Summer 2005

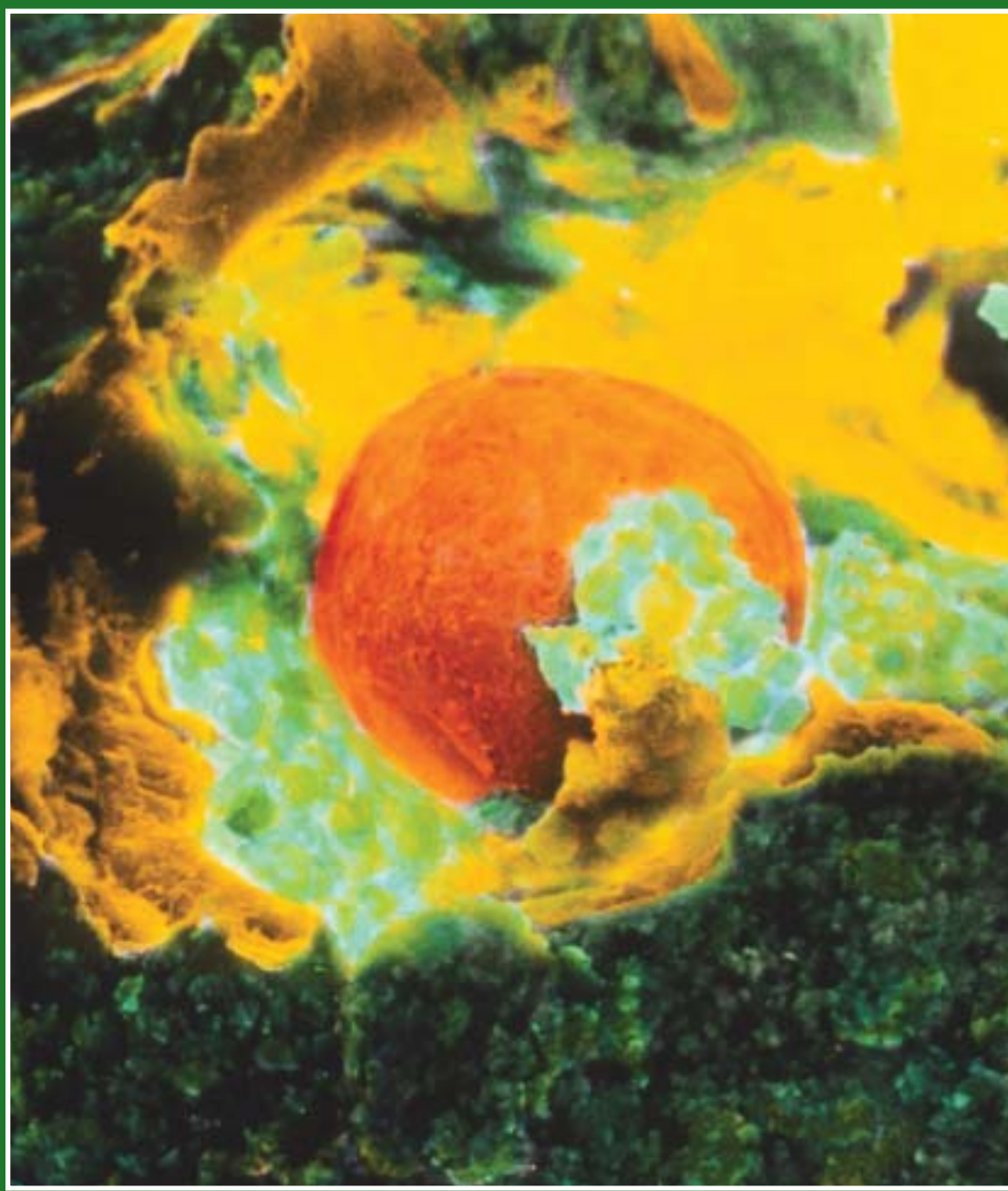
SCIENCE IN PARLIAMENT

Science Advice

Human Ageing

Nuclear Option

Charities



Society for Endocrinology
One Hundred Years of Hormones

The Journal of the Parliamentary and Scientific Committee http://www.scienceinparliament.org.uk

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

Hilary Benn uses science and technology to fight world poverty. Peter Saunders' British Science has been saved but we still need to Campaign for Science and Engineering. John Holman's science education is essential to the UK. Roy Anderson delivers advice on defence, science and technology to the MOD. John Beddington supports Defra's CSA with independent, expert, strategic advice. Donald Braben claims dissent is stifled by bureaucracy which is inimical to new science. Tom Kirkwood's life expectancy increases relentlessly although restrained by free radicals. Ageing in John Lever's proteins, collagen and elastin, leads to changes in cardiovascular and skeletal systems. Reynold Greenlaw's special glasses designed for those suffering from Parkinson's disease, enable them to walk more easily. Alec Broers responds with a definitive "yes" to the need for the nuclear energy option. Donald Miller's balanced energy policy provides a nuclear new build checklist with four points for early action. Ann McCall's technically viable phased geological nuclear waste repository awaits a decision to start. Godfrey Boyle argues for a non-nuclear future as in Germany, although this is closely integrated with French nuclear power. Tom Parkhill celebrates the centenary of Ernest Starling's discovery of chemical messengers or hormones. Failure of structural steelwork in the World Trade Center collapse contrasts with the ability of concrete to withstand intense fires. Lloyd Anderson's British Council Science hub networks with the global knowledge economy. Robert Freer compares the opinions of MPs and the public on nuclear power. Lawrie Haynes' nuclear cleanup supports the case for new nuclear build. Keith Lawrey checks out the Charities Bill.

Dr Douglas Naysmith MP
Chairman, Editorial Board,
Science in Parliament

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Front cover photo: Coloured SEM showing the ovulation process, Prof. P. Motta, Department of Anatomy, University "La Sapienza", Rome/SPL

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Science and International Development: Working together in the fight against poverty

The Rt Hon Hilary Benn MP, Secretary of State for International Development

2005 is an important year for the UK and for the world. It is the year in which the UK has chosen to make Africa and climate change the two priorities for its Presidencies of the G8 and the EU. It is the year in which we all have a unique opportunity to take decisions that could make poverty history.

Science and technology are an essential part of our fight against world poverty. For centuries we have seen new vaccines, medicines and new crops transforming peoples' lives. Achieving the Millennium Development Goals is, I believe, the greatest moral challenge faced by our generation; science and technology is one of our greatest assets in trying to do so. As John Smith said in 1993, we now need to "seize the opportunities which a modern world makes available".

In doing this we very much welcome the support, and scrutiny of Parliamentarians. The House of Commons Science and Technology Select Committee has played a particularly important role and their recent report, while recognising the high quality of much of our work, called on DFID to place a greater emphasis on the part science can play in international development.

We agreed with much the Committee had to say. We have already responded positively. We are, for example, increasing our central research budget by 58%, from £86 million last year to £136 million by 2007-08. Earlier this year we created a new senior post of Chief Scientific Adviser within DFID, to which we have appointed Professor Sir Gordon Conway. Sir Gordon has already made a valuable contribution to the Department and is now in the process of developing DFID's science and innovation strategy.

To illustrate the impact science can have on real peoples' lives, take this example. DFID-funded research in Zambia showed that when HIV-positive children were treated with an antibiotic called co-trimoxazole to avert some of the infections they were susceptible to, the anticipated death rate fell by 43%. In fact, the decline in the number of children who needed treatment was so dramatic the trial was stopped early to focus on this success. This research has led to important changes in policy and key organisations such as WHO and UNICEF are now spreading the word about the benefits of co-trimoxazole.

But, with the support of the international community, I believe scientists and policy makers in developing countries can make a still greater impact on peoples' lives. To do so they need to join forces even more closely and there are four main areas where I believe action is needed to make this happen:

Capacity – Developing countries need the local capacity to undertake, and to use, science and research. They also need the capacity to be "intelligent customers" of science and technology, able to make informed choices about the role that science and technology should play in their development.

Evidence – This Government is committed to an evidence-based approach to policy making. Evidence-based policy development should be an integral part of good governance in developing countries too. And this cannot happen if they do not have access to the evidence that science, and the scientific process, can bring to the table.

Affordability – Science and research should deliver practical, affordable and locally acceptable solutions. This is essential if the products of research are to be adopted and incorporated into policy and practice.

Partnerships – Governments cannot tackle poverty on their own. For science to really make the contribution it can, developing countries need to encourage and promote partnerships between scientists and policy makers; partnerships that include both the public and private sectors; and, most importantly, partnerships that include poor people.

Both the Commission for Africa report "Our Common Interest" and the report of the UN Secretary General for the Millennium Review Summit "In Larger Freedom" rightly stress the importance of science and technology in addressing the Millennium Development Goals. We agree with their conclusions. Through our combined efforts, we can end hunger and halt the spread of HIV.

The global community will be reviewing progress towards the Millennium Development Goals in September. Despite some important steps forward, we know already that we will have to do much better to have any chance of meeting the Goals by 2015. And we are increasingly recognising that this also means making ever better use of science and research.

Has British Science been Saved?

Professor Peter Saunders, Honorary Secretary, CaSE.

Save British Science, the pressure group whose aim is to improve the scientific health of the UK, has just changed its name. We are now calling ourselves the Campaign for Science and Engineering, though a formal change will occur only if it is agreed at our next AGM.

As you can imagine, there has been quite a lot of comment about this. Above all, many people have been asking us whether we now think that British science really has been saved. And, if it has, do we still need an organisation like SBS – or CaSE as we now have to get used to saying?

The answer to both questions is "yes", though, as a philosopher might put it, a lot depends on what you mean by the word "saved". SBS was founded in 1985 at a time when things were very bad for science in the UK. Basic science funding had been declining for many years, with an estimated deficit of 19 per cent for 1984-5 compared with 1977-8. And this at a time when we were enjoying large revenues from North Sea oil, an industry based on the application of basic science, and when other countries were increasing their expenditure on science and engineering.

In desperation, a small group of scientists decided to place an ad in the *Times*, putting the case for more funding for science. This led to an invitation from Sir Keith Joseph (as he then was), the Secretary of State for Education and Science. Sir Keith politely explained that scientists had to understand that the UK was not a wealthy country and couldn't afford more funding for science until we were better off. Like many others in positions of power and influence at that time, he did not see expenditure on science as an investment that would make a major contribution to the economy.

It was clear that there was a lot to be done if British science was to be saved, and so SBS turned itself into a permanent pressure group with Joe Lamb, John Mulvey and Denis Noble as the key players. Gradually, things started to improve, and while there were obviously many reasons for this, observers agree that SBS played a significant part. The first clear sign that things were changing was the appointment in 1992 of William (now Lord) Waldegrave as the first Minister of Science for 30 years. The decline in science funding slowed, and then was sharply reversed in the Comprehensive Spending Reviews following the election of the present Government in 1997.

Things are a lot different now from what they were when SBS began. Science funding has been greatly increased, and science and engineering now have a much higher profile both within government and beyond: in the media, for example. Their importance to the economy is widely recognised, and we cannot imagine any future government, of whatever political persuasion, returning to the policies of the 80s. So we can indeed say that British science has been saved.

But being saved and being in robust health are not the same thing. Serious problems remain, some on account of the years of neglect, and some with deeper roots. For the recent general election we produced a document entitled *Science Policy Agenda: 2005-2010*. It ends with a long list of recommendations, backed up by detailed evidence from the UK and abroad. Clearly, there is still a lot for CaSE to do.

Finally, what about the name? To be honest, we'd grown attached to it over the years, and it also had gained wide recognition: when we mentioned SBS we didn't have to explain what we meant. So we weren't at all keen to change.

But people kept asking us when we were going to, and eventually we realised that the name had some real disadvantages. It made British scientists appear ungrateful, as if they hadn't noticed all that has been done to improve the situation. And while our friends understood how SBS had evolved, it was giving the wrong impression to people who knew us less well. We sounded as if we were still trying to fight the battles of the 1980s, instead of facing the challenges of the new century.

That's why we decided the time had come to change the name. CaSE doesn't have the associations of SBS and it will take a while for people to get to recognise it. But it describes more accurately what we are now and what we are doing. The original aim of SBS was to catch the attention of government. Now that's been done, our task is to make the most of the opportunity on behalf of British scientists – and the UK as a whole.

Copies of *Science Policy Agenda: 2005-2010* are available free of charge from CaSE, 29 Tavistock Square, London WC1H 9QU.

New Chairman of the Parliamentary and Scientific Committee

I am proud and very pleased to have been elected as Chairman of the Parliamentary and Scientific Committee.

Richard Page, my immediate predecessor, has sensitively and diligently ensured that the Committee has maintained its strong reputation in both Houses. He has also presided over an excellent and topical programme while focusing our attention on keeping the Committee's procedures up to date.

Our previous Chairman's presence is also still to be felt. Ian Gibson skilfully used the Committee, and subsequently the House of Commons Select Committee on Science and Technology, to raise the profile of science in parliament. Certainly he has had the most marked effect of any politician with a scientific background in doing this since 1997. It will undoubtedly be a difficult task to follow these two.

