a pilot service for emergency responders from a joint Environment Agency-Met Office team based in the Met Office Operations Centre. The response from the resilience community has been positive and a number of flash floods have been successfully anticipated.

This significant breakthrough has happened thanks to developments in computer modelling and the extrapolation of radar data in a way that more closely replicates the life cycle of convective rainstorms. But it is also down to enhanced computer technology. The Met Office has proven the potential benefits of increased supercomputer resolution on extreme rainfall forecasts and this is one area where existing scientific advances could be readily translated into day-to-day operational capability. From 2009 the Met Office will be able to run 1.5 km resolution forecast models that could underpin severe rainfall and flood forecasts for an area beyond thirty square kilometres. With future enhancements to resolution even more localised forecasts will be achievable.

It has been widely suggested that last summer's events were insufficiently anticipated by a system that historically separated the Met Office's focus on extreme weather from the Environment Agency's focus on monitoring its impact on our rivers and coasts – with neither agency having responsibility for guarding against or forecasting flooding resulting directly from heavy rain.

The Environment Agency has since been granted overview of contingency planning against all types of floods. And it has also developed 'hotspots' mapping, plotting the topography of England and Wales to within six inches of accuracy. This expertise fully integrated with detailed weather prediction offers an opportunity for providing the consistency that emergency responders say they badly need.

If the French experience is anything to go by the benefits of a joint centre could extend far beyond better warnings. A pooled approach could also provide a focus for fully integrating meteorological and hydrological research for improved flood forecast modelling. Since the creation of the French single centre (SCHAPI) in 2003 a number of technical and scientific innovations have served to provide what is widely regarded as the best flood risk management system in Europe. These include interactive 'vigilance maps' providing river flow probabilities directly to the public as well as soil saturation assessments combined with topographical data and weather forecasts to produce predictions for the risk of surface water flooding.

By working more closely together, responsible agencies here could achieve an effective pooling of existing expertise within 12 months. With integration, emergency responders and operators of critical national infrastructure in the UK could be served by a system that is more fully aligned with our own world-beating science.

The Last Bus Stop on Earth

Steve Thompson

Science and Innovation Promoter, British High Commission, New Zealand

That was how one local Cabinet minister described New Zealand a few years ago, and it's true that New Zealand has a long way to go to find a sizeable market for its wares. But that just makes New Zealanders more determined.

While agricultural products still account for a large fraction of exports, New Zealand has been shaking off its image of millions of sheep with a concerted push into new ideas and innovation. There is much talk of the 'weightless economy', where exports don't have to rely on the weight and cost of freight travel. High Tech is of course the answer, and New Zealand is rapidly changing its image.

New Zealand has its own unique mix on offer. It differs in many technologies from Australia, with that country's history of mining. New Zealand is into biotechnology, based upon its agricultural heritage, and it also has built considerable strengths in ICT and data visualisation. Its nine universities are heavily into commercialisation. New Zealand universities, per dollar invested, produce more than twice the number of new companies than the US average, and over 50% more than Canada. New Zealand's eight Crown Research Institutes, while government-owned, were moved to a commercial footing in the early nineties. Some of its larger firms, such as Fonterra dairy products and Fisher and Paykel health care, maintain sizeable research capacities of their own, but the country is peppered with small groups thinking laterally (wackily would sometimes be a better description) to produce, for example, portable sensors and analysers which operate at a fraction of the cost of main-line instruments.

Much of this work uses a radically different approach to the problem at hand. New Zealanders tend to think differently, and are unlikely to go along with the 'received wisdom' on how something should be done. The results are astonishing, but two large problems arise around the 'proof of concept' stage. Firstly, the New Zealand venture capital market is far from mature, and struggles to find sufficient capital to spread risk among several ventures. Secondly, access to market is indeed difficult from the last bus stop.

Therein lies the reason for UK interest in New Zealand. New Zealand scientists are creative, innovative and commercially-minded, while New Zealand firms are small but very active in knowledge company start-ups. The lack of venture capital and access to markets means that there are many brilliant ideas waiting for the right conditions. From a trade point of view, New Zealand's 4 million people, in an area slightly larger than the UK, with a huge fisheries zone, offer a fertile field for collaboration in new products when combined with the UK's own scientific expertise, manufacturing capacity, and access to capital and markets.

What's the catch? Well, getting the UK's attention requires persistent effort. UK organisations are often unwilling to visit New Zealand on the off chance of finding a viable collaborator. Quite a bit of brokering is needed to introduce potential partners to each other. Even then, UK firms will ask why they have to travel that far for something they might do closer to home.

The answer lies in the remarks of those who do make the journey. Departing missions are likely to say something like "Wow, we had no idea. Why didn't you tell us about this place before? Their trade show was on a par with the best in the business. They don't mess around and are pragmatic and straightforward to deal with. They speak English, operate under a similar legal system, and have good IP protection".

A new R&D tax credit of 15% was implemented in 2007. New Zealand regulations are light-handed and responsive, and there is good assistance to commercialise research. New Zealand has recently signed a Free Trade Agreement with China. It is attuned to Asian time zones and people, and its own out-of-phase time zone and seasons can be used to advantage.

UK Trade and Investment already has a presence in New Zealand, but last year the High Commission moved to augment their work by engaging Dr Steve Thompson as science officer to build commercially orientated collaborations between research organisations with a commercial intent and/or firms with a research arm. Steve has worked in New Zealand's science system for ten years, and knows the senior players well. He works just upstream of UKTI in forming links that will go on to commercial exploitation.

Workers in this space may need some assistance to visit New Zealand. Once in the country, a joint team is generally formed with UKTI and NZ Trade and Enterprise (NZTE) colleagues to open as many doors as possible. NZTE is keen to see collaborations as a win-win for both countries and they contribute a portion of the costs of the science officer, as do UKTI, Northern Ireland, DIUS and the FCO.

Results to date are encouraging, with two investments arising, several agreements signed, and three missions completed, in health, vaccines, and greenhouse gases (GHGs). The latter is big business in New Zealand, with half its GHGs coming from livestock in the form of methane and nitrous oxide.

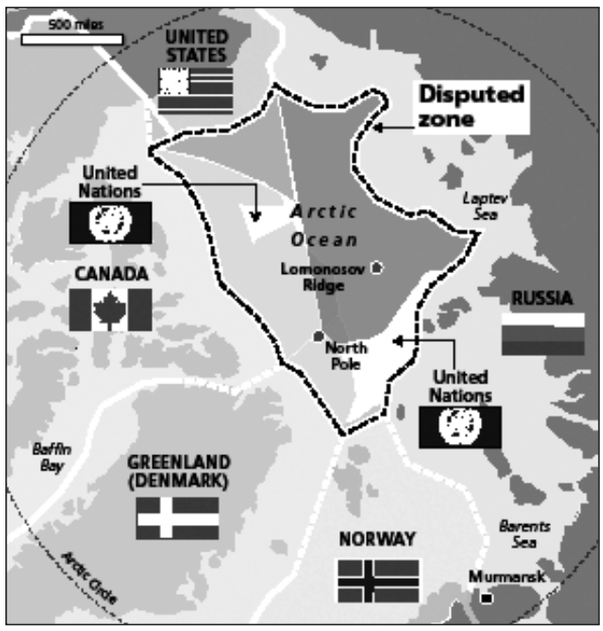
As the science position moves into full gear, six more missions are planned in Functional Foods; Dairy and Red Meats; Renewable Energy; Ag/Bio, Extremophiles (bugs which live in strange places); and Advanced Sensors. Contact *Steve.Thompson@fco.gov.uk* for details.

Postcard from Svalbard

Peter Friend

Department of Earth Sciences, University of Cambridge

The islands of Svalbard lie north of northern Norway, and most people know very little about them. David Cameron paid the islands a brief visit in April 2006, commenting on the evidence there for global warming, and the importance of oil exploration around the whole Arctic Ocean area. Since then, indeed, the Russians have symbolically laid claim to part of the sea-floor of the Arctic Ocean. The map, recently prepared by Durham University, shows the islands of Svalbard, dominating the Norwegian sector of the Arctic Ocean rim.



In spite of the lack of British territory in the Arctic, Britain has contributed to Arctic exploration since its early days. This postcard is a personal one arising from a recent visit in the summer of 2008, drawing attention to aspects of Britain's more recent role, and how this role is continuing now.

Our visit this summer was a personal one, with a tragic element to it. The object was to bring together members of a University expedition to Svalbard that I led in 1958. This expedition was one of many annual research visits directed by the late Brian Harland. Brian devoted much of his varied academic career to working out the geological history of this part of the rim of the Arctic Ocean, based in the Department of Earth Sciences (Geology) in the University of Cambridge.

This type of research is the key to understanding the potential for oil, and is also likely to be a central element in determining claims over sovereignty.

Our expedition in 1958 was typical of the University expeditions of the time, a low budget summer project run by a young group of nine graduate students and undergraduates. Recently one of our group, Dr John Taylor, suggested that we might meet on the fiftieth anniversary of the expedition to remember our early experiences. We particularly wanted to remember the death of one of our group, John Kirton, who was killed by a rock fall while collecting fossils on a remote mountain on one of Svalbard's ice sheets. The mountain is now called Kirtonryggen to commemorate this tragedy. In 2008, some eight members of the family of John Kirton's sister were able to join six members of the 1958 expedition to visit the base from which he had sledged.

The Harland expeditions had a strong belief in their research programmes. Not only did the research seek answers to questions about the history of the formation of this area of the Arctic rim, but it helped to extend knowledge of fundamental processes, such as plate tectonics, leading to a better understanding of how the Earth has been working. We also felt that that the experience of living and working together under conditions of isolation that are rarely experienced in present-day field-work, was a challenge and educational in the widest sense.

It is very satisfactory that today, despite its lack of Arctic territory, Britain continues to cherish its Arctic activities. The Natural Environment Research Council (NERC) continues to maintain a base in Ny Alesund in north-western Svalbard, and it is good that this has been named 'Harland Huset'. The Scott Polar Research Institute in Cambridge University continues to lead work on polar processes and climate, and CASP (formerly the Cambridge Arctic Shelf Programme) linked to the Department of Earth Sciences, Cambridge, continues to play a major role in researching the deep structural history of the Arctic Ocean area.

Harland Huset, the NERC base in Ny Alesund, Svalbard

House of Commons Select Committee on Innovation, Universities, Science and Skills

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

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

Oral Evidence

The Quality Assurance Agency's recent reports on standards in universities

On Thursday 17th July the Committee held a one-off session with Mr Peter Williams, Chief Executive of the Quality Assurance Agency and three colleagues focusing on the QAA's recent reports on standards in universities.

Current Inquiries

Engineering

On 29th January the Committee announced an inquiry into engineering. The inquiry is focused on the role of engineering and engineers in UK society, the role of engineering and engineers in the UK's innovation drive, the state of the engineering skills base in the UK, including the supply of engineers and issues of diversity (for example, gender and age profile), the importance of engineering to R&D and the contribution of R&D to engineering and the roles of industry, universities, professional bodies, Government, unions and others in promoting engineering skills and the formation and development of careers in engineering.

As part of the main inquiry the Committee has held three evidence sessions, hearing from young engineers, academics, academic institutions, bodies representing engineers, employers and industry, and other organisations with an interest in engineering. Further evidence sessions will take place over the coming months.

The inquiry is wide-ranging and the Committee is exploring some of the themes using case studies, two of which are nearing completion. The first was plastic electronics and focused on the current and future roles of engineers in the field of plastic electronics, the potential for plastic electronics in the UK/global economy, how universities, industry, venture capital and Government are involved in the development of the UK plastic electronics sector and whether the UK engineering and manufacturing sector are set up to handle growth in this area. The second case study was nuclear engineering and focused on the UK's engineering capacity to build a new generation of nuclear power stations and carry out planned decommissioning of existing nuclear power stations, the value in training a new generation of nuclear engineers versus bringing expertise in from elsewhere, the role that engineers will play in shaping the UK's nuclear future and whether nuclear power will prove to be economically viable and the overlap between nuclear engineers in the power sector and the military.

On 2nd July the Committee announced two additional case studies.

A case study looking at Engineering in Government will examine the role and effectiveness of the Government Office for Science and the Chief Scientific Advisers in providing engineering advice across Government and communicating issues relating to engineering in Government to the public; the use of engineering advice in Government policy making and project delivery, including examples of policy decisions or project delivery that have been or will be taken with or without engineering advice; how Government identifies the need for engineering advice and how Government sources engineering advice; the status of engineering and engineers within the civil service, including assessments of the effectiveness of the science and engineering fast streams, and the role and career prospects of specialist engineers in the civil service; the role and effectiveness of professional engineers and the engineering community in promoting engineering and providing engineering advice to Government and the civil service; and international examples of how engineers and engineering advice are imbedded in Government.

A second case study looking at Geo-Engineering will examine the current and potential roles of engineering and engineers in geo-engineering solutions to climate change; national and international research activity; research funding related to geo-engineering and the relationship between, and interface with, this field and research conducted to reduce greenhouse gas emissions; the

provision of university courses and other forms of training relevant to geo-engineering in the UK; the status of geo-engineering technologies in government, industry and academia; geo-engineering and engaging young people in the engineering profession; and the role of engineers in informing policy-makers and the public regarding the potential costs, benefits and research status of different geo-engineering schemes.

After Leitch: Implementing Skills and Training Policies

On 4th March the Committee announced an inquiry into the implementation of skills and training policies following the Leitch Report and how responses to the agenda set out in the Leitch Report will affect the broader structures of further education, higher education and lifelong learning. The inquiry focuses on the responses of RDAs to Leitch and how coherent and structured these are, what the existing regional structures of delivery are and what sub-regional strategies may be required; the role of the Learning and Skills Council and Sector Skills Councils in this context; the respective roles of the further education and higher education sectors in delivering a region-based agenda for Leitch and their co-ordination with one another and the impact on students of these initiatives, particularly in the context of policies for lifelong learning.

The Committee has held four evidence sessions. The inquiry began with an evidence session in Leeds to discuss planning and delivery of skills in the Yorkshire and Humberside region. The Committee subsequently heard from a number of interested parties including academics and representatives from industry, the UK Commission for Employment and Skills, Sector Skills Councils, Employment and Skills Boards, Regional Development Agencies, the Learning and Skills Council, representatives from further and higher education and unions. One further evidence session is planned, at which the Committee will hear from the Minister for Skills.

Scrutiny of the Draft Apprenticeships Bill

On 21st July the Committee announced an inquiry into the draft Apprenticeships Bill, which was published by the Government on 16th July (Cm 7452). The Committee will focus on whether the bill meets the Government's policy objectives to set up a system of 'world class' apprenticeships in the most effective way within a reasonable time frame; whether the bill is workable; whether the bill will lead to a renaissance in apprenticeships; what the bill will cost; what impact the bill will have on current institutional structures and whether there is anything missing from the draft bill. The Government is carrying out a consultation exercise on the draft bill (http://www.dcsf.gov.uk/consultations/conDetails.cfm?consultationId=1571) and will supply copies of the responses it receives to the Committee. The Committee will also consider evidence received directly from interested parties. The Children, Schools and Families Committee will be carrying out a separate inquiry into those parts of the draft bill that deal with apprenticeships for 16-18 year olds, including careers education in schools.

Reports

Renewable electricity-generation technologies

On 19th June the Committee published its Fifth Report of Session 2007-08, *Renewable electricity-generation technologies*, HC 216.

Biosecurity in UK research laboratories

On 25th June the Committee published its Sixth Report of Session 2007-08, *Biosecurity in UK research laboratories*, HC 360.

Government Responses to both of these Reports are due in the Autumn.

Government Response

Science Budget Allocations

On 17th June the Innovation, Universities, Science and Skills Committee published its Seventh Special Report of Session 2007-08: *Science Budget Allocations: Government Response to the Committee's Fourth Report of Session 2007-08*, HC 639. On Monday 7th July there was an Estimates day debate on the floor of the House on the Report. The Committee also published on its website correspondence regarding the Government Response to the Report between the Committee and the Secretary of State for Innovation, Universities and Skills and the Chief Executive of the Science and Technology Facilities Council.

Further Information

Further information about the work of the Innovation, Universities, Science and Skills Committee or its current inquiries can be obtained from the Clerk of the Committee, Dr Lynn Gardner, the Second Clerks, Glenn McKee and Edward Waller or from the Committee Assistant, Ana Ferreira on 020 7219 2792/8367/0859/2794; or by writing to: The Clerk of the Committee, Innovation, Universities, Science and Skills Committee, House of Commons, 7 Millbank, London SW1P 3JA. Inquiries can also be emailed to iuscomm@parliament.uk. Anyone wishing to be included on the Committee's mailing list should contact the staff of the Committee. Anyone wishing to submit evidence to the Committee is strongly recommended to obtain a copy of the guidance note first. Guidance on the submission of evidence can be found at http://www.parliament.uk/commons/selcom/witguide.htm. The Committee has a website: www.parliament.uk/ius where all recent publications, terms of reference for all inquiries and press notices are available.

House of Lords Science and Technology Select Committee

The members of the Committee (appointed 13 November 2007) are Lord Colwyn, Lord Crickhowell, Lord Haskel, Lord Howie of Troon, Lord Krebs, Lord May of Oxford, Lord Methuen, the Earl of Northesk, Lord O'Neill of Clackmannan, Lord Patel, the Earl of Selborne, Lord Sutherland of Houndwood (Chairman), Lord Taverne and Lord Warner. Baroness Walmsley and Lord Soulsby of Swaffham Prior were co-opted on 14 January 2008 for the purposes of the Systematics and Taxonomy inquiry and Lord Broers and the Earl of Erroll were co-opted on 25 March 2008 for the purposes of the Personal Internet Security follow-up.

Personal Internet Security

The Committee's original report on *Personal Internet Security* was published on 10 August 2007 (Session 2006-07, HL Paper 165), and was widely reported in the media. The inquiry, chaired by Lord Broers, looked at a broad range of security issues affecting private individuals when using the Internet. The Government response to the Committee's report was published as a Command Paper (Cm 7234) on 24 October 2007. The Committee was disappointed by the Government response and, as a result, sought comments on the response from those who gave oral evidence during the original inquiry. The Committee also took oral evidence from Ministers. The Committee published a short follow-up report, *Personal Internet Security: Follow-up*, on 8 July 2008 (Session 2007-08, HL Paper 131) in which it welcomed the Government's more positive approach to driving forward the personal Internet security agenda although noted that many of the Government's assertions were promises for the future rather than achievements in the present. The original report and the follow-up report were debated by the House on 10 October 2008.

Air Travel and Health

The Committee's report on *Air Travel and Health – an Update* was published on 12 December 2007 (Session 2007-08, HL Paper 7). It received good coverage in the media. The Government response was received at the end of February and was published with a commentary on 19 May 2008 (Session 2007-08, HL Paper 105). It is expected that both the report and the commentary will be debated by the House by the end of the current session or during the start of the new session.

Waste Reduction

Last year the Select Committee appointed a Sub-Committee, chaired by Lord O'Neill of Clackmannan, to inquire into Waste Reduction. The Sub-Committee heard from civil servants, academic experts and the Environment Agency on the various types of legislation which impact upon waste reduction. It also looked in detail at the various roles that designers, manufacturers and retailers can play in reducing waste. The inquiry examined a range of sectors; and evidence was heard from a number of industry organisations, from individual companies, officials at the European Commission and Ministers. The Committee's report was published on 20 August 2008 (Session 2007-08, HL Paper 163) and received substantial coverage in the media. The Committee made a number of recommendations including a recommendation that the Government take steps centrally to ensure that as much as possible was being done to encourage businesses of all sizes to reduce waste and that Government should take the lead in introducing true individual producer responsibility. The Committee is awaiting the Government response to the report. A debate on the report will take place during the course of the next session.

Genomic Medicine

The Select Committee has appointed a Sub-Committee, chaired by Lord Patel, to hold an inquiry into genomic medicine. The call for evidence was published on 25 February 2008 with a deadline for submissions of 21 April 2008. The inquiry is examining the policy framework in this area, the latest research and scientific developments, translation opportunities into the clinic, genomic databases and the use of genetic information in a healthcare setting. The Sub-Committee has held a number of public meetings since late April and has taken evidence from, amongst others, the Medical Research Council, the Department of Health, the Wellcome Trust, Cancer Research UK, and the Royal College of Physicians.

In early June 2008, Members visited the National Human Genome Research Institute in Washington DC where they spoke to experts in fields including population genomics, ethics, and translational research. They also met representatives from other organisations including the Food and Drug Administration, Harvard Medical School, and the American Society of Human Genetics. It is expected that the Committee's report will be published in spring 2009.

Systematics and Taxonomy

During 2007-08, the Select Committee undertook a short inquiry into systematics and taxonomy. The inquiry was a follow-up investigation from the Committee's past inquiries into this subject (in 1991 and 2002) and looked at the UK's capability in this field, taxonomic data

collection and management, and the skills base. The inquiry also looked at the application of taxonomic data, for example, in environmental change monitoring. The Committee took a range of evidence and published its report on 13 August 2008 (Session 2007-08, HL Paper 162). It concluded that the state of systematics and taxonomy in the UK, both in terms of the professional taxonomic community and volunteers, was unsatisfactory – in some areas, such as mycology, to the point of crisis – and that more needed to be done to ensure the future health of the discipline. The Government response to the report is awaited. A debate in the House will take place during the next session.

Further information

The written and oral evidence to the Committee's inquiries mentioned above, as well as the Calls for Evidence, 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 7219 6072. The Committee's email address is hlscience@parliament.uk.

Parliamentary Office of Science and Technology

Recent POST Publications

New Anti-Infectives

July 2008 *POSTnote 311*

Infections account for about 10% of all deaths in the UK. The efficacy of all current anti-infectives is threatened by the spread of drug resistance factors, with some drugs already made ineffective. Treatments are also required to tackle emerging diseases such as SARS. As a result, there is a pressing need for new anti-infective drugs. This briefing reviews the UK burden of infectious disease, current anti-infectives research and policy options to stimulate further drug development.

Biodiversity Indicators

July 2008 *POSTnote 312*

The UK is committed to a demanding European target to halt biodiversity loss and to a less stringent global target to reduce the rate of its occurrence by 2010. Biodiversity indicators measure progress towards these targets. This POSTnote explains the different suites of indicators that will be used and looks at issues surrounding them.

Large Scientific Facilities

July 2008 *POSTnote 313*

Since 2000 the Government has allocated over £800m to constructing ten new large scientific facilities, with £270m earmarked for five future projects. These facilities are planned and operated over long timescales, often involving international collaboration, and have significant economic impacts. This POSTnote describes the system used by the UK to plan new large scientific facilities. It gives examples of facilities both current and proposed, highlighting relevant policy issues.