Throughout my life, politics and science have been the two interests which have had most influence on me. Although at various times one rather than the other has dominated in terms of importance, and the need to earn a living (as a professional biologist), both have been a source of virtually endless interest and excitement. Although at various times one rather than the other has dominated in terms of importance, and the need to earn a living (as a professional biologist), both have been a source of virtually endless interest and excitement.

Doug Naysmith with Chemistry students on the House of Commons Terrace

I have usually tried to employ the rational, evidence-based approach which is essential to the scientific method to underpin my politics – not always successfully. Nevertheless, I believe it is essential to continue to try.

So in many ways, to become Chairman of the Parliamentary and Scientific Committee - the oldest all-party group in Parliament with the aim of bringing together scientists, parliamentarians, and representatives of many science-based industries – provides an ideal position from which to encourage rational, knowledge-based debate and discussion about many of the most important decisions we face.

As a Parliament, our record on discussions involving scientific subjects is quite mixed. On the one hand (reflecting unfortunately the way our media often handle scientific subjects) some of our debates on genetically modified materials of various sorts such as GM foods have been frankly appalling – although the Government to its credit has steadily maintained a quiet but firmly evidence-based approach. On the other hand we have had some first class debates on stem cells which have resulted in some of the best legislation on this subject in the world.

Clearly there is, as yet, much to do to ensure that parliamentarians are well informed and understand the needs of both scientists and the many enterprises which nowadays have a scientific basis. The Parliamentary and Scientific Committee – and this journal – will continue to play an essential role in that process.

Election of Officers

The following were elected at the AGM on 23rd May
President: The Lord Soulsby of Swaffham Prior
Chairman: Dr Douglas Naysmith MP
Deputy Chairmen: Dr Desmond Turner MP Mr Robert Key MP
Hon Treasurer: Dr Brian Iddon MP
Hon Secretaries: Dr Evan Harris MP Mr James Paice MP

New Members

Following the General Election we are delighted to welcome as new members of the Committee Ian Austin MP, David Davies MP, Robert Flello MP, Mrs Helen Goodman MP, Robert Goodwill MP, Michael Gove MP, David Jones MP, Ed Miliband MP, Andrew Pelling MP, Paul Rowen MP, Ed Vaizey MP and Stephen Williams MP.

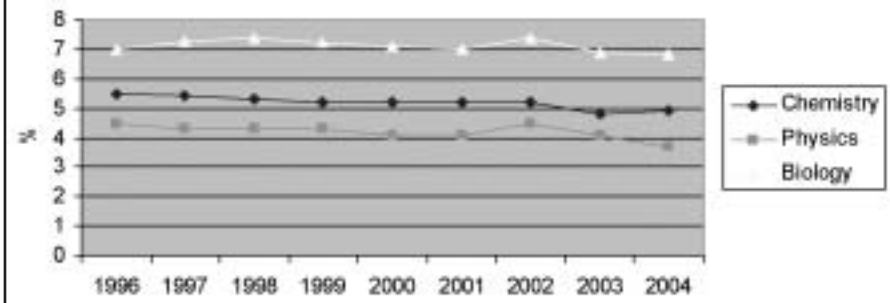
Science Education and the Science Learning Centres

John Holman, Director, National Science Learning Centre

Good science education is essential to the economic and social wellbeing of the UK. Ian Gibson, Chair of the Commons Science and Technology committee, said: "Graduates in science, engineering and technology are at the heart of our political and economic agenda. We need them to drive innovative R&D, support financial services, underpin policy-making and we need teachers to inspire future generations of scientists."[1] But it is not only for the future scientific elite that good science education is needed. As Lord May, President of the Royal Society, has said: "Today, as the frontiers of scientific understanding continue to expand, reaching down into the molecular machinery by which living things assemble themselves, it is ever more important to have a scientifically informed citizenry."[2]

Thus science teachers have what Lord Jenkin of Roding has called a "dual mandate" to inspire and prepare both a new generation of scientists and a new generation of citizens for life in a world dominated by the effects of science and technology.

Chart 2: Science A-Level entries as a percentage of the total entry

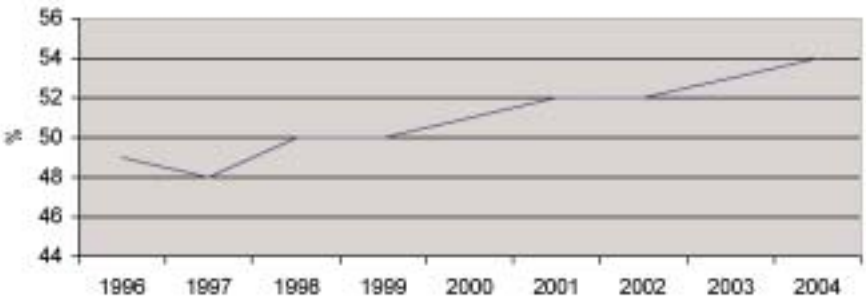


The state of science education

Nationally available data tells a contrasting story about pupils' achievements in science. Attainment in science in primary and secondary schools has risen steadily over the past 9 years (chart 1). Yet over the same period, participation in science past the age of 16 has fallen (chart 2).

Paradoxically, while pupils are achieving better and better results in science, when given a chance to choose whether to continue their study of science, less of them are doing so.

Chart 1: Percentage of pupils achieving grades A* - C in Double Science GCSE



What do students think?

An international comparative study based at the University of Oslo asked English school students about their views on science education. Some results are highlighted in the table.

On the whole, students believe science is important in their lives and for their future careers, and that everyone should study it. They do not find science excessively difficult, and many find it interesting, but students do not see themselves becoming scientists – and they do not enjoy science as much as other subjects.

This international study draws on results from 22 countries. Amongst these, despite their widely varying curricula, the developed countries share the English experience that science is less popular than other subjects. In developing countries, however, students' attitudes to science are much more positive: this suggests that there are strong social and economic factors at work, and that only part of the solution is to be found through actions in schools. Nevertheless, the low enjoyment rating of science lessons pinpoints a problem in schools.

Students' responses to statements about science in school (1277 students, most aged 14–15)[3]

Statement offered to student	Disagree %	Low disagree %	Low agree %	Agree %
School science is a difficult subject	25	34	28	14
School science is interesting	16	23	38	23
I like school science better than most other subjects	43	25	20	11
I think everybody should learn science at school	17	15	28	40
The things that I learn in science at school will be helpful in my everyday life	16	24	36	25
I think that the science I learn at school will help my career chances	14	19	34	33
I would like to become a scientist	58	21	13	8

The Science Learning Centres

Addressing the declining interest in science was the prime motivation behind the Science Learning Centres initiative, which was foreshadowed in the Labour Party manifesto in 2001 and taken forward in Sir Gareth Roberts' report *Set for Success*. This £51 million joint Wellcome Trust/DfES initiative has established a network of Science Learning Centres to provide high quality professional development for science teachers and technicians.

The central assertion behind the initiative is that inspired teachers are needed to inspire students. Scientific knowledge grows ever faster and the subject knowledge of a science teacher who graduated even five years ago can be seriously out of date. Furthermore, teaching methods advance in response to new technology and the changing curriculum, and teachers need to keep in touch with new techniques. This is particularly true if science teachers are to deal with the controversial issues surrounding science – issues relating to stem cell research or climate change, for example.

The nine Regional Science Learning Centres for England, funded by the DfES, are now open and offering a rich range of courses and professional development opportunities in areas ranging from contemporary science to new teaching techniques. The National Science Learning Centre opens in November in an £11 million purpose-built centre on the campus of the University of York, funded by the Wellcome Trust. Wellcome are investing a total of £25 million in the building and operation of the National Science Learning Centre, the largest single investment they have ever made in public engagement. This residential centre will have outstanding facilities dedicated to science teachers and is unique in the world. The teachers who attend the National Science Learning Centre will be able not only to update their subject knowledge and teaching skills but also to have a uniquely high quality professional experience in the company of fellow professionals with whom they have time to reflect and share good practice. We aim to build a cadre of teachers who have attended courses at the National Science Learning Centre and who can become the present and future leaders in their subject.

Complementing other initiatives

The Science Learning Centres stand alongside other government initiatives to improve education, in particular the National Secondary Strategy, with its remit for core subjects including Science. While the National Secondary Strategy focuses strongly on the standards-raising agenda, measured in terms of attainment in external tests, the Science Learning Centres focus on making science teaching more engaging and enjoyable by improving teachers' skills and their ability to inspire. Indeed, it has been argued that relentless pressure to raise standards contributes to the decline in participation post-16: there is evidence that the pressure to get students through the curriculum and to successful examination outcomes contributes to their declining interest in science[4]. The mission of the Science Learning Centres is to help teachers to inspire more young people towards science while at the same time maintaining increased achievement.

Measuring success

The Science Learning Centres initiative will be the subject of rigorous external evaluation by DfES and the Wellcome Trust. The evaluation study will ask many questions, including:

- How many teachers visit the Centres for professional development?
- How many report positive experiences?
- What lasting changes take place in the classrooms of those who come to the Centres?

In the end, what matters is the effect on pupils, and in particular:

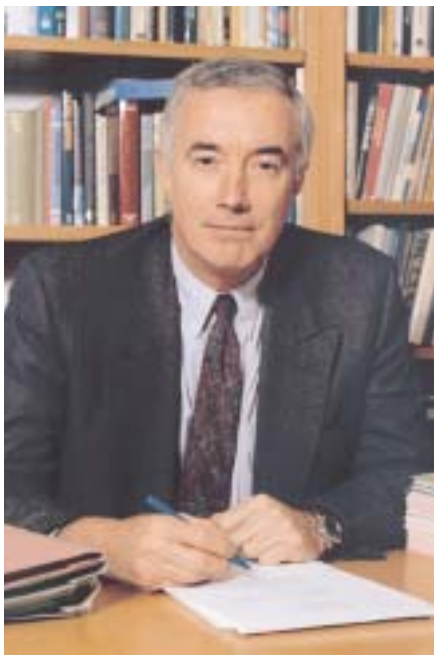
- Does pupils' interest and engagement in science increase?
- Does the proportion of pupils choosing to study science post-16 increase?

Realistically, it will take time before the effects of high-quality professional development for teachers work their way through the system so they can be detected in the behaviour of students. This bold initiative is a testament to the government and the Wellcome Trust's commitment to science, and one with which they will need to keep faith.

[1]Quoted in *Education in Chemistry*, May 2005
[2]Times Higher Educational Supplement, August 6 2004
[3]Jenkins, E., & Nelson, N. W. (2005). Important but not for me: students' attitudes toward secondary school science in England. *Research in Science & Technological Education*, 23(1), 41-57.
[4]Osborne, J. and Collins, S. (2000) *Pupils' and parents' views of the school science curriculum*. London: School of Education, King's College London.

The role of the Chief Scientific Adviser, MOD

Professor Roy Anderson FRS, FMedSci, MOD Chief Scientific Adviser



The Chief Scientific Adviser (CSA) post at the Ministry of Defence is the longest standing Science Adviser post in Government. It has its origins in the critical role played by scientists in the Second World War, and the very close relations developed during that period between the operational commanders and the defence research staff. The Chief Scientific Adviser's post was formally established with the creation of the Ministry of Defence, and the first in what has been a very distinguished list of scientists in this role, Sir Solly Zuckerman, was appointed in January 1960.

The responsibilities of the post have remained broadly similar since its creation. In addition to the traditional role of providing scientific advice to the top of the Department and to the armed forces, the Chief Scientific Adviser is responsible for the management of the defence research budget and also chairs the Board responsible for providing advice to Ministers on major investment and equipment procurement decisions, most recently entitled the Investment Approvals Board. The Chief Scientific Adviser also takes a very close interest in strategic technology issues across the broad science spectrum of relevance to defence, including those relating to nuclear affairs. In addition to having a seat at the Defence Council and the Defence Management Board, this breadth of responsibilities gives the MOD Chief Scientific Adviser post broad influence and authority.

The arrangement of breadth in responsibility has advantages for the MOD. It reflects the fact that science and technology are critical enablers for the UK armed forces, and defence issues in the broadest sense, perhaps more so now than has ever been the case given increased uncertainty in future threats. The pace of technology change continues to increase. And as developments in defence-relevant technology are now sometimes driven by the civil sector, rather than in defence laboratories, new problems emerge from the rapid proliferation of technologies that can pose a threat if in the wrong hands. For example, research advances in biomedical fields can be double edged. On the one hand they may improve our ability to develop new drugs and vaccines, but on the other hand they may make it easier to develop and manufacture novel pathogenic agents. Furthermore, changes in the geo-strategic environment since the end of the Cold War present a considerable challenge for long-term defence planners. Whilst our perception of the medium to long term threat has in the last few years changed on a yearly, if not monthly, basis, the MOD has to try to manage equipment and technology acquisition programmes often lasting up to 50 years from inception to disposal. One solution to this problem is to focus on the acquisition of "skeletal" platforms or frameworks, which can be easily adapted to, as it were, "plug and play" new sensor or weapon technologies.