UK Vaccine Capacity

August 2008 *POSTnote 314*

Annual seasonal influenza outbreaks and pandemic disease planning have generated parliamentary interest about the UK's position in sourcing adequate quantities of vaccines. A key policy issue concerns the extent to which the Government should stimulate vaccine research and manufacturing capacity rather than it being led by the commercial interests of the pharmaceutical sector. This POSTnote gives an overview of the position in the UK and how public health interests are reconciled with those of industry.

Current work

Biological Sciences – Animal Cruelty and Interpersonal Violence, Internet Pharmacy and Counterfeit Medicines and Behavioural Economics and Deferred Rewards

Environment and Energy – Security of Energy Supply, Assessing the Vulnerability of the Renewable Energy Industry to Climate Change, Future Nuclear Technologies, River Basin Management Planning, and Geo-engineering

Physical sciences and IT – Digital Preservation, E-democracy, and Green ICT

Work for Select Committees

Dr Wentworth was seconded as a specialist clerk to the Joint Committee on the Draft Marine Bill from May to July.

Staff, Fellows and Interns at POST

POST doctoral fellows:
Paul Dodds, Leeds University , ESRC Fellowship
Kirsty Newman, Wellcome Trust, short term placement

International activities

Dr Nath has continued her part-time secondment to work on POST's Africa programme, while the Association of Commonwealth Universities has awarded a scholarship to POST to bring a Ugandan parliamentary researcher to the UK on a three-month Commonwealth Professional Fellowship.

POST collaborated with the respected Swedish organisation, Vetenskap och Allmänhet (Science and the Public) to organise a special interactive session on *Politics and Science: how can we bridge the gap?* at the Euroscience Open Forum (ESOF) in Barcelona in July. Euroscience has established itself as the leading event for interaction between science professionals, policy makers and the media. As well as the Chair and Director of POST, presenters included the former Speaker of the Swedish Parliament, the Chair of POST's equivalent at the German Parliament, the vice-chair of its equivalent at the European Parliament and several other MEPs. Over 150 participants attended the event, even though it was scheduled for 8:30 am on a Sunday – and it received considerable acclaim for its pioneering approach and breadth of content.

Living with Environmental Change

The Earl of Selborne

The Living With Environmental Change (LWEC) programme launched in the Queen Elizabeth 11 Conference Centre on 18th June 2008 represents an unprecedented partnership spanning research councils, government and business. The programme connects world-leading natural, engineering, economic, social, medical, cultural, arts and humanities researchers with policy makers, business, the public and other key stakeholders.

The UK's main funders of environmental research have joined forces to provide decision makers with the best information to manage effectively and protect vital ecosystem services. The programme will improve our tools and knowledge needed to build resilience, mitigate problems, and adaptat to environmental change.

New science and research for a secure future

If we continue on our current path, by the end of this century, or earlier, our environment will be in a state that modern humans have never experienced. In parts of the world, supplies of food and water will be at risk and flood defences stretched.

The UK will not be immune. Already we know that tens of thousands can die in European heatwaves and that severe storms cause billions of pounds of damage to the economy, disruption to society and individual distress. We are confident that we can avoid many of the most seriously damaging consequences of a changing climate and environment, but only if we act with sufficient urgency and make the right choices about the future. Failure to act is likely to be very costly.

The drivers behind LWEC

The Fifth Treasury Challenge focuses on global change and the pressures this will bring to natural resources. Living With Environmental Change is the response by the major UK funders of environmental research to this challenge. LWEC has been developed with the Environment Research Funders' Forum (ERFF) and already has various partners from amongst the Research Councils, Government, business and other stakeholders. Not all partners are members of ERFF.

LWEC will meet many of the needs identified by the Stern Review, the United Nations' Millennium Ecosystem Assessment, and the recent reports by the Intergovernmental Panel on Climate Change. The programme will also contribute to delivery of the UK strategy for sustainable development, Securing the Future.

Aims

This ten-year programme, designed by all partners, aims to provide decision makers with the best information to manage effectively and protect vital ecosystem services on the time and space scales on which the economy is managed. It will aim to strengthen the evidence base for policy, not least by addressing the uncertainties that remain about the impacts of climate change and the links between natural capital and human well-being. It will communicate with all stakeholders and work to enhance people's skills and knowledge so that they can better comprehend change and its associated uncertainties. This will help people in all walks of life make better decisions and life choices and create increased opportunities for the development of individuals and the economy overall.

Through interdisciplinary research activities, knowledge exchange actions and training opportunities LWEC aims to deliver:

- whole-system assessments and risk-based predictions of environmental change and the effects on ecosystem

services, economies and communities on local-to-regional, and seasonal-to-decadal time scales;

- integrated analyses of the potential economic, social and environmental costs, benefits and impacts of different mitigation and adaptation responses;
- guidance for more effective sustainable management of ecosystem services as a foundation for resilient economic development and social progress;
- new technology and infrastructure solutions in the management of environmental change;
- a more research-informed dialogue and debate about the environmental challenges and choices that we face and their economic and social consequences.

Objectives

The following strategic objectives will inform progress towards the design of the programmes of work that will make up LWEC:

- To build effective mitigation, adaptation and resilience to climate change, including preparedness for changes to the intensity and frequency of extreme events, so that human health, well-being, and a healthy natural environment are ensured through use of sustainable and socially acceptable environmental management approaches and technologies.
- To assess the links and feedbacks between the natural environment, ecosystem services and human well-being; how these might continue to develop within environmental limits in the face of major environmental change; and how decision-making and local and national planning can take account of these links and feedbacks to help in the development of new social, environmental and economic opportunities.
- To promote human well-being, alleviate poverty and minimise waste by developing sustainable ecosystem management approaches for safe and secure food production and water supply.
- To protect human, plant and animal health by predicting how diseases, pests, hazards and other environmental factors will alter under forthcoming environmental change scenarios, assessing which sectors of society are most at risk and determining what management actions need to be taken.
- To make infrastructure, the built environment and transport systems resilient to environmental change and develop more sustainable, less energy-intensive systems and approaches that are socially acceptable, economically advantageous and more environmentally harmonious.
- To work with the diverse communities of the UK to understand how, on the basis of our various cultural backgrounds and belief systems, we live with our environment at present, how this is likely to alter as the environment changes, and how we might use this knowledge to develop thriving, cohesive and informed communities.

Meet the Technology Strategy Board

Lord Haskel

Member, House of Lords
Select Committee on Science & Technology

It is almost a year since the government-funded, but independently-managed, Technology Strategy Board (TSB) was established to bring new drive and focus to technology-enabled innovation in the UK. Business has an important role to play in the success of the TSB. At the same time sponsors and partners, whether in Parliament, Whitehall or other public sector bodies, need to understand its aims and activities and how it touches them.

For this reason an informal evening reception was held at the House of Lords on 18th June, in the convivial setting of the Cholmondeley Room and River Terrace, to meet key members of the TSB's governing body, executive group and technologist teams.

Entitled *Connect and Catalyse*, the newly-launched strategy outlines how the TSB will promote and invest in technology-enabled innovation for the benefit of business, to increase sustainable economic growth and to improve quality of life and explains how the Technology Strategy Board will:

- provide innovation leadership, promote knowledge exchange, build networks and invest in new ideas, and
- stimulate new areas of activity for business and provide a longer term view of future technology and innovation needs across the UK economy and globally.

Working with the research councils, regional development agencies and devolved assemblies, the TSB will invest more than £1 billion over the coming three years – and will use its proven ability to obtain matching private sector funding to double this to at least £2 billion.

The TSB will invest its resources according to three main themes:

- innovation in response to societal and economic challenges: "challenge-led innovation"

- innovation inspired by existing and emerging technology, where the UK leads or could lead: "technology inspired innovation", and
- encouraging a culture in which innovation can grow: an "innovation climate".

Challenge-led innovation

The TSB believes that major societal challenges – such as climate change and an ageing population – can be used to stimulate responses that both enhance the quality of life and increase wealth.

The principal way in which the TSB will support challenge-led innovation is through Innovation Platforms. Targeting one of today's challenges, each platform brings businesses together with relevant academic and research organisations, and with the government departments that control policy, regulation and procurement. Working together, they research, develop and deliver innovative technological solutions. There are currently five Innovation Platforms:

Assisted Living: developing technology to enable people who suffer from chronic long term conditions to live independently;

Low Carbon Vehicles: responding to the growing demand for lower carbon vehicles;

Intelligent Transport Systems and Services: overcoming issues associated with travel and traffic related issues;

Low Impact Buildings: responding to the Government's targets for improving sustainability, including for all new homes to be zero carbon by 2016, and new non-domestic buildings by 2019;

Network Security: concerned with the confidentiality, integrity and availability of network communications infrastructure.

Over the next three years five more Innovation Platforms will be introduced, in areas which address other major societal challenges.

Technology-inspired innovation

It is vital that the UK maintains core expertise in leading edge technologies to underpin sustainable business growth, and maintains a pipeline of new advances, to keep UK businesses at the leading edge. So the Board will invest in innovative research and development in areas where the UK is strong, and in the next generation of technologies and industries – such as advanced materials, biosciences, nanotechnology and high value manufacturing.

The innovation climate

To accelerate innovation, the UK needs a culture that enables, attracts, retains, celebrates and rewards talent and innovation – a welcoming innovation climate. The TSB will invest in networks and knowledge exchange. Two key investment areas will be:

Knowledge Transfer Networks, which are national networks in a specific technology or business application, bringing together people from businesses, universities, research, finance and technology organisations to stimulate innovation through knowledge exchange. There are currently 24 KTNs, with a total membership of over 30,000.

Knowledge Transfer Partnerships, which place high-calibre, recently-qualified individuals into a business to work on innovation projects. KTPs deliver real benefits for the business, increase business interaction with the university and provide excellent experience for the graduate. There are currently 1000 KTP placements and this figure will be doubled by 2011.

In conclusion, the TSB's strategic plan states that innovation and the application of technology are vital for the UK – both for our economy and to address social and environmental challenges. To innovate, businesses need inspiration, investment and breakthrough thinking. They need to join forces with experts and business partners. And they need to operate in an environment that is open to new ideas and which supports them.

Bringing all of this together, connecting and catalysing, is the key role of the Technology Strategy Board.

For further information about the work of the Technology Strategy Board, and to download a copy of "Connect and Catalyse" please visit www.innovateuk.org

Companion Animal Welfare – Regulation and Surveillance

Lord Soulsby of Swaffham Prior

Introduction

On 2 July Roger Gale and I were very pleased to have the opportunity to host a well attended Reception in the Jubilee Room in the Palace of Westminster to celebrate and publicise authoritative reports prepared by two different Working Groups of the Companion Animal Welfare Council (CAWC), firstly, on the regulation of companion

animal services related to the training and behaviour modification of dogs (July 2008) and secondly, a scoping report on companion animal welfare surveillance (May 2008). Both of these reports represent a major contribution to animal welfare by CAWC which is a UK-based charitable body that aims to set minimum welfare standards for companion animals in the same manner as already exists for food producing animals. Both these reports represent a major contribution to animal welfare by CAWC.

Both of these reports address issues that may concern a substantial number of the UK human population where it is estimated that just under 50% of UK households own a pet. Dog owners in particular have been subject to a variety of laws that relate to the behaviour of their dogs resulting in the growth of an industry catering for their training, and especially with the treatment of behaviours perceived as problematic. This perceived need for behavioural training has spread to include cats, horses, birds, rabbits, small mammals and reptiles.

A. Regulation

There is currently no requirement for proof of knowledge, skills or expertise as a pre-requisite for practising as a trainer or a clinical animal behaviourist (CAB). There are several organisations to which a person may be affiliated with requirements which differ, as well as a wide range of courses which can be used for professional self promotion. The public have little information on either the relative importance of the organisations and training courses involved or the locations where help can be obtained.