One obvious response to a future scenario of increased threat uncertainty is to ensure that we stay at the cutting edge of the development of new technologies. This not only benefits defence but also the civil industrial sector in the UK. This implies that we need to sustain our investment in defence science given the ever increasing pace of technological change, so that we have the technological ability rapidly to generate solutions to meet newly emerging threats. In doing so, we will be in a better position to manage the key process of inserting technology into on-going equipment programmes and also to de-risk technology before we commit to major investment decisions.

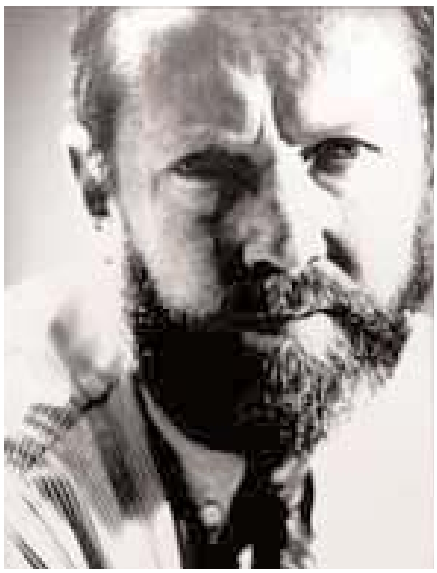
This all poses many new challenges for the defence science and engineering community. We need to do better at developing new ideas and, even more importantly, building on these new ideas to develop new products ready for the market place. In doing so, the defence research programme can help drive innovation and competitiveness in the UK defence industry. We have sought to focus our investment into those technology areas we believe are likely to be the most important in the future and also to achieve a better output from this investment plan. The incremental transfer of a significant element of the MOD's defence research laboratories into the public sector, through the establishment and gradual privatisation of QinetiQ, is aimed at moving the tremendous body of scientific knowledge and expertise in this organisation closer to the market place, so that it can better be exploited by both defence and civil sectors. Through the progressive introduction of competition, where this makes good sense, we have also sought to diversify our supplier base. This means we are now more often investing directly with industry and the University sector, helping to drive innovation and at the same time deliver improved value for money. And finally, the creation of new companies to help "spin-out" technology from our in-house laboratory, the Defence Science and Technology Laboratory, into the commercial world is helping to ensure that the UK economy continues to benefit from the Government's investment in defence science.

This, then, is the challenge faced by me and my colleagues in defence science. Our record is a good one. Inventions such as the new world-leading sonar system for the Royal Navy's submarines, the highly advanced techniques we use for dealing with terrorist bombs (both of which are saving lives, as I write, in Iraq), the new Storm Shadow missile and the world-leading chemical and biological detection and protection equipment used by our armed forces all have their origins in the defence research programme. And much less widely appreciated is the fact that much defence research has been responsible for many inventions that have created wealth and jobs in civil industry, including radar, the internet, thermal imaging systems and body imaging systems for medical and security applications.

In summary, this is an immensely exciting time for defence science and technology. We have a proud record of delivering world-leading technology to the UK armed forces, which has also had great benefits to the wider civil economy. As the Chief Scientific Adviser in the MOD, I greatly look forward to building on this record of success in tackling the many challenges facing the defence world as we move into the 21st Century.

The challenge of chairing the Science Advisory Council

Professor John Beddington CMG FRS



Introduction

The Department for Environment, Food and Rural Affairs (Defra) spends over £325 million a year on science (including research, monitoring, surveillance and evaluation) underpinning a wide range of policies including those covering environmental protection, farming and food, animal and plant health, and sustainable energy. It is one of the broadest science-based agendas of any government department and Defra is committed to ensuring that its science is robust.

The Science Advisory Council (SAC), which I chair, is a relatively new body established (February 2004) to provide Professor Howard Dalton FRS, Defra's Chief Scientific Adviser (CSA), with independent, expert, strategic advice on science underpinning the Department's policies, and through the CSA to Ministers.

How does SAC work?

SAC's role ranges from scrutinising Defra's science peer review and quality assurance processes, to commenting on strategic science priorities and looking in-depth at the science aspects of its various contingency plans. In our work there is an emphasis on openness and transparency. We want Defra, other key stakeholders and the public to see that the work we do is robust and independent and that the Council will both publicly challenge or endorse the science underpinning Defra policy.

SAC needs to be able to perform a broad array of functions, not least being able to offer science advice at short notice in the event of an emergency. We can do this because the SAC membership covers a considerable range of expertise, including the natural and social sciences, and a lay member to help bring a wider perspective into our work. Observers from the devolved administrations and the chief executives of the key research councils also participate. The Council works through sub-groups, which have the capacity to co-opt additional expertise relevant to their activity.

While the advice we provide may, in some cases, challenge the status quo, I hope this will be seen as a constructive contribution to shaping the evolution of Defra science.

SAC's activities

During its first year, SAC has developed its awareness of current Defra activities while starting to examine the underpinning process of science in Defra (risk management, governance of science advisory bodies etc). Our most extensive input to date has been on Defra's contingency plan for Foot and Mouth Disease. My challenge will be to help take this forward, building on the foundations laid by the first Chair, Professor Roy Anderson FRS. I am keen to develop a work programme that makes the best use of the expertise both within the Council and within the wider academic community. Two new pieces of work that are already under way will focus on Defra's science quality assurance processes and on the science that underpins Defra's contingency plan for Avian Influenza.

My role as Chair

As Chair, I have responsibility for the operation and output of the committee, including assessing the workload and ensuring the rigour of our discussions is not compromised. In the public arena, I am also the SAC's "figurehead" and one of my first actions as Chair was to commit to at least one open meeting a year to enhance the transparency of our activities and help build our public profile. Our function is to provide independent advice to the CSA – we are guided by requests from him. However, we can identify our own strategic agenda where we see the need and welcome suggestions for topics from Defra and elsewhere. Defra science supports a diverse range of policy areas but we are a strategic body. Unless we set ourselves clear priorities, we risk getting too involved in the detail, losing the opportunity to add real value to what is already being undertaken by Defra.

Diverse experience, diverse views

As Chair, I ensure that every member has the opportunity to be heard and that no view is ignored or overlooked. Our diverse range of expertise and experience gives us a unique perspective from which to scrutinise Defra science and all members are encouraged to contribute to work outside their area of immediate specialism to ensure that alternative views and experience are considered.

Alongside this I ensure that any significant diversity of opinion among SAC members is explored and discussed and, if it cannot be reconciled, is accurately reflected in our report to the CSA. Harnessing such a broad array of expertise is often a challenge in its own right!

Ambiguity and uncertainty

A particular challenge is to ensure that the full range of scientific opinion, including unorthodox and contrary scientific views, are appropriately taken into account. In any field, views on what constitutes "sound science" may be divergent. Both the evidence base and its interpretation to inform policy may be challenged. SAC can play a powerful role in identifying such divergence of opinion as part of its role to challenge Defra constructively. Similarly, SAC can also draw on the wider scientific community to support the CSA, particularly where the body of evidence may point towards a controversial policy decision.

Relationship with Defra

The organisational structure of Defra continues to evolve and we aim to keep a clear focus on the strategic priorities to which science contributes, while also developing good working relationships with key Defra people. However, like any good auditor, we must maintain the integrity of our independent position and avoid "going native".

Conclusion

The SAC is just starting out. Its role as Defra's senior non-departmental public body offering robust, independent, expert science advice is developing well and we have provided advice to the CSA on a number of issues. Our challenge now is to ensure that the SAC remains a vital support for the CSA and, through him, can improve the contribution that science makes in Defra's approach to its policy responsibilities.

BOOK REVIEW

Pioneering Research – A Risk Worth Taking

D W Braben
John Wiley & Sons 2004

Few subjects have a greater relevance to our modern societies than the future of science and whether, how and by whom it should be controlled. The arguments for and against various systems have been presented by Lord May OM, in his 2002 presidential address, by Mark Henderson, in his review of Lord Taverne's book "The March of Unreason" (Times 12.3.) and most comprehensively by Braben in this profound and provocative volume.

The essence of Braben's case, which is a masterly survey of the science that has had the most dramatic and far-reaching effects on humanity, is that the one factor which virtually all examples have in common is dissent. His survey is thorough, far-reaching, and convincing. But such is the scale and significance of the modern scientific establishment that, in Braben's words, "dissent is being stifled by bureaucracy, much of it well-intentioned, and strongly defended by the advocates of peer review." This procedure, he argues "is inimical to new science."

Even authoritative defenders of peer review are aware of this danger, for Lord May argued in his Presidential address that "dissenting opinion should be sought and considered" and that "uncertainties in science should be openly acknowledged." He quoted with approval the opinion of Max Perutz that "younger colleagues should have their heads, unencumbered by bureaucracy or hierarchy." This opinion is strongly supported by another distinguished American physicist, Luis Alvariz, who argued that the peer review system, in which proposals rather than proposers are reviewed, was "the greatest disaster to be visited on the scientific community in the 20th Century."

This somewhat esoteric debate lies at the heart of one of the most fundamental questions facing modern societies – whether, to what extent and how the vast expenditure on modern science and technology should be controlled. Some of the data presented by Braben will surprise even those who regard themselves as reasonably well informed on this topic, eg the fact that the number of scientific journals published globally in any one year (a rough indication of the number of practising scientists) has gone from a mere 10 in 1700 to 10,000 in 1900 and the phenomenal number of 100,000 in 1975. The US National Science Foundation has published figures which reveal that the number of doctoral scientists and engineers employed in that country alone is now just under 250,000.

Braben then draws the significant conclusion that despite this vast increase in S&T activity, annual real growth rates of world GDP per capita show a significant decline since the mid 1960's. He attributes this to the declining scale of "unfettered scientific exploration" which is "the primary feedstock of genuinely new technology."

This profoundly interesting analysis does not entitle us to conclude that there is no perceptible or defensible political process which will address, let alone solve, the problem. No democratic government will willingly abandon any attempt to influence the broad thrust, even if it should not attempt to define the detailed direction of scientific research and development. The balance of authority and decision is one which, however difficult, has to be drawn between support for the eccentric, the orthodox, the conventional and that which may eventually prove to be either unproductive and wasteful or the work of an inspired genius. The challenge to society is to devise an acceptable and practical distribution of opinion, authority and decision between the general public, its elected representatives, the bureaucracies with which they interact, the "peer review" hierarchies and those who have the imagination, courage and skill to ensure that the eccentric scientific genius is not stifled by orthodox opinion and procedures.

Pioneering Research is a wide-ranging and well informed analysis of this question, which is unlikely to feature in the manifestos of any political party. But the survival of civilisation and democracy itself may well depend on recognition of the fact that the question is, arguably, unlikely to be within the scope of what is today defined as "the public understanding of science." Where I would regretfully disagree with Lord May is his statement that "a substantial fraction of the total population can really be engaged with this issue." But unless the problem is successfully addressed Braben would doubtless agree with Sir Martin Rees that the 21st Century could well be our last. In the judgement of many it is the most important issue facing democracies today. I would hazard the personal opinion that no solution will be acceptable unless there is total confidence in the integrity, impartiality and relevance of scientific opinion on any major issue. If science becomes polemicised scientists cannot complain if the media classify their judgements in the same arena as those of politicians, the condemnation of whose reputation has become virtually obligatory.

Sir Ian Lloyd

Lord May – Presidential Address 2002, the Royal Society Ps 9 and 16

Braben – Ps 100 and 154

This article was first published in *"Science & Public Affairs"*, which is accessible in the Press Office area of www.the-ba.net

AGEING – PUTTING OFF THE EVIL DAY

MEETING OF THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE ON MONDAY, 23RD MAY 2005

An increasing number of people are living to a greater age when biological limitations are taking their toll on health and happiness through frailty, disability and disease. This poses a challenge for current research to acquire a better understanding of the biological basis of ageing and age-related diseases and to develop new science-based and technological solutions. These are designed to help the elderly maintain their freedom of movement and independence for as long as humanly possible, both for their own sake and that of society.

Tom Kirkwood describes the outcomes of his research designed to reveal the principal drivers which give rise to human ageing. John Lever shows how bioengineers evaluate the biomechanical aspects of ageing and thereby help to design and improve therapies for the increased longevity and health of the aged. Reynold Greenlaw presents the products of current research on technological aids for those suffering from Parkinson's disease and discusses additional technological support systems designed to help the aged maintain free and independent lifestyles for as long as humanly possible.

The Science of Ageing: New Frontiers

Tom Kirkwood
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Something remarkable happened yesterday: life expectancy increased by 5 hours. The same thing occurred the day before, and the day before that. In fact, on each of the more than 70,000 days of the last two centuries, life expectancy within the United Kingdom increased by a similar amount, adding up to a total of 40 years – a doubling in our average lifespan over just eight generations.

This relentless increase in life expectancy is so much a part of the fabric of our lives that one might think that we would have well established plans to accommodate it into our changing society, and that we would have invested time and effort to understand exactly why it is happening and whether and when it might end. The truth, however, is very different. Few of us properly appreciate just how fast life expectancy is changing, most of us continue to regard the societal implications of our continuing success in lengthening life with a mixture of bewilderment and concern, and we have, until very recently, largely neglected the challenge of asking what is really going on.