There is a statutory requirement for Local Authorities to employ animal wardens. However this seems to be primarily a reactive response dealing with problems as they arise, rather than a wider and inclusive proactive response of promoting or supporting preventive education of owners and training of their dogs.

Training clubs are finding that there is increasing competition for the use of halls even though this practice may have been part of community life for decades. Decisions to deny training venues are based on perceived health and safety concerns with reference to zoonoses, for example, which could be accommodated by reassurances that requirements for worming, vaccination and cleaning premises are met. In order to address these several issues the Working Group addressed:

1) The distinction between trainers and clinical animal behaviourists (CAB).

2) The professional requirements and regulation of trainers and CAB.

3) The availability and quality of educational provision for those wishing to practise as trainers or CAB.

4) The way forward will involve establishment of a framework, increased public awareness and ultimately legislative support.

B. Surveillance

There is very little formal monitoring of the welfare of companion animals in the UK as no body attempts or is responsible for keeping an overview on companion animal welfare. Suggestions for taking on this task varied from veterinary schools to the Pet Advisory Committee (PAC). Whichever body takes responsibility for this will need to have the capacity and resources to host and support a committed individual to begin to develop this work and the capacity to liaise with and co-ordinate activities with many individual specific taxa groups.

There seems no reason for or advantage in such work being developed separately in England, Scotland, Wales and Northern Ireland and it is hoped that the regions would all work together in this area. It could be argued that welfare surveillance is the collective responsibility of all companion animal owners and others who benefit from the companion animal industry. Welfare surveillance will not be possible without some funding to support it and ways need to be found for raising funds for it, at least partly from this community.

A surveillance system would help in improving animal welfare and has received support from many of the key organisations likely to be involved to the extent that efforts should be made to begin a pilot scheme. Organisations representing the keepers of various breeds or other taxa who believe that they may be able to help in starting and developing a welfare surveillance initiative should liaise and try to find a way, by working with experts in epidemiology and on both health and behavioural aspects of welfare assessment, to set up and initiate a programme of work on the lines recommended in the report.

References

The Regulation of Companion Animal Services in Relation to Training and Behaviour Modification in Dogs. A Report Published by the Companion Animal Welfare Council, July 2008, pp50.
Companion Animal Welfare Surveillance. A Scoping Report Published by the Companion Animal Welfare Council, May 2008, pp12.

Both Reports, as well as others published by CAWC can be accessed via the CAWC Website. www.cawc.org.uk
email cawc@cawc.freeserve.co.uk

G8 '08 – Space Solutions for Climate Challenges

Ian Taylor MP and Bill Olner MP

How do we actually know who is emitting what? This year's Parliamentary Space Committee summer reception gave us a simple answer: satellites can help the world police our promises on climate change, and UK satellite technology can play a central role.

The Parliamentary Space Committee is one of the oldest and most established all-party groups in Parliament, with over 100 members in both houses. Its Summer Reception in the Members' Dining Room, is always a well attended affair and attracts a good number of MPs. This year it was held on 2nd July and was no different. Ian Pearson MP, Minister for Science and Innovation, was the guest speaker at a special event aimed at providing a perspective from space of the climate challenges confronting the imminent 2008 G8 summit in Japan. Growing global pressures on energy, food and water impact on us all. We were invited to hear about satellite based tools that can help monitor and deliver our common vision of a sustainable, low carbon society.

Over the last 25 years, global satellite measurements have proven that our climate is already changing. Increasingly, however, we are turning to satellites to police our promises. Satellites monitor illegal logging, observe changes in terrain, speed crisis response and predict severe weather. Now advances in satellite technology provide policy makers with reliable, independent tools for monitoring compliance with agreements on cutting greenhouse gases.

Space is no stranger to the G8. In 2005, the Gleneagles communiqué on climate change declared the G8's support for creating a global health check for Planet Earth. Europe's contribution is Global Monitoring for Environment and Security (GMES), the world's biggest environmental monitoring programme.

Kyoto has left the world with an enduring challenge – how to monitor compliance with agreed targets. There is an urgent need to create a global monitoring system so that, as the UN recently put it, we can "know with any degree of certainty what the world's total emissions are and hence whether it is on track for the overall target."

Satellites are a vital part of a global monitoring system. They remain the only way of monitoring gradual environmental change at a global level and the varying impacts of climate change on individual countries and regions. They provide the first global tool for monitoring compliance and assessing risks. They also help re-routing aircraft and traffic intelligently and provide low carbon, solar powered communications thereby providing some of the solutions to climate change.

Ian Pearson MP

UK Space is one of the UK's biggest success stories and adds £7 billion to the economy, supports 70,000 jobs, is growing four times faster than the rest of the UK economy, has the most highly skilled workforce in manufacturing and enjoys 7% of the global space market forecast to be worth £543 billion by 2020. For example, UK designed instruments are monitoring sea surface temperatures to better than 0.1 degrees accuracy. A UK science led mission will use radar from space to monitor the melting ice caps to sub millimetre accuracy. UK Space is committed to helping make Britain the most dynamic low-carbon economy in the world.

The UK's leadership in satellite monitoring technology and associated ground data processing systems, combined with our leadership in climate science and climate change policy is the best opportunity for Britain to ensure that the world's biggest environmental monitoring programme meets our needs. In recognition of UK's leadership, Europe has offered to create a new international facility in Britain to lead Europe's climate and environmental monitoring and to build on UK leadership in the science and engineering of climate change. The UK also has the opportunity to lead the atmosphere monitoring missions within GMES. These opportunities will not be realised if the UK does not reverse its low funding for GMES in November 2008.

France and Germany have committed 14 and 18 times more than the UK to the current phases of GMES, and the EC has set aside €1.2 billion. Britain's policy focus on climate change has ensured that GMES now includes a set of instruments that will ensure continuity in CO_2 monitoring until 2020. However, unless the UK reverses its current minimal funding to GMES, the UK's climate priorities within GMES will not happen. A proportionate contribution to GMES, relative to the size of other economies, would cost the UK around £20 million a year over seven years. Britain's policy towards GMES is led by the Department for Environment, Food and Rural Affairs.

Selected Debates and Parliamentary Questions & Answers

Following is a selection of Debates and Questions and Answers from the House of Commons and House of Lords. Full digests of all Debates, Questions and Answers on topics of scientific interest from 2nd June to 22nd July 2008 from both Houses of Parliament can be found on the website:

www.scienceinparliament.org.uk

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

Agriculture and Food

Food Security
Debate in Westminster Hall on Tuesday 3 June

Mr David Drew (Stroud)
Food and food politics are highly contentious issues at the moment. I wish mainly to talk about the UK scene, although I shall finish by saying a few things about the international scene. It is quite difficult to define food policy, let alone food policy security. We have a problem in this country and in the western world, and I want to highlight some things that we ought to take account of. I can raise the issues, but I hope that the Minister will respond with some answers about the Government's thinking.

It is difficult to identify which Department and which Minister will take responsibility for the issue. The Food Standards Agency reports to the Department of Health, the Cabinet Office is spending a great deal of time on the issue of food co-ordination, and other Departments – such as the Department for Business, Enterprise and Regulatory Reform and the Department for Children, Schools and Families – are involved with the issues about what we feed our children in schools. A panoply of Ministries take partial responsibility for the matter.

The Cabinet Office says: "The term 'food security' is used in different ways but it is essentially a matter of identifying, assessing and managing risks in food supply." It continues: "The multiple dimensions and interpretations of 'food security' can hinder any discussion."
It then looks at the six key criteria by which food security should be measured. They are: availability, which is to do with production, supply and so on; access – to do with affordability and physical accessibility; affordability in its own right – to do with what households can and cannot afford; safety – to do with what we eat and feeling secure in the knowledge that what we eat will not poison us or do long-term damage to our bodies; resilience, as the food chain has to be capable of being protected and supported; and finally, confidence, as there must be public confidence in all those issues, so that people feel that they can purchase the food.

The Parliamentary Under-Secretary of State for Environment, Food and Rural Affairs (Jonathan Shaw)
We take food security extremely seriously. The UK enjoys a high level of food security: we have access to enough quality and nutritious food from the UK and from the range of countries with which we trade. In addition, recent CAP reforms mean that European farmers are much better able to respond to market signals. However, there are increasing pressures on land use arising from climate change, the need to feed a growing global population with changing consumption patterns, and competition from other uses such as biofuel production.

We recognise the effect of high global food prices for consumers around the world, but the developing world feels the impact most. We need a coherent and holistic response from the international community. Helping the worst affected is an immediate challenge. Food is becoming increasingly unaffordable for, and inaccessible to, poor households around the world and the humanitarian agencies that provide food aid. Every day 25,000 children die because they do not have enough to eat.

Food prices are expected to fall from their current peak, but they are likely to remain above recent levels in the medium term, so we need to tackle the underlying causes and long-term challenges of poverty and hunger facing 850 million people on our planet. We agree with the World Bank that there is enough food in the world to meet demand, but there are clearly problems with distribution – there is not enough food in the right place – and affordability.

We must also prepare for the impact of climate change on agricultural markets and the livelihoods of the poor. Any response to the current situation must be environmentally sustainable in the medium and long term. We must not jeopardise the long-term availability of our natural resources or exacerbate the climatic changes that already threaten food production in the world's poorest and most vulnerable nations. For example, harmful land use changes, particularly deforestation, contribute to climate change.

Bee Industry
Debate in Westminster Hall on Tuesday 17 June

Dr Ian Gibson (Norwich, North)
I want to say something very quickly about the honey bee and why we are very interested in it. In 1973, Karl von Frisch won a Nobel Prize in physiology and medicine for his pioneering work on comparative behavioural psychology and communication between bees. He was the

first scientist really to discover how species of bees utilise sensory perception and he established the importance of their waggle dance for communication. I do not intend to demonstrate waggle dancing to everyone here today, but there are nine species of bees and nine varieties of the waggle dance.

Massive winter losses of bee colonies in the USA and Canada of more than 60 per cent have been attributed to what we call colony collapse disorder, or CCD. The causes of such dramatic losses are not yet really understood and research suggests that there is a combination of factors: the parasitic varroa mite; the virus that the mite vectors or carries; and nosema, a fungal infection. All these factors, together with some kind of stress disorder, may be forming the lethal cocktail that is destroying bee colonies.

The UK is beginning to experience similar problems. Notwithstanding the ravages of varroa, normal winter losses are between 5 and 10 per cent of bees. However, in 2006 beekeepers reported mysterious losses over the winter of between 10 and 15 per cent of bees; rather large numbers of bees were dying. There were similarities to CCD, but it is still not clear that it is exactly the same problem, because there are some differences to CCD.

The British Beekeepers' Association has done some sterling work in this area. Its study of the work of 10 per cent of its 11,500 members revealed that the average loss of bees this winter was 30 per cent, which is three times the expected level. So, something is happening to honey bees across the world and it is now affecting bees in this country.

Lord Rooker stated in the House of Lords last November that if we did not deal with the current and potential threats we could lose our honey bees in this country within 10 years.

Bill Wiggin (Leominster)
I pay tribute to the British Beekeepers Association, which has done much to raise the profile of beekeeping and to inform us about the importance of bees to our country. It has put a tremendous amount of effort into its campaign, and its commitment to bee health is keeping the issue high on the political agenda. I understand that its campaign has already succeeded in attracting the support of 30,000 people who have signed its petition.

This debate is timely, and I hope that the Minister will be able to reassure us of his Department's commitment to bee health. The British bee industry is far more than just the sweet taste of honey. Who could imagine an English summer without the humble honey bee? Bees are amazing creatures whose value is easily overlooked. The Department for Environment, Food and Rural Affairs estimates that there may be more than 270,000 managed bee colonies in the UK, there being 5 billion bees in the winter rising to 16 billion in the summer.

As hon Members have already pointed out, the pollination service provided by those colonies and bees could be worth about £165 million, and estimates of their total contribution to our economy is somewhere in the region of £1 billion. They also add tremendous value to our countryside, especially in pollinating wild flowers.

Most of Britain's 44,000 beekeepers are not professional, keeping bees to make profits from honey sales and pollination services. They are small-scale hobbyists, whose numbers have been increasing. In greater London, for example, between 1999 and 2006 the number of beekeepers doubled to at least 2,000. However, because so many beekeepers are hobbyists, they are more vulnerable to the pressures now facing the nation's bees. As their livelihoods do not depend on beekeeping, many may be discouraged from continuing if they lose their colonies. In the USA beekeepers have significant commercial interests in re-stocking, but those incentives are simply not available for UK beekeepers. That is a very real problem for us at the moment.

The Parliamentary Under-Secretary of State for Environment, Food and Rural Affairs (Jonathan Shaw)
The development of the Government's strategy confirms our ongoing commitment to protecting and improving the health of honey bees and to sustaining and supporting beekeeping now and for future generations. The aim of the strategy is a sustainable and healthy population of bees for pollination and honey production in England and Wales via strengthened partnership between Government and other stakeholders. It seeks to address the challenges facing beekeepers. In particular, it sets out outcomes, activities and priorities for protecting and improving the health of honey bees in England and Wales, and the roles and responsibilities of Government and other stakeholders in achieving those objectives. The intention is to provide direction and focus for Government, beekeepers and other stakeholders to work together for the next decade on sustaining honey bees. Strengthened partnership working is crucial in achieving the strategy's aim and outcomes, and it will ensure that both current and evolving threats to bee health are effectively identified, assessed and acted upon.

Energy and Environment

Severn Barrage
Debate in Westminster Hall on Wednesday 9 July

Mr David Drew (Stroud)
In my part of the world, the barrage is controversial. Of all its possible effects, my constituency will probably face the greatest impact. We have a port – the wonderful port of Sharpness. I suspect that it would not survive, even if the great port of Bristol does, because of where the barrage is likely to built – if it is to be built. Even if it were built upstream, the barrage would still have an impact on Sharpness.

We also have the wonderful facility of Slimbridge, home of the Wildfowl and Wetlands Trust. Although I do not want to discuss biodiversity, one cannot help seeing the downside of the probable impact of the barrage. I know that we have said that there are likely to be advantages as well as disadvantages, but we will not be able to recreate those wetlands.

There are two main barrage proposals, the Weston to Cardiff and the Shoots barrages, and a number of

alternatives. Even the more minimalist barrages will be huge projects. Huge capital expenditure will be involved, and they will give rise to huge obligations in terms of the amount of electricity that will have to be produced to get the right pay-back.

John Penrose (Weston-Super-Mare)
If the Weston to Cardiff barrage is built, a hulking piece of civil engineering will come ashore on the border between my constituency and that of Wells. That could have a dramatic impact not just on biodiversity, but on the economy of a seaside town such as Weston-super-Mare.

Doug Naysmith (Bristol North West)
My main concern is the impact on the Bristol Port Company and its customers. Bristol port is the largest bulk-cargo port in the southern half of England. It relies on its ability to accept very large, deep-draught ships to import materials at economic rates. It also has good transport links to the UK's major population centres. The port handles 27 per cent of UK imported aviation spirit, and changes to that could affect the aviation industry, to which Bristol has close links – Airbus and Rolls-Royce, which are heavily involved in the aviation industry, are both in my constituency. Bristol is also the UK's second largest import facility for power station coal, and 30 per cent of total UK animal feed capacity is located at the port of Bristol. In terms of deep-sea volumes handled, Bristol is the leading UK port for the import of motor vehicles. Also planned – this will mean further additions to trades at Bristol's port – are a £500 million deep water container terminal and several biomass power stations, which will be fuelled with imported woodchip. All those cargoes are viewed as important because of their strategic significance or the nationally significant volumes handled – or sometimes both.

It is well known that there is considerable movement of both sediments and sands in the Severn estuary, and that the capability to model the estuary's transport systems for sand and sediment remains rudimentary. However, there is a clear expectation that post-construction there will be increased deposition of silts, clays and sand banks, which will be bound to affect the deep-water navigation channels, which are, at present, self-scouring. There will also be changes in the sand banks and post-barrage reduction of water density and levels of water on high tides. It is only on those higher tides that deep-draft ships can access Bristol's two major docks.

Any effective reduction of water would have an immediate adverse impact and make the port economically unattractive to a cargo owner. That is currently the case for fewer than 30 per cent of tides, but the figure could rise to more than 50 per cent of tides post-barrage. Should such an adverse impact arise, cargo owners would be faced with two alternatives. Those customers could use other ports, but many of the facilities needed for strategic bulk cargoes, such as deep water, storage land, pipelines, and inland road and rail transport simply do not exist at other ports.

Robert Key (Salisbury)
The decision facing the Government is so great that, in the end it will be a political decision, and I bet it will be taken at Cabinet level. The decision, I believe, will be that the damage caused by building a Severn barrage, which would irreversibly and for ever change one of the most special estuaries in the British Isles, will be rejected. That does not mean that I oppose the principle of generation of energy by water – far from it. I think, however, that the Government would be much better advised to avoid any serious consideration of blocking the Severn estuary in favour of concentrating efforts on various kinds of tidal barrage and tidal flow technology, which is short of development at the moment.

The Minister for Energy (Malcolm Wicks)
Our decision on a tidal power scheme on the Severn is some way down the line yet, for good reasons which I shall outline. We are carrying out a feasibility study to look at the costs, benefits and impacts of a tidal power scheme, which could be a barrage in one of several possible locations, or a lagoon or lagoons. Only when we have completed our study and analysed all the issues, including the costs, will we make a decision on whether to support a scheme and, if so, on what terms. The decision will be taken in the context of our wider energy and climate change goals. I shall not say too much about them, but there is always a danger that if we discuss one approach, whether nuclear power, windmills, the Severn barrage or lagoons, people think that we are forgetting the other things. For fundamental reasons relating to the nation's energy security as well as the need to tackle climate change, we have made a bold and right decision about nuclear power. We are demonstrating the technology of carbon capture and storage, and we have published ambitious targets, but the targets will not distort the decision-making process for the barrage. I heard the concerns voiced about renewable energy, and we should consider the barrage in that context.

Health

Chronic Fatigue Syndrome: Research
Question and Written Answer on Thursday 12 June

Dr Cable (Twickenham): To ask the Secretary of State for Innovation, Universities and Skills how much has been allocated from public funds for research into the biomedical causes of myalgic encephalomyelitis/ encephalopathy in 2008-09; what proportion of Government spending on research into the condition this sum represents; how much has been allocated for research into psychological conditions in 2008-09; and how many clinical co-ordinating centres serving patients with psychological disorders have (a) closed and (b) had a reduction in public funding since 2003.

Ian Pearson: The Medical Research Council is one of the main agencies through which the Government support medical and clinical research. Myalgic encephalomyelitis (ME) is a strategic priority area for the MRC and the Council is continuing to promote research in this area. The MRC does not have set budgets for specific illnesses and research proposals in all areas compete for the funding available. The MRC welcomes applications for support into any aspect of human health and these are subject to peer review and judged in open competition,

with awards being made on the basis of the scientific quality of the proposals made.

The MRC currently supports a number of studies in CFS/ME, as follows:

Professor K Bhui, Queen Mary and Westfield College: Chronic fatigue and ethnicity (£162,000)

Dr C Clark, Centre for Psychiatry, Barts and the London School of Medicine: General and specific risk markers and preventive factors for chronic fatigue and irritable bowel syndromes (funding approved in November 2007 £367,000)

Professor A J Weardon et al, University of Manchester: Randomised controlled trial of nurse-led self-help treatment for primary care patients with chronic fatigue syndrome (£743,000)

Professor P D White et al, Queen Mary and Westfield College: The PACE Trial: A RCT of CBT, graded exercise, adaptive pacing and usual medical care for the chronic fatigue syndrome (£2.07 million).

The Department of Health does not allocate funding specifically for psychological centres. Primary care trusts (PCTs) have the responsibility for providing funding for health and social care services to meet the needs of their local population from their general funding allocation. Information on the number of psychological centres is not collected centrally.

Health: Biosimilars
Question and Written Answer on Monday 21 July

Lord Walton of Detchant asked Her Majesty's Government:

What steps they are taking to ensure that, while the Parliamentary Review Health Review report on the introduction of biosimilars into clinical practice outlines precautions to be fulfilled before some such preparations can be approved for clinical use in the United Kingdom, the public and the medical profession can be assured that those biosimilar preparations produced by reputable pharmaceutical companies which have been licensed by the European Medicines Agency and the Medicines and Healthcare Products Regulatory Agency can safely be prescribed.

The Parliamentary Under-Secretary of State, Department of Health (Lord Darzi of Denham): Licensed biosimilar medicines will expand the number of drugs available to patients. Since the complex nature of biological medicines requires careful testing and specialised control of production, it is important that additional factors are taken fully into account when biosimilar medicines are manufactured and assessed. Special European Union regulations are in place to ensure that biosimilar manufacturers supply comprehensive data to demonstrate the quality, safety and efficacy of their product and its similarity to the original reference medicinal product.

All medicines, including biological medicines, should be prescribed by clinicians in accordance with the summary of product characteristics which provides full information about the product, including its side effects and its use.

All new medicines carry a black triangle symbol when they are first marketed in the United Kingdom. This denotes that the product is under intensive surveillance and this period usually lasts for two years. Biosimilar products are designated black triangle medicines and carry the black triangle symbol in the British National Formulary. All biosimilar products should also have in place at the time of licensing a full risk management plan that describes what is known about the safety of a product and describes the activities required on behalf of the company to ensure that relevant safety information is collected in the post-marketing period.

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

Science Policy

Nanotechnology: Research
Question and Written Answer on Friday 13 June

John Battle (Leeds West): To ask the Secretary of State for Innovation, Universities and Skills what research his Department is funding into developments in nanotechnology; and if he will make a statement.

Ian Pearson: The Research Councils support research and related training in nanotechnology. For example, the Engineering and Physical Sciences Research Council (EPSRC) has spent over £132 million since 2003 on nanotechnology, and is currently investing about £40 million per annum in research grants and supporting 40 new PhD studentships per annum in the area.

A new £50 million cross-Council programme covering NanoScience through Engineering to Application was announced in December 2007 as one of six strategic priorities over the CSR period (2008-09 to 2010-11). From this, £6.5 million has been committed to explore new methods of harvesting solar energy, for example by developing new types of solar cells.

In addition, the Technology Strategy Board (an Executive NDPB of DIUS) currently provides funding of £19.5 million to projects at the nanoscale and a further £15 million on microscale engineering projects incorporating elements of nanotechnology. The Nanotechnology Knowledge Transfer Network (KTN), established in 2007, works with the network of KTNs funded by the Technology Strategy Board and has a role in co-ordinating the UK network of 23 Micro-Nano Technology (MNT) Centres, including two centres offering services on the characterisation of micro and nano-scale materials. £54 million has been provided to establish and maintain the MNT centres, jointly funded with the regional

development agencies and devolved Administrations.