The early increases in life expectancy were easy enough to understand. Improvements in sanitation, nutrition, housing and education all worked together to reduce the heavy burden of infectious disease that struck down our predecessors at startling rates, particularly at young ages. This continued with the introduction of vaccines and antibiotics. By the time we entered the second half of the 20th Century, the causes of mortality had been transformed. Deaths now occurred mainly in later life from causes linked to the degenerative conditions associated with ageing. At this point, most organisations charged with forecasting future life expectancy predicted that the increase would slow down and eventually halt, as human lifespan bumped up against the ineluctable reality of the ageing process. They were wrong.

During recent decades life expectancy has continued to increase. Furthermore, the increases are now being driven by dramatic falls in *old-age* mortality, indicating that the ageing process is much more malleable than was previously thought. Although unexpected, this malleability of the ageing process is compatible with new scientific understanding of the ageing process. This understanding needs to inform public policy and practice to a much greater extent than has happened so far.

What Controls the Length of Life?

To explain what is happening to human longevity we need to know what controls lifespan. In spite of a widely held belief that some kind of biological clock programmes the ageing process, we now know that this is highly unlikely. The main reason is that when we survey the animal kingdom we discover that although many species, when in protected environments, age in broadly similar ways to us, ageing is hardly ever seen in wild populations.

For most natural populations, mortality due to accidents, predation, starvation, disease, and cold is such that death occurs well before "old age". This means that whatever functional value is assigned to a clock for ageing, for example as a means to control population growth, there is scant evidence that such value is actually realised. Also, it is extremely difficult to see how such a clock might have evolved under natural selection, if animals in the wild do not normally survive to an age when the actions of the clock become apparent.

Although we must discard the idea of a genetically programmed clock *for* ageing, we know that genes do influence length of human life. Research on twins has shown that genetic factors explain about 25% of the variation in human lifespan. Resolution of the conundrum that genes influence longevity, but not by programming a clock, comes in large measure from a concept known as the "disposable soma" theory.

Instead of asking why genes might cause death, we need to ask how assiduously our genes should strive to keep the body alive. In particular, how much of its energy budget should an organism be prepared to invest in the maintenance and repair of its body (soma)? The answer is simple. Maintenance, which requires significant amounts of energy, needs only to be good enough to keep the organism in sound condition for as long as it has a reasonable chance of survival in the wild. For example, more than 90% of wild mice die in their first year, and more than 99% die before their second birthday. Thus, any investment of energy by the mouse in mechanisms to keep the body strong beyond a couple of years benefits at most 1% of the population. This must be set against the advantages that might accrue from using such energy for other functions, such as reproduction.

What holds for the mouse was similar also for our human ancestors, although of course the timescales were longer. Early humans probably had no more than 30-35 years expectation of life in the "wild" conditions of our evolutionary past. From the genetic point of view, it was just too expensive to evolve survival mechanisms that would keep the body working well indefinitely, when in reality an accident would be likely to cut us down while still in our prime.

The Malleability of Ageing

Once we recognise that ageing happens not because we are programmed to die, but because our genes evolved to place limited priority on mechanisms for long-term survival, many features of ageing begin to fall neatly into place. We see that the primary cause of ageing is the accumulation of unrepaired cellular and molecular damage. This fits well with a very wide range of experimental observations.

As we live our lives, all kinds of faults arise within our cells. For example, each time a cell divides it must copy the billions of nucleotides that make up the genetic sequence that defines our biological identity and programmes all of our functions. The DNA copying machinery is exquisitely accurate, but a few DNA mistakes are likely to be made every time a cell divides. Gradually, the DNA sequences of our cells become corrupted. Added to these copying errors is the onslaught of damage caused by highly damaging molecules called "reactive oxygen species", also known as "free radicals", which are formed as accidental by-products of our cells' dependence on oxygen to produce cellular energy. Free radicals damage DNA at a high rate, and they also damage other cellular constituents, such as proteins and the energy-forming organelles called mitochondria. Damaged proteins contribute to a range of age-related disorders, including cataract, Alzheimer's disease, and Parkinson's disease. Damaged mitochondria accumulate in many tissues as the body ages and probably contribute to the declines in function that are so commonly experienced during ageing.

Combating the accumulation of damage is a wide repertoire of repair and protection systems. For example, if damage to DNA contributes to ageing, the capacity for DNA repair will be an important determinant of the rate of ageing. This idea has been confirmed by several studies showing that when different species are studied, a higher level of DNA repair activity is associated with longer lifespan. There is also some evidence that human centenarians have higher repair levels than the general population, suggesting that innate differences in repair capacity may be part of the basis for heritability of human longevity.

Once we recognise that ageing is driven by an accumulation of damage, at rates which are held in check by repair, it becomes straightforward, at least in principle, to understand the malleability of the ageing process. Factors that increase exposure to damage accelerate ageing. Factors that boost repair functions slow it down. For example, we know that nutrition affects human life span both adversely in the case of poor nutrition (diets rich in sugars, saturated fats, etc) and positively in the case of good nutrition (diets rich in fruits, vegetables, unsaturated fats, red wine, etc). Similarly, the effects of lifestyle factors (eg exercise) and environmental factors (eg poor housing) can be understood, even though a great deal more work is needed to determine the magnitudes and precise mechanisms of action of these effects.

Conclusions

Even though we have as yet invested tiny amounts in scientific understanding of healthy ageing, we can begin to understand why lifespan is continuing to increase. The kinder conditions of modern life are helping our bodies to reach old age with less accumulated damage – a 70-year old today is indeed biologically younger than a 70-year old of a generation or two ago. But in what ways exactly? And will the trend continue, or will increasingly sedentary lifestyles and fast-food diets halt or even reverse it? What does the increase in lifespan mean for health in old age? We need urgently to take better stock of what we know and act accordingly. Even more important, we must work to fill the enormous gaps that still remain in our emerging knowledge of the human ageing process.

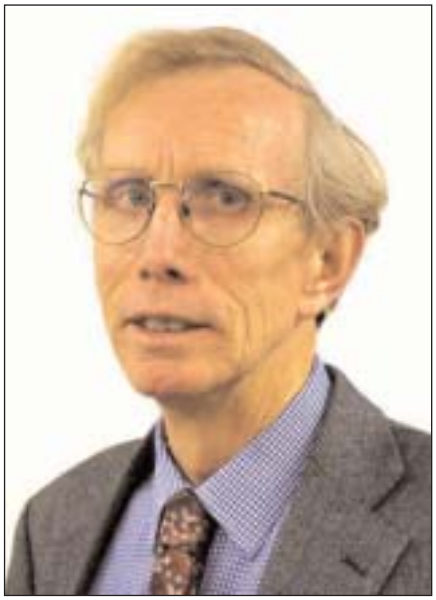
Suggested Further Reading:

Kirkwood TBL *Time of Our Lives: The Science of Human Ageing*. London: Weidenfeld & Nicolson, 1999.

Kirkwood TBL Understanding the odd science of ageing. Cell 2005;120:437-447.

Biomechanical Aspects of Ageing

M John Lever, Department of Bioengineering, Imperial College London



Introduction

Ageing causes all too visible changes in the external appearance of the body. The skin wrinkles and sags, the skeleton atrophies and the body stoops. These signs are the result of progressive alterations in the structure of certain bio polymers that are components of the hard and soft skeletons that support the various organs of the body. Of particular importance are the two proteins collagen and elastin. Collagen confers stiffness and strength to body tissues while elastin confers compliance. Consequently, modification of the amounts and detailed structure of these two components alters the mechanical properties of the tissues, so not only does their appearance change but also their ability to perform their normal functions.

Indeed much of the diminished performance of many of the organs in the body on ageing can be attributed to adverse changes in tissue mechanics and explains why this topic is of such interest to Bioengineers. Working in an engineering faculty at Imperial with plenty of opportunities to collaborate with scientifically-thinking physicians and surgeons provides an ideal environment to explore some of these problems. This brief review will concentrate only on changes in the cardiovascular and skeletal systems, but will be indicative of how most body tissues can be adversely affected.

Changes in connective tissues on ageing

The production of the fibrous structural proteins in the body is determined by genetic programming, by interactions between adjacent cells and by environmental factors including the mechanical forces applied to the tissues. Collagen is constantly being replaced, and so bones, for example, are able to remodel themselves if the prevailing stresses are altered. This occurs in bed-bound patients who undergo skeletal atrophy or, conversely, in tennis players in whom the bones of the racquet arm become thicker and stronger.

Collagen consists of protein molecules which are tightly bound to each other and then further linked to form long fibres or flat sheets. It can be replaced quite rapidly, as when wounds heal, and in all normal tissues there is a balance between the expression of new protein and enzymatic degradation and mechanical damage to older molecules. As we age, this balance shifts and degradation wins out over production. Some of the fragments, matricryptins, can themselves cause additional trouble by stimulating the production of enzymes that attack other proteins or lead to the production of cytotoxic free radicals. Collagen fibrils may more cross-linked in older than younger individuals and while this might be expected to make them stronger, such changes seem to cause diminished production. Excess cross-linking is exacerbated by elevated sugar levels, explaining in part why diabetics are more prone to connective tissue diseases.

Elastin, a protein which is coiled to confer rubber-like properties, is even more problematical since its production is almost completely switched off at puberty so that the replacement in adults is negligible. Not only is elastin progressively lost on ageing but it easily fragments, diminishing its compliance, and becomes calcified, also making it stiffer.

Cardiovascular changes

Our large blood vessels contain very large quantities of elastin and in arteries it enables the heart pulse to be quickly transmitted around the body. As we lose elastin and its properties change, the vessels become wider and stiffer. The heart now has to pump into more rigid pipes, making it work harder, and making it more likely to fail. In arteries close to the heart,

mechano-receptors monitor blood pressure by sensing the degree of stretch of the vessel wall. As the wall stiffens, they become less able to sense changes so blood pressure rises, causing hypertension.

As collagen structure changes, blood vessel walls become unable to cope with the large pressures sometimes generated by the heart and aneurysm can occur.

The heart and veins have valves to keep blood flowing in the right direction around the body. With loss of elastin and collagen, the flaps of tissue that constitute the valves are no longer able to come together across the widened vessels and blood can leak backwards through them. The heart will, once again, have to work harder. On suddenly standing, incompetent valves in veins may allow blood to flow downwards towards the feet taking it away from the brain, leading to dizziness. Venous pressure will also rise above normal in the legs and feet, causing excess exudation of fluid, oedema.

Atherosclerosis

Other changes occurring in blood vessels with increasing age are probably associated with blood flow as much as with the mechanical properties of the vascular tissue. Fluid mechanics is usually associated with other branches of engineering, aeronautics, mechanical, chemical and civil engineering. But it is also an important component of bioengineering. Unlike most engineering constructs, blood vessels are compliant structures which branch, have complex three-dimensional geometries, and carry a fluid, blood, which has highly non-ideal rheological behaviour in a pulsatile manner. Not surprisingly, blood flowing in arteries displays very complex patterns including swirling, eddies and reversal of flow direction. Any fluid flowing over a surface exerts a shearing stress. Just as normal stresses applied to bones can change their properties, shear stresses applied to the inner surface of blood vessels may underlie the development of atherosclerosis which shows a predilection for sites where the most complex flow patterns are observed.

Once formed, the fate of an atherosclerotic plaque may be also determined by the mechanical stress that it bears. Large forces exerted by shear or changes in blood pressure may cause fracture. The exposed contents may be swept downstream blocking smaller vessels and causing an infarct which might lead to heart attack or stroke. Alternatively a thrombus may form on the damaged tissue which can either block the artery or become dislodged and cause a blockage downstream. Plaques may also weaken the underlying wall, and atherosclerosis is an underlying cause of aneurysms.

Skeletal changes

Articular cartilage is present on the surfaces of adjacent bones in moveable joints and acts as a lubricant and a shock absorber. It is a stiff gel, comprising very large sponge-like molecules, proteoglycans, bound together by fibrous collagen. Mechanical and biochemical fragmentation of this collagen can allow fissuring of the articular cartilage, reducing its lubricating function. This is one of the features of osteoarthritis. Progression of the condition can lead to complete loss of the layer of cartilage causing the bones to grind together with resulting severe pain.

Bones also contain very large quantities of collagen, as well as the mineral component, hydroxyapatite. Osteoporosis is a progressive reduction of bone mass in the skeleton, resulting largely from the progressive degradation of collagen. There is a thinning both of the compact surface bone and progressive attrition of the three-dimensional plates of the "spongy" bone, that comprises the inner part of many bones. All older people have some osteoporosis and continual and usually symptom-free compression fractures in the vertebrae lead to distortion of the spine, while the neck of the femur and radius bone of the arm become susceptible to fracture on falling.

As indicated above, sustained and repeated forces applied to bone causes it to hypertrophy and herein lies a simple approach to controlling the development of osteoporosis. Increased mobility and simple exercises can have dramatic effects on bone density and limit the susceptibility to fracture.

Conclusion

So, what can we do in the future? Cosmetic surgery can disguise degradation of the skin. But surgical intervention will never tackle the more critical changes that occur within internal organs which shorten life expectancy and in those that do survive, lead to severe disability, with enormous costs involved in caring for the aged.

Bioengineers can devise techniques for tracking tissue changes which will hopefully reveal problems before they become critical. For prevention of the mechanically mediated effects of ageing we have to learn, firstly, how to limit the adverse changes in our structural proteins. Body movement, including exercise, contributes to damage, but this should not be compromised, since to do so would invoke other adverse changes in the body. Secondly we have to learn how to deal with the progressively increasing amounts of mechanically compromised protein fragments while maintaining adequate stocks of healthy material. In particular, we need to understand, better, how we can overcome the switching off of elastin production at an early age. Tissue and genetic engineering may prove the answer and bring us at least to a healthier future if not immortality.

INDIGO: A technical aid for people with Parkinson's disease

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Parkinson's disease (PD) is a common neurological disorder. Research indicates a prevalence of approximately two per thousand of the general population, with the older population being most affected. In Europe, the average age of onset is slightly below 60 years. Untreated, the mortality of people with PD is three times higher than healthy controls; however, with the advent of modern pharmacology, the life expectancy of PD patients is tending towards the (male) average. Estimates of the number of people with PD in Europe lie between 700,000 and 1,000,000 with 72,000 new people diagnosed every year.

The cardinal symptoms of PD are tremor, rigidity and bradykinesia (slowness of movement). A shuffling walk, start hesitation (inability to start walking at will), and freezing are mobility problems that appear in the mid to late stages of PD. These mobility problems get worse with longer duration of illness and result in people with Parkinson's disease (PwPD) gradually leaving the home less and less and eventually becoming inactive even in the home. This confinement at home and restriction of activity can lead to social isolation and have a significant adverse effect on the quality of life of PwPD. The walking-related symptoms of PD are not greatly improved by medication or surgery. Standard mobility aids such as walkers or walking sticks do not improve walking in PD.

Since the seminal observations of Purdon Martin (Martin, 1967), it has been known that provision of external stimuli such as horizontal lines marked on the floor over which the PwPD steps can substantially improve walking in PD. There is experimental support for this observation from studies using visual markers on the floor (Morris et al, 1996; Azulay et al, 1999; Lewis et al, 2000), which have been shown to improve the stride length and gait velocity of PwPD. The rationale behind the use of external stimuli to improve mobility in PwPD is the phenomenon of paradoxical kinesis. An often cited example of paradoxical kinesis is the triggering effect of emotive or dangerous external stimuli, such as an immobile PwPD being able to walk normally when triggered by unusual external situations such as during a fire. The phenomenon of paradoxical kinesis has experimental support from functional imaging studies (Jahanshahi et al, 1995; Hanakawa et al, 1999). These have shown that external triggers for movement such as a tone or transverse lines on the floor, "normalise" blood flow in PD and are associated with use of an alternative route to action via the lateral premotor cortex-parietal-cerebellum instead of the medial premotor system which is impaired in PD (Jahanshahi et al, 1995; Hanakawa et al, 1999).

Despite the evidence for the value of external stimulation in improving mobility in PwPD and its possible physiological mechanisms, no viable commercial device of proven efficacy is available for use by PwPD as an aid to mobility. INDIGO (INDdependently I GO) has been developed from the results of an earlier EU R&D project called "PARREHA" (PARkinson REHAbilitation) (IST-1999-12552, 2000-2003) and earlier was called PARKWALKER. The company PARKAID was founded by PARREHA partners out of their own resources to further develop INDIGO.

INDIGO displays moving visual

cues in the user's peripheral visual field within specially adapted glasses running MPEG video software on dedicated portable hardware. The video is generated by a mini MPEG player worn on the user's belt or placed in their pocket. Commonly an endless video of black and white stripes scrolling slowly upwards is used. The sets of visual cues have been constructed in conjunction with PwPD. Once set up, all the user needs to do is to put on the glasses and press the On button. This simplicity is essential since the device is intended as an aid to daily living by PwPD. This user group has the motor disabilities of PD and is typically over 60 years old and may not be confident with equipment that looks too "technical".

INDIGO provides the user with support during intermittent akinetic phases. Users wearing INDIGO can walk more easily and freely. A further benefit is likely to be accident avoidance and reduction of the number of falls and injuries suffered by people with PD.

Comparable devices (such as dark glasses with flashing red LEDs inside) exist in research laboratories at the University of Washington, USA, the University of Iberoamericana, Mexico and the Technion Institute in Israel. These devices are research tools and have not been subjected to controlled clinical trials or commercialised.

This year INDIGO has won the support of the UK Parkinson's Disease Society. This is the largest

PD society in Europe (30,000 members) and has agreed to fund a two year clinical trial to answer two questions crucial to the further development of these aids: firstly, what is the size and clinical profile of the PD population who would benefit from INDIGO (and similar aids) and secondly, what is the objectively measured effect on gait of INDIGO compared to lines on the floor or walking unaided with no visual cues. This trial will be conducted by Professor Jahanshahi's group at the Institute of Neurology, University College London.

If proven effective, the social contribution of the INDIGO system will be to offer PwPD increases in mobility, freedom and quality of life which no other IT application can offer. The device is entirely complementary in that it can be used alongside conventional pharmacological and medical treatments.

Links:

(1) ParkAid: http://www.parkaid.net/

(2) Oxford Computer Consultants Ltd.: http://www.oxfordcc.co.uk/

(3) Institute of Neurology, University College London: http://www.ion.ucl.ac.uk/

(4) The Parkinson's Disease Society: http://www.parkinsons.org.uk/

Enquires to:
reynold.greenlaw@oxfordcc.co.uk

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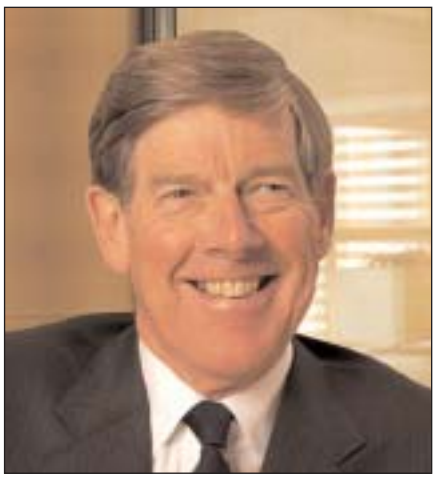
In discussion the following points were made:

There is a very surprising linear increase in the age of death with time for which there is currently no explanation. The death rates of the elderly in their 80s are only half of what they were 50 years ago. There is definitively no clock that drives the ageing process and all searches for it have failed. There is no programme and there are no genes for ageing, although longevity tends to run in families and studies of identical twins show that 25% of longevity can be accounted for in this way. Variability in ageing of the human population is immense. There is however a link between diets high in antioxidants and an increase in longevity. The jury is out on the potential role of dietary supplements such as vitamin C. Early nutrition, such as in utero, is a factor in controlling the trajectory through life. Brain exercise is also important in maintaining functional capacity with age. Technology transfer of bright ideas from the laboratory is still a major problem in the UK, and has been for a long time, with inadequate financial and managerial support to pull these through to the market place

MEETING OF THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE ON MONDAY 13TH JUNE 2005

Will nuclear energy still be an option if or when we realise the need to exercise it as an essential component of the plans to meet our ambitious climate change commitments and to ensure base-load supplies of electrical power for the UK? A satisfactory procedure for the disposal of radioactive waste is essential if progress is to be made – so why is there still just "a blank sheet of paper" in the UK after 40 years of planning while others move ahead? Renewables have a chance to demonstrate their environmental credentials and fill gaps in supply created by the escalating costs, increasing demand for and environmental impacts of fossil carbon-based fuels.

The Nuclear Energy Option – Will we still need it – and if so – When?



A N Broers

In short my answer is yes – I see no alternative if we are to meet our obligation to protect the environment. At the same time we have to provide a secure supply, and avoid fuel poverty, so we will have to consider all of the alternatives, especially the renewables.

We have been fortunate in the UK because in our "dash for gas", we succeeded, almost by accident, in meeting our commitment under the UN Framework Convention on Climate Change – by 2000 we had already returned to 1990 levels of greenhouse gas emissions. Since February, however, the Kyoto Protocol commits the EU to a further 8% reduction between 2008-12. But again the UK has committed to do more. We have courageously agreed to a 12½% reduction, and furthermore, the Government has committed to a domestic goal of 20% by 2010. These are laudable aims but provisional data for total UK emissions of carbon in 2004, whilst 4.2% lower than 1990, show a 1.5% increase over 2003.

Our electricity consumption between 1990 and 2004 increased by 25½% but CO_2 emissions decreased by 15½%, due to a combination of increased supply from nuclear generators, greater use of natural gas, and improved efficiency. The total electricity supplied by all generators in 2004 was 2% higher than in 2003 (some 7.5 TWh) but the fuel used was 0.9% lower.

It is worth noting that our gas production is declining as the UK Continental Shelf reserves deplete. The production of indigenous natural gas fell by 6.7% between 2003 and 2004. Most importantly, the UK became a net importer of gas in 2004, the first time since 1996, and it has been estimated that we have used just over half of our gas reserves, and with increased demand, it is expected that we will be importing 80% of our gas by 2020.

The 2003 Energy White Paper sets out the framework for our future energy policy. It identifies the challenges as: environment; decline of indigenous energy supplies; and energy infrastructure updating. It sets four goals: to cut CO_2 emissions by 60% by 2050; to maintain reliability of energy supplies; to promote competitive markets in the UK and beyond; and to ensure adequate and affordable home heating. The Government believes that these goals will be achieved by the market framework being reinforced by policy instruments. Targets were not set for the share of total energy or electricity supply to be met from different fuels, preference being for a market framework to give investors, business and consumers the incentives to determine the balance to meet the overall goals most effectively.

The White Paper continues by recognising that energy efficiency measures are thought likely to be the cheapest and safest way of meeting the four goals, but that renewable energy would play an important part in reducing carbon emissions. The target set by Government was that by 2010 some 10% of our electricity should be generated from renewable sources with a view to achieving 20% by 2020. The House of Lords Science and Technology Committee report "Renewable Energy: Practicalities" prepared under the chairmanship of Lord Oxburgh, was not optimistic about the possibility of meeting these aims. It states "We found almost no-one outside Government who believed that the White Paper targets were likely to be achieved. This was partly for practical reasons – planning consents, availability of

labour and equipment and so on – and partly as a direct consequence of the Renewables Obligation method of support. We judge that by 2010 the United Kingdom may have achieved 6-7% renewable generation".

Our problems can potentially be solved in the long term by nuclear fusion, by replicating the thermonuclear reactions powering the Sun, but even the most optimistic of the experts say that this will take thirty years and the official timetable is closer to fifty. Progress with JET, the Joint European Torus, at Culham, has been significant. Within the doughnut shaped plasma chamber, called the Tokamak, fusion has been achieved and the strong magnetic fields of the Torus have been successful in keeping the plasma away from the walls of the containment vessel so that it does not melt.

The next stage in demonstrating that the process can be made practicable is to build ITER, the International Tokamak Experimental Reactor facility either in France or in Japan, both are seeking to host the facility. Then an International Materials Irradiation Facility is needed to show that the materials can withstand the intensive neutron irradiation. When all of this is complete DEMO, the demonstration power plant will be built and finally PROTO the prototype power station. The current timetable for all of this is fifty years but a fast track alternative where these tasks would be carried out in parallel might achieve the same in thirty years.

So we cannot rely on fusion to solve our near term needs in terms of greenhouse gas reduction. However, we do have nuclear fission. Our experience of generating electricity from nuclear fission extends back to 1956. The technological problems are well understood and manageable but there are well known issues, some sociological, some political, which will make it difficult to gain public and political acceptance for new build.

Other than for importing the uranium, the UK has been self-sufficient in employing nuclear fission, through plant design, operation, regulation, uranium enrichment, fuel fabrication, reprocessing and waste treatment. However, in 1995 the Government determined that nuclear power should be phased out and decommissioning undertaken as soon as reasonably practicable. Draft legislation was published in mid-2003 to set up and fund the Nuclear Decommissioning Authority. The NDA has now been established and is charged with dealing with the legacy of nuclear waste previously managed by BNFL and the UKAEA.

The disposal of nuclear waste is the issue which has created most public concern, but it will have to be dealt with whether or not we build new nuclear plants. If we were to build ten new nuclear stations and operate them for sixty years, there would only be an increase in the UK's existing waste stockpile of about ten per cent. It is also important to note that the wastes arising from a modern Pressurised Water Reactor are much less than those from the Magnox gas-cooled reactors. The costs of decommissioning a light water reactor will also be five times less than that for a Magnox reactor due to the smaller volume of material and graphite moderator.

It is crucial that the Government's Committee on Radioactive Waste Management (CoWRM) accelerates their deliberations and delivers their recommendations on the way ahead. Other countries are ahead of us. For example, a Parliamentary vote in Finland in May 2002 supported the building of a nuclear reactor on economic, energy security and environmental grounds. Finland is well advanced with provisions for the encapsulation and storage of spent fuel. They already operate underground repositories for intermediate level waste and an underground rock characterisation facility will verify the site selection for geological storage over the next few years.

The Nuclear Non-Proliferation Treaty is designed to minimise the danger that could arise from the "leakage of nuclear material, relevant technology or nuclear expertise". Verification of compliance is carried out by the International Atomic Energy Authority. There are broader questions on the possibility of terrorist groups acquiring nuclear, chemical or biological weapons.