In April this year the National Measurement System (NMS) Unit in DIUS approved several new projects to be delivered within the NMS Chemical and Biological Metrology Programme. Two thirds of the work, worth more than £5 million over three years, addresses the field of nanotechnology. The projects aim to develop measurement standards and will be led by the National Physical Laboratory (NPL). NPL will involve several partners in the research.

Science Budget
Debate in House of Commons on Monday 7 July

Mr Phil Willis (Harrogate and Knaresborough)
I welcome the opportunity to debate the Innovation, Universities and Skills Committee report on the science budget allocations, and, on this estimates day, to have a debate on the departmental estimates and on budget issues. At the heart of the problems over the Science and Technology Facilities Council (STFC) budget is the financial legacy that the STFC was left with following the merger of the Particle Physics and Astronomy Research Council (PPARC) and the Council for the Central Laboratory of the Research Councils (CCLRC). The Government have repeatedly denied that the origins of the STFC's budget shortfall have anything to do with an inherited deficit from CCLRC by pointing out that the STFC was formed without a budget deficit. That is absolutely true, and the Committee has no wish to reopen that argument. However, the Government have consistently missed the point. As Professor Keith Mason, the former chief executive of PPARC and current chief executive of the STFC, so correctly put it: "the base line budget allocation to the ex-CCLRC...was not fully raised to compensate for the running costs of Diamond and ISIS Target Station II". That was the point.

Let us consider the facts. CCLRC would have had a budget deficit of approximately £80 million, in today's money, had it continued as a stand-alone council, because its baseline allocation was not sufficient to meet the running costs associated with Diamond and the ISIS second target station coming online. That is shown in the National Audit Office report "Big Science", from January 2007 – it is not something that we made up. The STFC was given approximately the combined budget of CCLRC and PPARC and the STFC's budgetary shortfall is almost exactly the same size as the amount that CCLRC would have been short of had it been able to continue as a stand-alone council. Those facts cannot be dismissed on the grounds that CCLRC should have planned its budgets more carefully on the basis of a flat cash settlement. That might be true, but it is unfair to saddle former PPARC users with a deficit derived from CCLRC. That is exactly what happened as a result of the budget settlement.

The Government assured us that there would be no legacy issues associated with the merger. They got it wrong and they should take responsibility for that, rather than hiding behind other people's decisions. Although we know the outcome of the programmatic review, we still do not know what the grant allocations will look like. Will the Minister consider a modest STFC uplift to prevent significant grant cuts if Professor Bill Wakeham recommends that when he reports in the autumn?

The Minister for Science and Innovation

(Ian Pearson)
The Government welcome the report of the Select Committee's inquiry into the science budget allocations, and we very much welcome this debate. I appreciate the overall constructive way in which Mr Willis raised the issues mentioned in the report. There are clearly matters on which we continue to disagree, and I do not think that his characterisation of our response to the report was accurate. We have taken its recommendations carefully into account and, in many cases, agreed with them. The report has been very helpful to us. We set out our position in a positive response, and I am pleased to have this opportunity to discuss the issues involved further.

As has been mentioned, the science and research budget has doubled in real terms from £1.3 billion in 1997 to £3.4 billion in 2007-08. The new comprehensive spending review allocation means that the budget will increase to almost £4 billion in 2010-11. That is an average increase of 2.7 per cent a year in real terms over the next three years. Within a tight financial framework, that is a strong settlement and highlights the Government's long-standing support for science and research in the UK, as set out in our 10-year science and innovation framework. I was very pleased that the hon Members for Harrogate and Knaresborough and for Oxford, West and Abingdon (Dr Harris), and Labour Members, recognised that strong support for UK science.

The STFC has been referred to this evening, and the first thing that I want to do is acknowledge the concerns that have been expressed in the particle physics and astronomy community about the science budget allocations. The Government are working with the STFC to review the way in which its allocation was handled, and to ensure that all the relevant lessons are learned for the future.

Grid Computing
Question and Written Answer on Monday 21 July

Lord Dykes asked Her Majesty's Government:

What is their assessment of the growth of grid computing techniques and innovations in the United Kingdom compared to that in other countries; and whether they have any proposals for further measures to expand these activities within government bodies and universities.

The Parliamentary Under-Secretary of State, Department for Innovation, Universities and Skills (Baroness Morgan of Drefelin): The UK has a strong grid computing community in terms of both technology development and adoption. This community has benefited from the investments made through the e-science research programme which ran from 2001 to 2007 and was funded by the research councils and the then DTI.

Examples of adoption in the UK can be seen in numerous industries including finance, manufacturing, pharmaceutical and retail.

A national grid service (NGS) has been developed with the main support for the NGS currently provided through the Higher Education Funding Council for England (HEFCE) supported Joint Information Systems Committee (JISC). The Engineering and Physical Sciences Research Council (EPSRC) currently provides support to this service via JISC and has contributed 50 per cent of the costs for the two-year period 2007-09. It is also now considering the role that the NGS can have in enabling leading research groups to carry out high-quality research in the UK.

The current focus of the Technology Strategy Board funded Grid Computing Now! Knowledge Transfer Network is on specific issues including green IT and software licensing and how these impact on the public sector in particular.

The Technology Strategy Board is also currently developing a UK technology strategy for information and communication technologies, which will cover grid computing among other technologies, methodologies and models.

Research: Cyber Infrastructure
Question and Written Answer on Tuesday 22 July

Lord Dykes asked Her Majesty's Government:

Whether they intend to increase funding for cyber-infrastructure research projects in companies and universities in 2008-09 and 2009-10.

The Parliamentary Under-Secretary of State, Department for Innovation, Universities and Skills (Baroness Morgan of Drefelin): The Engineering and Physical Sciences Research Council (EPSRC) provides opportunities for funding for cyber-infrastructure research through its Information and Communication Technologies (ICT) programme, which will be investing £225 million in new research grants in the period 2008-09 to 2010-11, and through the Digital Economy programme, which will be investing £83 million in new research grants in 2008-09 to 2010-11.

The Technology Strategy Board is currently developing a UK technology strategy in the areas of "Information and Communication Technologies", and "Electronics, Photonics and Electrical Systems". Funding will also be provided to stimulate business research and innovation focused on addressing key societal challenges such as "Intelligent Transport Systems and Services", "Assisted Living" and "Low Impact Buildings", which could provide opportunities for funding cyber-infrastructure research where appropriate. Funding in these areas will be approximately £40 million per annum.

DIUS investments in space technologies, while not directed at cyber-infrastructure, may in the future and in some cases find a use in related applications.

Progress of Legislation before Parliament

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

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

Parliamentary and Scientific Committee News

Science in Parliament

Being the last in the current Volume (No 65), the Autumn issue would normally contain a cumulative Index to all the issues in the Volume. The Volume Index for 2008 has not been included in this issue and can be found on the Committee's website:

http://www.scienceinparliament.org.uk - Publications, Science in Parliament

The first issue in the new Volume (No 66) will be published in February 2009, and will have a new look, in response to comments received during the membership survey conducted in May this year.

Euro-News

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

Monthly digests of European legislation, taken from the Official Journal of the European Communities, can be found on the website: www.scienceinparliament.org.uk. Please log in using the members' and subscribers' password (available from the Committee Secretariat) and go to Publications, Digests

Arctic sea ice in 2008 likely to reach second lowest level ever

This summer, the Arctic sea ice will probably not shrink below the record low observed in 2007. However, it is highly likely that there will be less ice than in 2005, the year with the second lowest sea ice extent ever measured. These predictions come from scientists on the EU-funded DAMOCLES ('Developing arctic modelling and observing capabilities for long-term environmental studies') project. The scientists' forecast is based on a specially designed computer model developed at the Alfred Wegener Institute (AWI) in Germany.

Arsenicosis from Drinking Water in Bangladesh

Researchers from Queen's University Belfast have developed a low-cost, eco-friendly and easy-to-use groundwater treatment technology that addresses the problem of widespread arsenic poisoning in southern Asia. The development came out of a project called TiPOT (Technology for in-situ treatment of groundwater for potable and irrigation purposes), which is part of the EU-funded Asia Pro Eco Programme.

A 2007 report estimated that over 70 million people in eastern India and Bangladesh are regularly exposed to high levels of arsenic in drinking water and staple agricultural products such as rice. Worldwide, an estimated 137 million people in 7 countries are affected.

TiPOT includes partners from India, Ireland, Germany, Spain and the Netherlands and is part of the EU's Asia Pro Eco Programme, which is dedicated in part to improving environmental performance in Asian economic sectors by exchanging technologies and practices. TiPOT seeks to improve vastly the quality of life and enterprise opportunities for the millions of marginalised people affected by arsenicosis.

EU funds heart project

The EU's Seventh Framework Programme (FP7) has awarded €14 million to a 4-year project, euHeart, for the improvement of the diagnosis, therapy and treatment of cardiovascular disease (CVD). The consortium comprises public and private partners from 16 research, academic, industrial and medical organisations from 6 European countries.

In the EU alone, CVD takes the lives of 1.9 million people annually and costs an estimated €105 billion in healthcare. Advances in the management of coronary heart disease and chronic heart failure are, therefore, seen as crucial to reducing the human cost and financial burden of CVD.

The euHeart consortium focuses on developing technologies for the diagnosis and treatment of heart conditions such as heart failure, coronary artery disease, heart rhythm disorders and congenital heart defects. Specifically, it aims to develop computer models of the heart on multiple scales, from the molecular level to that of the whole organ, that can be adapted to individual patients.

A person suffering from CVD could benefit from having a personalised computer model of their heart because it would address their own peculiarities. For example, the electrical activity in every patient's heart is subtly different; for certain conditions a computerised model reflecting the patient's unique heart structure and function would enable doctors to test the results of destroying different areas of tissue before they have to operate.

Multi-scale models have been used mainly in basic research, as the difficulty of adapting these models to individual human beings makes clinical applications impractical. To overcome this problem, the euHeart project intends to develop its models using novel information and communication technologies together with existing clinical data such as computed tomography (CT), magnetic resonance imaging (MRI) and ultrasound scans, as well as measurements of blood flow and blood pressure in the coronary arteries and electrocardiograms. Gene defects in individual patients could also be taken into account.

Pre-diagnosed conditions such as heart arrhythmias would likely be the first to benefit from advances in computer modelling of CVD. Heart failure, coronary artery disease and diseases of the heart valves and aorta would also be major clinical focus areas.

Creating the highly personalised tools proposed by the consortium is no small feat: the euHeart consortium brings together an incredible amount of expertise and talent from across the EU to make this mammoth task possible. Different parts of the programme are co-ordinated by Philips Research, King's College London and the University of Oxford; the consortium also includes participants in Germany, Spain, France and Belgium. The project is part of the Virtual Physiological Human (VPH) initiative, which aims to produce a unified computer model of the entire human body as a single complex system.

EU Scientific Risk Assessment Advisory Structure

On 5th September 2008 the European Commission adopted Decision 2008/721/EC establishing the new EU Scientific Risk Assessment Advisory Structure on matters related to consumer safety, public health, and the environment. Scientists who advise the Commission may influence the lives of millions by having their advice taken up in the drafting of new laws and regulations. The Advisory Structure is a place where cutting-edge science meets political and legislative power and serves directly the whole of our society. This also will bring about a deep sense of personal satisfaction and professional prestige to participating scientists. The call for expressions of interest will be open for applications between 29th September and 31st October 2008. More information about this opportunity and the application form are available at: http://ec.europa.eu/health/ph_risk/committees/call_expression_en.htm

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Public Policy
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The British Ecological Society
British Nutrition Foundation
British Society for Antimicrobial Chemotherapy
Economic and Social Research Council
The Engineering and Technology Board
HFEA
Institute of Biology
Institution of Civil Engineers
NESTA
Prospect

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

Quality Management
Campden-BRI (formerly CCFRA)
LGC
National Physical Laboratory

Radiation Hazards
Health Protection Agency
LGC

Retail
Marks and Spencer

Science Policy
ABPI
Academy of Medical Sciences
Biochemical Society
Biosciences Federation
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The British Ecological Society
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British Pharmacological Society
CABI
Clifton Scientific Trust
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LGC
Lilly
Medical Research Council
NESTA
National Physical Laboratory
Plymouth Marine Sciences Partnership
Prospect
Research Councils UK
Royal Academy of Engineering
Royal Institution
The Royal Society
Royal Society of Chemistry
Semta
STFC
UFAW

Seed Protection
CABI

Sensors and Transducers
AMSI
C-Tech Innovation
STFC

SSSIs
Kew Gardens
Natural England

Statistics
EPSRC
The Engineering and Technology Board
Royal Statistical Society

Surface Science
C-Tech Innovation
STFC

Sustainability
Biosciences Federation
The British Ecological Society
CABI
C-Tech Innovation
EPSRC
Institute of Biology
Institution of Chemical Engineers
Institution of Civil Engineers
London Metropolitan Polymer Centre
Natural England
Newcastle University
Plymouth Marine Sciences Partnership
SCI

Technology Transfer
CABI
Campden-BRI (formerly CCFRA)
C-Tech Innovation
LGC
London Metropolitan Polymer Centre
NESTA
National Physical Laboratory
Research Councils UK
Royal Society of Chemistry
STFC

Tropical Medicine
Health Protection Agency
Society for General Microbiology

Viruses
ABPI
Health Protection Agency
Society for General Microbiology

Water
AMSI
Campden-BRI (formerly CCFRA)
C-Tech Innovation
Freshwater Biological Association
Institute of Biology
Institution of Chemical Engineers
Institution of Civil Engineers
LGC
Plymouth Marine Sciences Partnership
Royal Society of Chemistry
SCI
Society for General Microbiology

Wildlife
Biosciences Federation
The British Ecological Society
Institute of Biology
Natural England
Natural History Museum
UFAW

Research Councils UK

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Communications Manager
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Website: www.rcuk.ac.uk

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

Contact: Jake Gilmore
Communications Manager
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E-mail: enquiries@ahrc.ac.uk
Website: www.ahrc.ac.uk

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

Biotechnology and Biological Sciences Research Council

Contact: Dr Monica Winstanley
Head of External Relations
BBSRC, Polaris House, North Star Avenue
Swindon SN2 1UH. Tel: 01793 413204
E-mail: external.relations@bbsrc.ac.uk
Website: www.bbsrc.ac.uk

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

Economic and Social Research Council

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lesley.lilley@esrc.ac.uk
http://www.esrc.ac.uk

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

EPSRC

Engineering and Physical Sciences Research Council

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Public Affairs Manager,
EPSRC, Polaris House,
North Star Avenue, Swindon SN2 1ET
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E-mail: jenny.whitehouse@epsrc.ac.uk
Website:www.epsrc.ac.uk

EPSRC is the main government agency for funding research and training in engineering and physical sciences, investing around £740 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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20 Park Crescent, London W1B 1AL.
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simon.wilde@headoffice.mrc.ac.uk
Website: www.mrc.ac.uk

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

Natural Environment Research Council

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Swindon SN2 1EU
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E-mail: requests@nerc.ac.uk
Website: www.nerc.ac.uk

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

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

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

Science & Technology Facilities Council

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STFC
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E-mail: mark.foster@stfc.ac.uk
Website: www.stfc.ac.uk

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

Association of the British Pharmaceutical Industry

Contact: Dr Philip Wright
Director of Science & Technology
12 Whitehall, London SW1A 2DY
Tel: 020 7747 1408
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E-mail: pwright@abpi.org.uk
Website: www.abpi.org.uk

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

The ABPI's mission is to represent the pharmaceutical industry operating in the UK in a way that:

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

Association of Marine Scientific Industries

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Association of Marine Scientific Industries
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London EC2R 8AY
Tel: 020 7628 2555 Fax: 020 7638 4376
E-mail: amsi@maritimeindustries.org
Website: www.maritimeindustries.org

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

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

The Academy of Medical Sciences

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Website: www.acmedsci.ac.uk

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

AIRTO

Contact: Professor Richard Brook
AIRTO Ltd: Association of Independent Research & Technology Organisations Limited
c/o CCFRA, Station Road, Chipping Campden, Gloucestershire GL55 6LD.
Tel: 01386 842247
Fax: 01386 842010
E-mail: airto@campden.co.uk
Website: www.airto.co.uk

AIRTO represents the UK's independent research and technology sector - member organisations employ a combined staff of over 20,000 scientists and engineers with a turnover in the region of £1.5 billion. Work carried out by members includes research, consultancy, training and global information monitoring. AIRTO promotes their work by building closer links between members and industry, academia, UK government agencies and the European Union.

Biochemical Society

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Chief Executive,
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Email: chris.kirk@biochemistry.org
Website: www.biochemistry.org

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

BIOSCIENCES FEDERATION

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Biosciences Federation
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Fax: 01223 246858
E-mail: rdyer.bsf@physoc.org
Website: www.bsf.ac.uk

The Biosciences Federation is a single authority representing the UK's biological expertise. The BSF directly represents 51 bioscience organisations, and contributes to the development of policy and strategy in biology-based research – including funding and the interface with other disciplines – and in school and university teaching by providing independent opinion to government.

British Association for the Advancement of Science - the BA

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

The BA (British Association for the Advancement of Science) exists to advance the public understanding, accessibility and accountability of the sciences and engineering. The BA aims to promote openness about science in society and to engage and inspire people directly with science and technology and their implications.

Established in 1831, the BA is a registered charity which organises major initiatives across the UK, including the annual BA Festival of Science, National Science and Engineering Week, programmes of regional and local events, and the CREST programme for young people in schools and colleges.

The British Ecological Society

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

The British Ecological Society's mission is to advance ecology and make it count. The Society has 4,000 members worldwide. The BES publishes four internationally renowned scientific journals and organises the largest scientific meeting for ecologists in Europe. Through its grants, the BES also supports ecologists in developing countries and the provision of fieldwork in Schools. The BES informs and advises Parliament and Government on ecological issues and welcomes requests for assistance from parliamentarians.

British Nutrition Foundation

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Email: c.price@nutrition.org.uk
Website: www.nutrition.org.uk

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

BRITISH PHARMACOLOGICAL SOCIETY

Today's science, tomorrow's medicines

Contact: Kate Baillie
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Fax: 020 7417 0114
Email: kb@bps.ac.uk
Website: www.bps.ac.uk

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

Contact: Dr Ana Padilla
Parliamentary Officer
The British Psychological Society
30 Tabernacle Street
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Fax: 020 7330 0896
Email: ana.padilla@bps.org.uk
Website: www.bps.org.uk

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

British Society for Antimicrobial Chemotherapy

Contact: Tracey Guest, Executive Officer
British Society for Antimicrobial Chemotherapy
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Tel: 0121 633 0410
Fax: 0121 643 9497
E-mail: tguest@bsac.org.uk
Website: www.bsac.org.uk

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

BVA British Veterinary Association

British Veterinary Association

Contact:Chrissie Nicholls
7 Mansfield Street, London W1G 9NQ
Tel: 020 7908 6340
E-mail:chrissien@bva.co.uk
www.bva.co.uk

BVA's chief interests are:

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

BVA carries out three main functions which are:

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

CABI

www.cabi.org

Contact: Dr Joan Kelley,
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Website: www.cabi.org

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.

Campden & Chorleywood Food Research Association

Contact: Prof Colin Dennis, Director-General
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Gloucestershire GL55 6LD.
Tel: 01386 842000 Fax: 01386 842100
E-mail: info@campden.co.uk
Website: www.campden.co.uk

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

Cavendish Laboratory

UNIVERSITY OF CAMBRIDGE

The Administrative Secretary, The Cavendish Laboratory,
J J Thomson Avenue, Cambridge CB3 0HE, UK.
E-mail: dhp24@cam.ac.uk
http://www.phy.cam.ac.uk

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

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

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

High Energy Physics: LHC experiments. Detector development. Particle physics theory.

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

Chartered Institute of Patent Attorneys

Founded 1882 Royal Charter 1891

Contact: Michael Ralph -
Secretary & Registrar
The Chartered Institute of Patent Attorneys
95 Chancery Lane, London WC2A 1DT
Tel: 020 7405 9450
Fax: 020 7430 0471
E-mail: michael.ralph@cipa.org.uk
Website: www.cipa.org.uk

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

Clifton Scientific Trust

CLIFTON SCIENTIFIC Trust

Contact: Dr Eric Albone
Clifton Scientific Trust
49 Northumberland Road, Bristol BS6 7BA
Tel: 0117 924 7664 Fax: 0117 924 7664
E-mail: eric.albone@clifton-scientific.org
Website: www.clifton-scientific.org

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

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

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

Clifton Scientific Trust Ltd is registered charity 1086933

C-Tech Innovation Limited

Contact: Paul Radage
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Fax: +44 (0) 151 347 2901
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Website: www.ctechinnovation.com

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

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

The Engineering and Technology Board

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

The Engineering and Technology Board (ETB) is an independent organisation that promotes the vital role of engineers, engineering and technology in our society. The ETB partners business and industry, Government and the wider 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.

Freshwater Biological Association

Contact: Dr Michael Dobson, Director.
Freshwater Biological Association, The
Ferry Landing, Far Sawrey, Ambleside,
Cumbria, LA22 0LP, UK.
Tel: 01539 442468 Fax: 01539 446914
www.fba.org.uk info@fba.org.uk
Registered Charity Number : 214440

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

Health Protection Agency

Contact: Justin McCracken, Chief Executive
Health Protection Agency Central Office
7th Floor, Holborn Gate, 330 High Holborn
London WC1V 7PP
Tel: 020 7759 2700/2701
Fax: 020 7759 2733
Email: webteam@hpa.org.uk
Web: www.hpa.org.uk

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

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

Human Fertilisation and Embryology Authority

Contact: Tim Whitaker
21 Bloomsbury St
London WC1B 3HF
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Fax: 020 7291 8201
Email: tim.whitaker@hfea.gov.uk
Website: www.hfea.gov.uk

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

Institute of Biology

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Website: www.iob.org

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

IOP Institute of Physics

Contact: Public Relations Department
76 Portland Place, London W1B 1NT
Tel: 020 7470 4800
E-mail: public.relations@iop.org
Website: www.iop.org

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

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

Institute of Physics and Engineering in Medicine

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E-mail: r.w.neilson@ipem.ac.uk
Website: www.ipem.ac.uk

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

IChemE

Institution of Chemical Engineers

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

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f: +44 (0)1788 560833
e: afurlong@icheme.org
www.icheme.org

Institution of Civil Engineers

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Website: www.ice.org.uk

ICE aims to be a leading voice in infrastructure issues. With over 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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Institution of Engineering and Technology
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E-mail: mdonovan@theiet.org.
Website: www.theiet.org

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

KEW GARDENS

PLANTS PEOPLE POSSIBILITIES

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

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

Contact: Prof Simon J. Owens
Tel: 020 8332 5106
Fax: 020 8332 5109
Email: s.owens@kew.org
Website: www.kew.org
Two stunning gardens-devoted to building and sharing knowledge

LGC

Setting standards in analytical science

Queens Road, Teddington
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E-mail: info@lgc.co.uk
Website: www.lgc.co.uk

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 21 laboratories and centres across Europe and in India..