The Health and Safety Executive, through its Nuclear Installations Inspectorate, regulates nuclear safety under site licences. There are well developed and tested arrangements in place for responding to any nuclear emergency at any UK civil nuclear site. To aid public understanding of the safety significance of events and their consequences an International Nuclear Event Scale has been developed by the International Atomic Energy Agency and the Nuclear Energy Agency of the OECD.

Finally , the application of nuclear technology demands a highly skilled workforce – not only for nuclear power but in the health sector, where it plays a key role in modern medicine, and in industry. The perceived shortage of people with the necessary skills is a serious concern.

Conclusions

- The demand for electricity is growing and emissions of Carbon Dioxide are increasing.
- Ageing nuclear plants are being decommissioned but replacing their generating capacity with that from renewable sources does not reduce Carbon Dioxide emissions.
- A balanced portfolio of energy sources is necessary to ensure adequate levels of security of supply.
- Nuclear energy is no longer regarded as uneconomic.
- The skills base in terms of nuclear engineers and technicians must be maintained.
- Government must take the difficult decisions concerning supporting nuclear fission whilst awaiting nuclear fusion technology and demonstrate leadership on the waste disposal issue.
- Finally, but most importantly, the public are partners and they must be brought on side to support the necessary actions, as exemplified by the intense debate and decisions taken in Finland.

A Balanced Energy Policy

Sir Donald Miller FREng FRSE
Chairman, Scottish Power 1982-92

My first criterion for a robust electricity supply is a mix of fuels and sources. In the early 1960's, 90% of Scotland's electricity was from NCB coal at significantly higher prices than South of the Border and subject to the threat of interruption. The search for greater security led the Scottish Companies in 1964 to embrace nuclear generation with the commissioning of the Hunterston A 2x 300 MW Magnox reactors. These achieved the highest performance of any reactors world wide for most of their operating lifetime and in the light of this experience they were followed in 1972 by the Hunsterston B 2x 600 MW AGRs.

The more robust electricity supply system this provided allowed support to England and Wales of 2000MW on a regular basis during the miners' strike as well as profitable trading across the Border. Further diversity was provided by oil and gas fired generation as well as 700 MW of pumped storage. With growth in demand and to maintain our cost advantage, we turned again to nuclear in 1987 with the Torness 2x 650 MW AGRs so bringing Scotland's nuclear share to over 50%. Without subsidies of any kind and with full financial provision for the costs of decommissioning and waste disposal, tariffs were amongst the lowest in the UK.

The run down of UK nuclear capacity, losing 50% in 5 years and virtually all in a further 12 means not only the loss of 22% of the UK's electricity supplies but also a massive reduction in diversity.

We take the reliability of our electricity for granted but the role of diverse generation in achieving this is not recognised. Those who remember other times regard with disbelief a scenario in which we rely for 90% of our energy on unstable regions of the world, mainly Russia and its former Republics with smaller amounts from the Middle East. That is what is in prospect unless we do something about it – and do it soon.

At present the UK's only concession to maintaining diversity is renewables. In the quantities proposed these are proving neither economic nor environmentally friendly and their effect on reducing greenhouse gases is insignificant. Nor is it generally realised that the cost of their electricity to the consumer, including subsidies and support costs, is four times that of conventional generation. There are more effective and less costly means at our disposal, of which nuclear is one.

A recent report by The Royal Academy of Engineering shows new nuclear (including provision for decommissioning and waste disposal) at 2.3p/kwhr against 5.4p/kwhr for on-shore wind. This is without the subsidies and the high costs of transmission for renewables all of which additional costs are paid for by the electricity consumer. UK energy policy today requires a positive attitude to nuclear; without this we are not retaining the nuclear option, at least in any effective way.

Public sector R and D spend in the UK on nuclear power is virtually non-existent. The US Government on the other hand has stated its intention of increasing its budget to $240m with the objective, jointly with the private sector, of banking a portfolio of licensed sites ready for new construction.

Other assurances for potential developers are being created because of course a successful nuclear programme needs to bring together not only R and D but also design, licensing, manufacturing and construction skills, and not least, a competent customer.

This last is important; in the case of nuclear it is the owner who holds the licence and has to deal with the nuclear licensing authority. This is an ongoing and demanding activity throughout the station life and in today's industry few of our generators will have that particular competence.

Nevertheless we have a lot going for

us. Despite the discouraging climate of recent years the UK nuclear industry is in a position to provide us with an up-to-date and economic design of reactor which uses proven technology from earlier plant. This design has the important advantage of relying on natural effects for cooling in an emergency: gravity, natural water circulation and compressed gas. I refer to the passively cooled 1000MW PWR developed by Government-owned British Nuclear Fuels and their subsidiary American Westinghouse.

As an example of these passive features, the reactor steel containment doubles as the emergency heat exchanger with a high level static water supply displacing the multiple chains of pumps and other "engineered safety features", typical of Sizewell and the current French/German design. Not only does this offer improved inherent safety but also greatly reduced complexity and costs as well as shorter build time. This is all achieved with greatly reduced numbers of components.

Although a new design, the AP1000 is based on proven technology and should prove readily licensable. In the USA, following two years work by the Nuclear Regulatory Commission, it has now been granted a full licence. Regrettably, in the UK, not a single man-hour of the Nuclear Inspectorate's time has been devoted to this potentially world-beating British-owned design.

It is worth emphasising here the important advantages of concentrating all our resources from the outset on a single preferred design; we saw this clearly in the case of the Torness/Heysham B reactors, built simultaneously by Scottish Power and CEGB. Major components will in any case be bought in following competitive tender so there need be no concern that concentrating on a single preferred design from the outset will dilute commercial disciplines. No such loss of focus is allowed to impede the effectiveness of nuclear construction programmes across the Channel.

The next hurdle is the Planning Inquiry System. Repeated examinations of the same reactor design, one for each site need to be replaced by applications for any type of reactor licensable in the UK by the Licensing Authority. Consent on this basis was granted for the Torness site.

But we still need an owner/developer. It was recently claimed that no generating company in our market-led supply industry has yet applied to build a nuclear station. There are good reasons for this, so let us examine each in turn and identify solutions.

No generating company operating in a competitive market could be expected to build the first in a new series of nuclear construction, with the second and third units coming in at much lower costs – typically 80%. Then, just as oil companies form consortia to limit commercial risks in developing major fields, so the majority of nuclear plant, including that in Scotland, has been built by partnerships. This suggests a grouping of companies (three or four would be about right) for each project and secondly, a firm commitment in the initial series for not one station but at least three.

We need to ensure also that our competitive market caters for the very different cost structure of nuclear – the high initial capital, offset by low running costs. Other generators can respond by, for example, varying the operating regime or relying on commercial safeguards such as linking the largest element in their costs (fuel purchase) to the electricity market price. The nuclear operator is peculiarly exposed to Regulator induced instabilities in the market (British Energy found this to their cost) as he must secure a sale for his output at all times. I am not aware of any nuclear plant which has been built without a guaranteed market for its production. In short, when we are talking about investments which will continue for 40, maybe 60 years, we need to recognise the limitations of our essentially short term market for electricity.

But solutions are available. In the case of renewables, each distributor is required to purchase a fixed proportion of his energy from that source. If that is acceptable for wind power with all its limitations why not the same with nuclear – at one quarter of the price.

In the US the need for assurances for new nuclear construction has been recognised with the DOE's publication of a risk sharing scheme worth up to $450m for the first of a new design and up to $250m for each of three subsequent units. The DOE will reserve the right to select the reactor design. The aim is to have new build in place for 2010.

To make an impact on securing our future electricity supplies (not to mention greenhouse gas emissions) and at an economic cost, we need to deploy all the available technologies and that includes a start on new nuclear build now. My checklist for early action is as follows:

a A firm commitment from Government to the earliest construction of not less than three PWR stations. These should include a conditional decision, subject to licensing, in favour of the AP1000 design. The advantages of concentrating our resources on a single design from the start should not be lightly thrown away.

b Reinforce NII resources to allow an immediate start on the licensing of the AP1000.

c Consult with the Regulator and major generators to establish satisfactory market conditions for the output of the new reactors. This is essential to secure financing on acceptable terms.

d Reinforce those areas of R & D which cannot be funded from normal commercial recoveries. Specifically this should include building up a bank of suitable licensed sites.

The ball is squarely in the political arena; let us hope for all our sakes that we shall see an early try!

Radioactive Waste – Is There a Solution?

Eur Ing Ann McCall, Head of Safety, Nirex

Introduction

Radioactive waste exists, it will remain hazardous for hundreds of thousands of years and it is crucial that appropriate measures are put in place for its long-term management.

Viable solutions exist for its long-term management. Many other countries have radioactive wastes to manage. Geological disposal is the preferred option for the majority of countries and most of those are now developing concepts that incorporate retrievability and a phased approach to implementation.

In the UK, Nirex has undertaken extensive development work on geological disposal of radioactive waste and more recently on its phased geological repository concept. Whilst technical solutions have been available for many years in the UK there has never been successful implementation of those solutions.

A technically viable concept in itself is not enough to solve the problem. There is a need to take account of lessons that have been learned from previous experience in the UK and overseas relating to:

- The structure of organisations involved in its implementation.
- The process by which a solution is selected and implemented.
- The behaviour of all parties involved.

Provided these lessons are acted upon we believe the UK's radioactive waste management problem can be solved without further delay.

Lessons and dialogue

Following the failure in 1997 to obtain planning permission for underground investigation of a potential repository site at Sellafield, Nirex set out to learn lessons from that experience. The aim was, through extensive dialogue, to gain an understanding of why previous attempts to solve this problem have failed. Those lessons could then be applied in the development of a new approach which could then lead to the successful implementation of a long-term radioactive waste management solution in the UK.

Structure

In terms of structure, one of the main lessons was the need for the organisation responsible for long-term waste management to be independent of the nuclear industry and for clear separation of long-term and short-term issues.

- Under nuclear industry ownership Nirex was seen by many as a front for the Industry.
- The independence of Nirex's overall objectives, including decisions on packaging standards and specifications, was questioned because of its ownership.
- The need for separation of the organisations looking at short-term and long-term is necessary to avoid long-term issues being "out-prioritised" due to short-term pressures, and so that tensions between short-term and long-term issues are resolved in an open and accountable manner.

In line with Government policy[1] Nirex has now been made independent of the nuclear industry and the Nuclear Decommissioning Agency (NDA). This has been achieved by placing the ownership of Nirex under a Defra/DTI holding Company Limited by Guarantee.

Process

A key lesson was that the process for selection and implementation of a long-term waste management solution must be open, transparent and accountable at all stages. Specific issues included:

- The adversarial nature of the planning process in particular where a planning application is rejected and referred to a public inquiry.
- Recognition of the need to address local issues in order to allow a national policy to be implemented at a given site.
- The need to develop and gain broad acceptance for each step in the implementation process ahead of its application, eg the approach and criteria to select suitable sites.

The Government has now established its Managing Radioactive Waste Safely (MRWS) process. As

part of this process the Committee on Radioactive Waste Management (CoRWM) has been set up to recommend a long term management solution for the UK's intermediate-level waste.

Behaviour

Lessons learned relating to behaviour include the need to:

- Work at stakeholders' speed, be responsive and allow for involvement of a wide range of stakeholder groups
- Have a wide ranging transparency policy
- Reflect stakeholder views in our work programme eg retrievability.

Nirex is now seen as a very different organisation by the main stakeholders it interacts with and considerable progress has been made in transforming its reputation among the close watchers of UK radioactive waste management.

Phased Geological Repository Concept

The Phased Geological Repository Concept is a multi-barrier, phased approach, based on storing wastes deep underground, beyond disruption by man-made or natural events. The development of the concept takes full account of the lessons learned and feedback from continuing dialogue. An example that has fundamentally changed the concept is the incorporation of retrievability.

Before 1997 many stakeholders had asked Nirex to incorporate retrievability into its geological repository concept. These were resisted and we argued that if necessary the waste could be mined out of the facility. We were missing the point.

Following a programme that integrated dialogue with technical development it was established that retrievability could be provided and this is now at the heart of the phased geological repository concept. The incorporation of monitoring and retrievability means that choices on how, and if, to proceed towards closure of the facility are offered to future generations without placing an undue burden on them.

Work has been undertaken to review the status of the Phased Geological Repository Concept as a viable option for the management of the UK's radioactive waste. This has involved an extensive review of the concept including analysis of:

- Our own safety and environmental assessments of the concept.
- Regulators' scrutiny of our work and ongoing dialogue with a broad range of stakeholders including feedback on our programme under our Transparency Policy.
- Previous reviews of our work such as Sellafield Rock Characterisation Facility Inspector's report from the Public Inquiry, the Royal Society Study Group and other related information eg House of Lords, UKCEED

The report on this work and its underlying references have been reviewed by regulators and external specialists.

The results of the above "concept review" supports our view that sufficient work has been done to demonstrate viability of the Phased Geological Repository Concept as the basis for packaging standards and to provide the confidence to proceed with a process to select a suitable site in the UK for its implementation.

By having a viable concept, Nirex is able to derive standards and specifications for packaging of radioactive waste in the UK. Government policy is that ILW will continue to be packaged to Nirex standards and specifications during the MRWS process. These standards and specifications and Nirex's related assessment process are now embedded in UK regulatory arrangements and subject to regulatory scrutiny. Much of this waste is currently stored untreated in ageing facilities beyond their original design life. The standards and specifications allow the waste to be packaged now in a form that is suitable for its long-term management.

A viable concept is essential to identify what is required from a specific site for a phased geological repository. This will form a fundamental part of any site selection process in the UK. It will also form the basis for the characterisation and confirmation of the geological suitability of any potential site.

The Phased Geological Repository Concept has been developed for ILW and certain long-lived LLW. Recently Nirex has drawn upon the vast body of knowledge and experience internationally and has developed a geological repository concept for the UK's HLW and Spent Fuel. This work has been undertaken in collaboration with SKB of Sweden and other national waste management organisations.

Conclusions

Regardless of any decision on new nuclear build in the UK, radioactive waste exists now and something needs to be done for its long-term management. Most other countries are planning to store such wastes in a deep geological repository.

After many years of research both in the UK and internationally we believe that we can demonstrate the Phased Geological Repository Concept to be a viable technical option. However, we are well aware that there is a wide gulf between a technically workable option and a solution that has sufficient support to be implemented, in particular, with the support of people who will be most directly affected. Hence, we believe the implementation of a technically viable option must be done through a process that takes account of social and ethical issues in an open and transparent manner.

Any consideration of new nuclear build requires a full understanding of the wastes that would be created and arrangements need to be made for their long term management. Failure to do so could result in the generation of even more hazardous radioactive waste with consequent risks to man and the environment.

[1]Mrs Beckett's statements of July 2003 and July 2004.

Non-Nuclear Sustainable Energy Futures: What Can the UK Learn From Germany?

Godfrey Boyle, Director of the Energy & Environment Research Unit, Faculty of Technology, The Open University; editor and co-author of Renewable Energy: Power for a Sustainable Future, Oxford University Press, 2004

The debate on the nuclear energy option has been reopened in the UK by those who believe renewables and energy efficiency cannot hope to achieve the 60% cuts in fossil-fuel carbon emissions that will be needed by mid-century to avert catastrophic climate change.

Yet Germany, with higher electricity consumption, more nuclear power stations but poorer fossil and renewable energy resources, is on-course to phase-out nuclear energy by 2020, is phasing-in renewable energy many times faster than the UK and has detailed plans to cut its emissions by 80% by 2050.

In 2003-4, Britain's renewable energy sources contributed 1.3% of the country's primary energy and 3.5% of its electricity while in Germany renewables contributed some 3% of primary energy and 7.9% of electricity. So how do Germany's and Britain's plans for the rest of this decade and beyond compare?

The UK Government's 2003 White Paper on energy emphasised the role of renewables, combined heat and power and energy efficiency in enabling the UK to meet the Kyoto treaty commitment to cut greenhouse gas emissions (mainly carbon dioxide, but including other gases) by 12.5% by 2012. No new nuclear power stations would be built, though the option of doing so in future was left open. By the end of 2004, the UK had reached its Kyoto target. Through the Renewables Obligation the Government plans to increase renewable electricity to 10% by 2010 and to 20% by 2020. It has also pledged to cut 20% of the emissions of CO_2 the principal greenhouse gas by 2012.

Germany's renewable electricity targets are similar: 12.5% by 2010 and 20% by 2020. But by 2010 it also aims to achieve a 10% contribution of renewables to *primary* energy. Germany's Kyoto target is for a 21% cut in greenhouse gas emissions. By 2004, it had reached 19%. The rate of growth in Germany's renewable energy supplies has been astonishing: between 1998 and 2003 the contribution of biomass energy doubled, wind power capacity quadrupled and the number of solar photovoltaic roofs increased six-fold. By 2003-4, Germany's installed wind and solar photovoltaic capacities were respectively 19 and 70 times as great as those of the UK.

Premium prices are paid for renewable power under Germany's Renewable Energy Sources Act, but only €1 per month per household is added to electricity bills and no increase in taxes. Each year the price paid for electricity from new photovoltaic installations falls by 5%, giving solar manufacturers a strong incentive to reduce prices as the size of their market expands. But the premium prices are guaranteed for 20 years, giving confidence to investors.

TABLE

	GERMANY	UNITED KINGDOM
Gross Domestic Product (GDP) (2003)	$2,270 billion	$1,666 billion
GDP per person	$27,550	$27,630
Population	82.4 million	60.3 million
Land area	349,000 sq km	242,000 sq km
Population density (persons per hectare)	2.4	2.5
Annual electricity demand (TWh) (2003) (1 Terawatt-hour (TWh) = 1 billion kWh)	506 TWh	338 TWh
Annual electricity use per person, kWh (kilowatt-hours)	6140 kWh	5578 kWh
Percentage of Electricity from Nuclear (2003)	28.8%	22.7%
Percentage of Electricity from Renewables (2003)	7.9%	3.5%
Percentage of Primary Energy from Renewables (2003)	3%	1.3%
Capacity of wind power installed (2004)	16,600 megawatts	880 megawatts
Number of Photovoltaic Roofs & Capacity (2003)	>100,000 410 megawatts	<1000 5.9 megawatts

The renewable energy sector in Germany has a turnover of €10 billion with 120,000 employed in 2003. Investment is predicted to reach €18-20 billion per year with 400,000 employed by 2020. Germany has also been encouraging combined heat and power generation and stringent regulations on the energy performance of buildings.

Germany's plans for the rest of this century are described in the Environment Ministry's 2004 report *Ecologically-Optimised Extension of Renewable Energy Utilisation in Germany* which envisages primary energy use falling to around half the current level by 2050. By then, renewables should be supplying 65% of the nation's electricity, 45% of its heat and 30% of its transport fuel. Nuclear power will have been phased out three decades earlier and fossil fuel use reduced to around 20% of current levels enabling Germany to achieve an 80% cut in greenhouse gas emissions.

So why has renewable energy, and wind energy in particular, progressed so slowly in the UK? This has largely been due to misconceptions about wind power, its costs and its environmental effects and the electricity system.

The publication of *Wind Power in the UK* concluded that it is relatively cheap, with on-shore wind currently costing around 3.2p/kWh and offshore some 5.5p/kWh. These reduce to about 1.5-2.0p/kWh and 2.0-3.0p/kWh by 2020. By 2010, some 7.5% of UK electricity could come from roughly 4,000 MW of on-shore turbines and another 4,000 MW of off-shore capacity. Moreover, contrary to the 2004 report of the Royal Academy of Engineering, the additional reserve and balancing power requirements of wind power are not onerous. By 2020, some 20% of UK electricity could come from wind at a modest additional cost of 0.17p/kWh. These conclusions are similar to those of the German energy agency DENA, which reported in 2005 that it would be feasible for 20% of Germany's electricity to come from wind by 2020, that the requirement for additional reserve power and new power lines would be modest, and that the additional cost to householders would be 0.5 eurocents per kWh.

The development of wind power in the UK has been hindered under the Renewables Obligation by financial incentives to seek the windiest sites, which are often the most visually conspicuous and therefore most likely to be opposed by amenity groups. The value of the Renewables Obligation Certificates (ROCs) is determined by market forces and can go down as well as up. This is unlike the German approach where investors will be paid a fixed price for electricity over 20 years. However, the new guidelines issued to Local Authorities have resulted in a higher rate of planning approvals for on-shore wind farms.

Several UK offshore wind farms have been built, but progress has slowed as a result of mergers among the large Utilities and their reluctance to bear the risks, preferring to wait and learn from others' mistakes. The capital grants offered by the DTI to offshore wind projects are insufficient to compensate firms for the initial risks – though few doubt that offshore wind will be highly successful and profitable.

So how can the UK progress renewable energy and energy efficiency? More and "smarter" support is needed – with higher funding levels for technologies, earlier in their development, such as offshore wave, tidal and wind, biofuelled electricity and photovoltaics. The DTI has improved funding recently, with wave and tidal receiving capital grants and fixed price support, in addition to increases in value of ROCs.

Renewable electricity is important, however electricity provides less than 20% of UK delivered energy; incentives to increase the proportion of renewable energy used in heating and transport are urgently needed. Better community involvement in local renewable energy projects would improve acceptance.

Incentives for efficiency and penalties for inefficiency, backed up by stringent regulatory measures are needed for buildings, industry and transport. The UK should accept that energy is cheap, and that increased costs will encourage more efficient use with special protection for low-income consumers.

The Government's purchasing power could stimulate the market for low- and zero-carbon goods and services. There should be scope for low interest loans to assist investment in renewable and sustainable energy projects – perhaps through public-private partnerships, with Government funding some of the investment at low interest rates and the private sector funding the rest at higher rates of return.

Universities are aware of the need for education and training for the thousands of specialists who will be required to build and maintain the sustainable energy infrastructure of the 21st century. A major public education programme is also needed to better inform non-specialists on key issues.

Germany's track record and future policies demonstrate that it is quite possible to deploy renewables and energy efficiency *fast*. The scenario for 2050 shows how an 80% cut in CO_2 emissions by 2050 can be achieved without nuclear power. This is similar to the UK Royal Commission on Environmental Pollution's scenario number four for 2050, which entailed a 47% cut in primary energy use, with energy mainly supplied by renewables with a much-reduced fossil fuel contribution and no nuclear power.

A new nuclear programme for the UK is undesirable because it would starve renewables of investment and send the wrong signals to investors and to other countries.

The 2003 White Paper strategy remains broadly correct, but the UK Government needs to make a greater commitment to renewables and energy efficiency comparable to Germany, if its ambitious and laudable CO_2 reduction targets for 2050 are to be achieved.

In discussion the following points were made:

The finances and activities of the nuclear industry should be transparent in future although for historical reasons associated with the Cold War and military priorities, this was not always the case hitherto. Current Franco-German policies for power generation should be regarded as a combined and integrated system, with plans for future investment in nuclear facilities being made in France and for renewables in Germany, especially for geothermal power, their secret weapon. Hence an overview of future German plans for power generation should also take account of their investments to be made in France. Thermal generating power is an essential requirement as a back up to wind-power making it four times more costly than nuclear power. Future requirements for investment in power generation before 2030 are £30bn for Wind or £10bn for Nuclear. Progress is being made with fusion but the timescale before the delivery of commercial power from this source leaves a window that could filled by nuclear fission. Current stocks of Plutonium are sufficient to fuel two reactors for 25 years each. A coherent narrative is urgently needed to put together an integrated framework for nuclear waste disposal. A balanced energy system is needed and time is now very short. We must deliver something that is workable. The rotation of wind turbine tips is restricted by the speed of sound. Renewables are based on new technologies that are currently too risky to rely on when we already have the means to develop power and reduce CO_2 emissions. If we have a problem with climate why throw out the one method we have for reducing climate change? Don't look back, but be prepared for changing technologies in future.

One hundred years of hormones

Tom Parkhill, Society for Endocrinology

In 1903, Ernest Starling and his brother-in-law, William Bayliss, were repeating Pavlov's (of Pavlov's dogs fame) experiments on secretion of digestive juices into the gut. Pavlov believed that secretion was solely under nervous control, but Bayliss and Starling showed that a circulating factor, which they called secretin, also played a part. Over the next couple of years, it became obvious that secretin was one of a class of factors which are released into the bloodstream and stimulate activity in a different part of the body. Over dinner at Caius College, Cambridge, Starling and the distinguished biologist William Hardy pondered what they might call these new circulating factors. A classical colleague, W T Vesey, produced the Greek verb for "excite" or "arouse". In July 1905, Starling first used his new word in the Croonian lectures at the Royal College of Physicians, *'These chemical messengers, however, or hormones (from ὁρμάω, I excite or arouse) as we might call them…'*

A hundred years on, hormones are centre-stage. Most non-scientists might not know exactly what a hormone is, but the concept of a chemical surging through one's body is familiar to everyone, and terms such as testosterone and adrenalin are in everyday use.

We now understand how hormones rule our lives. They determine our mood, our weight, when we go through puberty, how aggressive (or awake) we feel, our stress levels, and how strong our bones are. They control our sugar and water balance. They determine whether we will grow to normal height, become fantastically tall or remain very short. They regulate our reproduction and wreck our adolescence. At the same time, there are important areas of endocrinology where a better understanding is beginning to allow us to take control, and where the practical use of the science will allow us to make decisions which will affect not only our own individual lives, but perhaps even the lives of future generations.

A growing problem

The frightening increase in the levels of obesity and type 2 diabetes (where your body does make insulin, but doesn't respond to it properly, ie becomes insulin resistant) is one of the great public health challenges of the twenty-first century. Almost two thirds of UK adults are now overweight or obese, and obesity is one of the main risk factors for type 2 diabetes; as the level of obesity rises, so does the incidence of type 2 diabetes. Diabetes UK estimates that there are approximately 1.8 million people in the UK with confirmed diabetes, with up to a million more who have undiagnosed type 2 diabetes. The diabetes epidemic means that, internationally, we are seeing a doubling of the incidence of diabetes every generation. Controlling how the population gains weight and understanding why this leads to diabetes underlies much of the current work on the prevention and cure of diabetes and obesity. From work on islet cell transplantation, to elucidating the mechanism of insulin resistance, to work on how hormones control our appetite, hormones are central to tackling the problem. For example, there's a significant amount of work under way into how the hypothalamus secretes hormones that control our appetites. UK researchers are amongst the world leaders in the development of hormonal methods of appetite control.