London Metropolitan Polymer Centre

Sir John Cass Department of Art, Media & Design

Contact: Alison Green,
London Metropolitan University
166-220 Holloway Road, London N7 8DB
Tel: 020 7133 2189
E-mail: alison@polymers.org.uk
Website: www.polymers.org.uk

The London Metropolitan Polymer Centre provides training, consultancy and applied research to the UK polymer (plastics & rubber) industry. Recently, LMPC has merged with the Sir John Cass Department of Art, Media & Design (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.

Lilly and Company Limited

Answers That Matter.

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Managing Director,
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E-mail:k.briner@lilly.com
Website:www.lilly.com or www.lilly.co.uk

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

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

Marks & Spencer Plc

Contact:
David Gregory
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35 North Wharf Road
London W2 1NW.

Tel: 020 8718 8247
E-mail: david.gregory@marks-and-spencer.com

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

We have over 620 UK stores, employing over 75,000 people - 278 stores internationally in 39 countries.

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

Merck Sharp & Dohme Research Laboratories

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Licensing & External Research, Europe
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Herts EN11 9BU
Tel: 01992 452838
Fax: 01992 441907
e-mail: tim_sparey@merck.com
www.merck.com

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

The National Endowment for Science, Technology and the Arts

NESTA Making Innovation Flourish

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Email: nicholas.bojas@nesta.org.uk
Website: www.nesta.org.uk

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

National Physical Laboratory

National Physical Laboratory
Hampton Road, Teddington
Middlesex TW11 0LW
Tel: 020 8943 6880 Fax: 020 8614 1446
E-mail: enquiry@npl.co.uk
Website: www.npl.co.uk

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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Fax: 01733 568834
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Website: www.naturalengland.org.uk

Natural England has the responsibility to enhance biodiversity, landscape and wildlife in rural, urban, coastal and marine areas; promote access, recreation and public well-being, and contribute to the way natural resources are managed so that they can be enjoyed now and by future generations.

Natural History Museum

Contact: Joe Baker
External Relations Manager
Natural History Museum
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E-mail: joe.baker@nhm.ac.uk
Website: www.nhm.ac.uk

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

Newcastle University

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E-mail: business@ncl.ac.uk
Website: www.ncl.ac.uk

Newcastle University has a well-balanced portfolio of research funding with a significant portfolio of FP7 EU activity with more than 50 projects involving some 500 partners. A member of the Russell Group, Newcastle University is committed to 'excellence with a purpose' - a commitment it is taking further through the development of Newcastle Science City and as a partner in the N8 group of Northern research-intensive universities.

The Nutrition Society

Contact: Frederick Wentworth-Bowyer,
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Fax: +44 (0)20 7602 1756
Email: f.wentworth-bowyer@nutsoc.org.uk

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

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Website: www.pharmaq.no
http://www.pharmaq.co.uk/shop

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

Plymouth Marine Sciences Partnership

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Fax: +44 (0)1752 633 102
E-mail: forinfo@pmsp.org.uk
Website: www.pmsp.org.uk

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.

Prospect

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Prospect Head of Research and Specialist Services, New Prospect House
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www.prospect.org.uk

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

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

The Royal Academy of Engineering

Contact: Philip Greenish CBE,
Chief Executive
3 Carlton House Terrace
London SW1Y 5DG
Tel: 020 7766 0600
E-mail: philip.greenish@raeng.org.uk
Website: www.raeng.org.uk

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

The Royal Institution

The Royal Institution of Great Britain

Contact: Dr Gail Cardew
Head of Programmes
The Royal Institution
21 Albemarle Street, London W1S 4BS
Tel: 020 7409 2992 Fax: 020 7670 2920
E-mail: gail@ri.ac.uk Website: 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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Website: www.royalsociety.org

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

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

RSC | Advancing the Chemical Sciences
The Royal Society of Chemistry

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Parliamentary Affairs
The Royal Society of Chemistry
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E-Mail: benns@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

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Fax: +44 20 7614 3905
E-mail: a.garratt@rss.org.uk
Website: www.rss.org.uk

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

semta

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Website: www.semta.org.uk

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

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

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

society for general Microbiology

Contact: Dr Faye Stokes
Marlborough House, Basingstoke Road,
Spencers Wood, Reading RG7 1AG.
Tel: 0118 988 1830 Fax: 0118 988 5656
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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 Chemical Industry

SCI where science meets business

Contact: Andrew Ladds,
Chief Executive
SCI International Headquarters
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Tel: 020 7598 1500 Fax: 020 7598 1545
E-mail: secretariat@soci.org
Website: www.soci.org

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

Society of Cosmetic Scientists

FOUNDED 1948 SCS SOCIETY OF COSMETIC SCIENTISTS

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Secretary General
Society of Cosmetic Scientists
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Fax: 01582 405217
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Website: www.scs.org.uk

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

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

Universities Federation for Animal Welfare

UFAW Established 1926

Contact: Dr James Kirkwood,
Scientific Director
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Email: ufaw@ufaw.org.uk
Website: www.ufaw.org.uk
Registered Charity No: 207996

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

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

Science Diary

The Parliamentary and Scientific Committee

Contact: Annabel Lloyd
020 7222 7085:
lloyda@pandsctte.demon.co.uk
www.scienceinparliament.org.uk

Tuesday 21 October 17.30
Nuclear Waste – What to do with it?
Speakers: Richard Waite, Radioactive Waste Management Directorate, Nuclear Decommissioning Authority

Dr Peter Bleasdale, Managing Director, National Nuclear Laboratory, British Nuclear Fuels plc

Tuesday 18 November 17.30
Food Security – Is it Achievable?
Speakers: Professor Colin Dennis, Director General, Campden and Chorleywood Food Research Association Group

Professor Chris Lamb FRS, Director, John Innes Centre

Tuesday 9 December 17.30
Why Does Public Health Matter?
Speakers: Dr Rosalind Stanwell-Smith, Hon Senior Lecturer, London School of Hygiene and Tropical Medicine

Professor Lord Krebs Kt FRS, Nuffield Council on Bioethics

Sir William Stewart FRS, Chairman, Health Protection Agency

Tuesday 20 January 2009 17.30
Have we Passed Peak Oil Yet?
Speakers: Dr Steven Koonin, Chief Scientist, BP

Steven Sorrell, Senior Fellow, Sussex Energy Group, Science & Technology Policy Research, University of Sussex

The Royal Institution

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

Saturday 1 November, drop in between 10.00 and 16.00
Family fun day

Monday 3 November 19.00
The fiction lab

Tuesday 4 November 19.00-20.30
The making of Mr Gray's Anatomy
Ruth Richardson

Monday 10 November 19.00-20.30
The brain, consciousness and controversies
Baroness Susan Greenfield and Prof Christof Koch

Wednesday 12 November 19.00-20.30
The matter of the heart
Dr Susie Whiten

Wednesday 19 November 19.00-21.00
The science of scent: a feast for the nose
Will Andrews

Tuesday 25 November 19.00
The forum
Baroness Susan Greenfield

Thursday 27 November 19.00-20.30
Surgical search – maze or game?
Prof Ara Darzi

Monday 12 January 19.00
The fiction lab

Thursday 15 January 19.00-20.30
Cancer therapy from within
Mathew Kallumadil and Prof Quentin Pankhurst

Monday 19 January 19.00-20.30
The age of wonder
Richard Holmes

Wednesday 21 January 19.00-20.30
An evening with Carol Vorderman
Baroness Susan Greenfield and Carol Vorderman

Tuesday 27 January 19.00-20.30
Superstition: belief in the age of science
Prof Robert Park

Thursday 29 January 19.00-20.30
Ice, mud and blood
Chris Turney

The Royal Society

The Royal Society runs a series of events, both evening lectures and two day discussion meetings, on topics covering the whole breadth of science, engineering and technology. All the events are free to attend and open to all.

Highlights in the next few months include:

Monday 17 and Tuesday 18 November (all day)
Towards a low carbon energy future

Tuesday 25 November 18.30
Mapping memory: the brains behind remembering
Professor Eleanor Maguire
Royal Society Rosalind Franklin Award 2008

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

The Royal Academy of Engineering

3 Carlton House Terrace
London SW1Y 5DG

www.raeng.org.uk/events or events@raeng.org.uk

020 7766 0600

The BA

Please see www.the-ba.net for information.

Royal Society of Edinburgh

22-26 George Street
Edinburgh EH2 2PQ.

Tel: 0131 240 5000
Fax: 0131 240 5024
events@royalsoced.org.uk
www.royalsoced.org.uk
All events require registration and, unless otherwise indicated, take place at the RSE.

Monday 24 November 18.00
Regenerative Medicine: How will it change my life?
Public Discussion Forum

Tuesday 25 November - Full Day
James Clerk Maxwell Conference

Monday 1 December 18.00
Our Genetic Inheritance - for Better or for Worse, in Sickness and in Health
Professor David Porteous FRSE

Tuesday 17 February 18.00
ECRR Peter Wilson Lecture
Professor John Beddington CMG FRS

Thursday 26 February 18.00
Alcohol our Favourite Drug: from Chemistry to Culture
Public Discussion Forum

Friday 27 February - Full Day
Alcohol our Favourite Drug: from Chemistry to Culture Conference

Royal Pharmaceutical Society of Great Britain

Contact: events@rpsgb.org
www.rpsgb.org/events
Unless otherwise stated events are held at the Royal Pharmaceutical Society of Great Britain, London

Monday 10 November 09.55-16.30
Equipping our Students for a Changing Profession
A joint symposium of the Academy of Pharmaceutical Sciences and the Royal Pharmaceutical Society of Great Britain.

Monday 24 – Wednesday 26 November
Tabletting Technology for the Pharmaceutical Industry
A 2½-day residential course organised by the Royal Pharmaceutical Society of Great Britain in partnership with the Academy of Pharmaceutical Sciences

Held at the Moller Centre, Cambridge.

Tuesday 2 December 09.30–17.30
The current state of dissolution testing
A one-day symposium by the Joint Pharmaceutical Analysis Group.

Wednesday 2 February
The Development of Veterinary Medicines
A joint symposium of the Academy of Pharmaceutical Sciences, the Royal Pharmaceutical Society of Great Britain and the Veterinary Pharmacists Group.

Monday 9 – Wednesday 11 February
Stability Testing of Pharmaceuticals
A Three-day course organised by the Royal Pharmaceutical Society of Great Britain in partnership with the Academy of Pharmaceutical Sciences

Held at the Moller Centre, Cambridge.

Visit our website www.scienceinparliament.org.uk

- Full details of Parliamentary and Scientific Committee events
- Current and previous issues of Science in Parliament
- 2008 Volume Index
- Digests of Debates and Parliamentary Questions at Westminster and of European Legislation

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The Academy of Medical Sciences

The Academy of Medical Sciences 10 1998-2008 Research at the heart of health

Celebrating our first decade

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

The Academy is the independent body in the United Kingdom which represents the whole spectrum of academic medicine through its 910 Fellows from across the UK.

Since our establishment in 1998 we have played a pivotal role in determining the future of medical science. Our portfolio of working group reports, consultation responses, symposia documents and discussion papers has established the Academy as a unique resource for independent, expert advice on medical science policy and career developments.

A new home for the Academy

We are delighted to announce that, following a merger with the Novartis Foundation, the Academy will be opening its new headquarters at 41 Portland Place in 2010 on completion of a major refurbishment.

Our vision is to create an independent, professional headquarters for the Academy in the heart of medical London that will provide a focal point for the UK's medical science community.

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