To HRT or not to HRT?

In 2002, the US National Institute of Environmental Health Sciences labelled steroidal oestrogen a "known carcinogen", which was probably a shock to the more than 30 million Americans taking hormone replacement therapy or the contraceptive pill. Around 3.5 million British women use the pill at any one time, and the Royal College of Obstetrics and Gynaecology estimated in 2002 that around a third of British women in the 50-64 age group were taking HRT. The publication of the US *Womens' Health Initiative* Study, followed by the British *Million Women Study*, changed everything for HRT. The realisation that HRT increases the risk of breast cancer led to large numbers of women discontinuing post-menopausal HRT. However, HRT is still a valid treatment in many circumstances, and the supply of reliable information reaching the public has been far outstripped by an avalanche of HRT scare stories in the last three years. The average GP, never mind the woman in the street, is confused by the deluge of

contradictory information. The Society for Endocrinology believes that the lack of good information on HRT for the public has been one of the failures of the medical community and the government over the last three years, and this needs to be addressed.

The declining male?

Oestrogens, or at least oestrogen-like compounds, are also present in our environment. The last 20 years have seen increasing evidence on hormonally-active substances disrupting natural ecosystems. In the late 1960s it was found that female whelks had developed male characteristics, especially if they were in proximity to the antifouling agent tributyl tin. The example that probably first hit the international headlines was the decline of the Florida alligator population, believed to be due to endocrine disruption. But there is ample evidence of endocrine disruption even in British freshwater fish populations. So far, there's limited evidence that this endocrine disruption is causing problems in the human population, but of course this needs to be closely monitored, especially in the light of the rapidly decreasing male sperm counts observed in recent decades.

The emancipated female

Hormone treatments in the last hundred years have led to control of type 1 diabetes, thyroid conditions, pituitary conditions, and many other potentially fatal or debilitating conditions, but the best-known successes of endocrinology in recent years are probably in reproduction and oncology. A world without the contraceptive pill (first used in 1956) would be very different to the one we know today. Many researchers are now working towards development of a "male pill", and most activity centres around finding the right combination of hormones to eliminate fertility while maintaining libido.

Hormones and cancer

Cancer treatment has been revolutionised by the understanding of the role of hormones and growth factors in cancer development and progression. Tamoxifen, which helps slow the growth and reproduction of breast cancer cells by blocking oestrogen in the breast, was developed in the UK, and is one of the great triumphs of British endocrinology. Now, new drugs such as aromatase inhibitors and SERMs (tamoxifen is a SERM) hold out the prospect of not only controlling breast cancer, but also preventing it in those most at risk. The substantial reduction in mortality from breast cancer has to be one of the main medical achievements of the late twentieth century.

The next hundred years

In her recent book, *The Truth About Hormones*, journalist Vivienne Parry estimated that a quarter of all Nobel prizes in medicine and physiology in the last 35 years have been awarded in endocrinology. Given the quality of current research and the range of topics it covers, this could easily be exceeded in the next 35 years.

In many ways, the challenges in endocrinology are the same as in many other areas of British science and clinical practice. We need more good young scientists to take up the discipline, and then we need to keep them both in research and in the UK. There is a frightening lack of good young endocrine scientists to replace the current generation of senior scientists, and this will not change until there are better and clearer career structures – scientists with young families do not want the insecurity of repeated 2-3 year grants on low salaries. In clinical endocrinology, there are similar issues in terms of attracting top young doctors into an academic discipline such as endocrinology. The current UK training system makes it less attractive to opt for a career in clinical research.

Another issue for parliamentarians is that many of the major medical issues of the twenty-first century, such as obesity and osteoporosis, are being dealt with on a fragmented basis. For instance, osteoporosis research and care can take place in endocrinology, rheumatology, gerontology etc, with sometimes little co-ordination, despite the fact that most new developments are endocrine in origin.

Many endocrine diseases are comparatively rare, and also complex, and need to be treated in specialist centres, where surgeons see many cases each year and physicians are involved in current research. For instance, in an article in the *British Medical Journal* in 1999 Clayton and colleagues demonstrated that surgeons in specialist centres obtain substantially better results in the case of pituitary tumour operations. It is important that the current moves towards care at community level do not prevent patients with rare and complex diseases being managed by appropriate specialists.

Pavlov received the 1904 Nobel prize for his work on nervous secretion in the gut. As Pavlov went on to become famous for his later work on conditioned reflexes, his work on gut secretion became comparatively neglected. But it was Starling's discovery of hormones that came to influence all our lives.

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Where to find out more:

The Society for Endocrinology is commemorating the hormone centenary through a special website, www.100yearsofhormones.org. The site contains an article on the history of endocrinology as well as a series of "Starling Reviews", which look at important issues in endocrinology in the foreseeable future. *The Endocrinologist*, the newsletter of the Society, also contains an article on "Ten hot hormones", a brief introduction to some of the hormones which are currently attracting most research attention (http://www.endocrinology.org/sfe/endocrinologist/end07508.pdf). If you'd like to receive regular copies of *The Endocrinologist*, or if you want more information on endocrinology, contact Tom Parkhill or Jo Thurston on 01454 642206, info@endocrinology.org.

Steel's Fire Performance Under Scrutiny

The ability of structural steel to withstand major fires is under scrutiny. The latest findings of the US-based National Institute of Standards and Technology into the collapse of the World Trade Center coupled with the recent collapse in fire of the perimeter steel columns of the Madrid Windsor Torre building question the performance of structural steel in fires in high rise buildings, reports Anna Scothern, Head of Performance at The Concrete Centre.

The collapse of the World Trade Center towers following the terrorist attacks of September 11th 2001 resulted in the death of 2,749 people, over 350 of which were fire fighters and emergency response personnel. The National Institute of Standards and Technology (NIST) has conducted a major building and fire safety investigation into the factors that contributed to the collapse of the buildings. Its findings confound the original belief that one of the main factors of the structural steel failure was the high temperature of the aviation fuel fires. According to NIST, the fire load was due to the office contents and not the aviation fuel, the majority of which was dissipated and vaporised in the initial impact and explosion. It was this impact of the aircraft that triggered the resultant structural steel failure by dislodging the fireproofing. This was followed by the failure of the connections which resulted in external column instability and progressive collapse.

Particularly damning for the steel frame is that, according to NIST, the building design of the towers was robust with sufficient redundancy. So this was a robust steel frame that failed to withstand an office loading fire. American and European clients are now demanding high rise buildings to be designed to survive complete burnout.

Initial investigations into the recent fire that devastated the Windsor Torre in Madrid again highlight the problem of steel's performance in fire. Failure was limited to the perimeter steel frame whereas the internal concrete frame survived complete burnout with no collapse.

The fire which started on the 21st floor of the 32-storey building quickly spread due to lack of fire stops between the curtain wall façade and the concrete floor slabs. Designed and built in the 1970s, the tower was built using traditional methods of design. Extensive refurbishment was under way at the time of the fire. Part of the refurbishment programme was to bring the building's fire standards up to date with the installation of a range of active fire prevention and resistance measures.

Failure of the structure happened with the collapse of the steel perimeter columns which resulted in the floor slabs collapsing as the edge support was taken away. The massive concrete transfer slab at the 20th floor prevented further progressive failure. However, as the debris fell the cladding below was smashed and the fire spread to lower floors.

The height of the tower and extent of the blaze meant that firefighters could only mount a containment operation. The fire was eventually put out after 26 hours. Preliminary investigations have found that thanks to the concrete slab at the 20th floor and the inherent fire resistance of the central concrete columns and core the building remained standing with the structural failure being confined to the perimeter steel section.

The structural concrete performed extremely well demonstrating once again the robustness of traditional methods of construction. However, the intensity of the fire proved too much for the perimeter steel frame. It is understood that sprinklers were being installed but this is an example of what can happen when sprinklers fail to contain the initial fire. American data collected following the WTC fires show that 1 in 6 sprinklers fails in actual fires.

The scrutiny on steel's ability to withstand major fires comes at a time when the performance of reinforced concrete structures during fires has been fully vindicated by the BRE in its report "Fire Safety of Concrete Structures: Background to BS8110 Fire Design". The report found that in many cases the presumed periods of concrete fire resistance is very conservative. The BRE report investigated the background to methods for establishing the fire resistance of reinforced concrete

Windsor Torre during deconstruction.

structures specified to BS8110. In particular, it examined and revisited the original research and test results that underpin the tabulated data.

The research brought together a body of information that covers test results and research carried out over a number of years. With the passing of time there was a concern that much of the important work supporting the development of codes and standards could have been lost if it was not published. It was felt that there was a need to collate and assess all the relevant information to ensure that the important lessons from the past were recorded and used to help define the strategy for a new generation of codes and standards. To this end, the research focused on the original research and tests underpinning the tabulated data in BS8110 in order to assess the relevance of the prescriptive approach to modern concrete construction.

The research found that the experimental results used as data for developing the tabulated approach to BS8110 fully supported the provisions of the code in relation to assumed periods of fire resistance. Furthermore, the research found that these provisions are in many cases very conservative as they are based in the assumption that structural elements are fully stressed at the fire limit state and take into account the spalling characteristics of concrete.

Not only does the BRE report clearly demonstrate that evidence from the concrete performance in real fires over a number of years prove that the tabular approach has been effective. It also suggested that the conservatism of the existing data means that further research would potentially result in even greater construction and cost economies for concrete structures.

The prescriptive approach of individual elements of BS8110 will continue to be popular despite the increasing adoption of the whole building performance-based approach of the Eurocodes. The research carried out by BRE is important not only because it fully validates the fire resistance of concrete by highlighting the conservatism of the prescriptive approach but also because by doing so it proves the relevance of the historic tabulated data for future high rise and low rise buildings.

The concrete industry is not resting on its laurels. Research continues across Europe, America and Japan to develop bespoke concrete mixes able to withstand the most intense fires, for example those experienced in tunnels where the temperature can reach 1350ºC. Design guidance is being developed for the new generation of fire Eurocodes and research continues to develop a better understanding of the robustness of concrete buildings in fire.

British Council Science from the Past to the Future

Dr Lloyd Anderson
Director, Science, British Council

The British Council started in 1934, to make "the life and thought of the British peoples more widely known; and to promote a mutual interchange of knowledge and ideas". Right from the beginning, science played a crucial role in its work.

At the outbreak of war J G Crowther (1899-1983) was appointed the first Director of the Science Department. His view was that scientific knowledge should serve as a transnational *lingua franca* in discussions leading to a narrowing of disparities between rich and poor.

This was an exceptionally far-sighted ideal but it was not always shared. In 1942, the British Government, acting through the British Council, decided to establish a Cultural Scientific Office in Chungking but the idea that British culture might be enriched, as Crowther believed that it would be as a result of a deeper understanding of Asian science and technology, was derided in high places. Who would dispute that today?

Crowther also saw that many academics in Nazi Germany and Austria would eventually be either banished or killed. The work of the Society for Visiting Scientists, another product of Crowther's directorship at the British Council, deserves wider recognition for the hospitality and financial assistance which it extended to scientists from the occupied countries.

From about 1943 onwards the Science Department, represented by Crowther, played an important part in creating the international cultural body which ultimately became UNESCO. The three themes apparent here from the start of our work with scientists – science as an international *lingua franca*, scientific promotion in-country, and the encouragement of networks of visiting researchers – are as important for what we do today as they were in the 1940s.

In 2005, cultural relations are more relevant than ever. Science, engineering and technology help to extend our understanding of the world and develop imaginative solutions to shared problems. Science provides a common platform for collaboration and discussion, bringing people together across deep cultural divides, with a universal language that encourages the mutual understanding essential for a more peaceful, secure and prosperous world. Science is also a central driver for social and cultural change.

A successful science and innovation strategy stressing the achievement of world-class excellence for the UK needs a clear international dimension. As the Treasury's 10-year Framework notes, international competition is rising rapidly, and a supply of new ideas is crucial to British competitiveness in a global economy. This in turn is dependent on securing the UK's reputation internationally. Surveys show that a reputation for economic success based on science and innovation, world beating companies and an international financial trading centre influences people's favourable perceptions of the UK more than any other factor.

Science is increasingly complex, requiring co-operation between laboratories and researchers from a range of institutions around the world and sophisticated information processing and sharing. It cannot be carried out in isolation. 5% of the world"s science is carried out in the UK. 95% is not. This makes effective international networking central to ensuring the UK can capitalise on its ability to invent and innovate. We need to work closely with other countries if we are to be seen as a global hub for scientific and technological innovation and new knowledge.

The British Council, with its presence in 110 countries, is in a unique position to help form the networks necessary to the pursuit of a global knowledge economy. And the UK is well placed to facilitate such networks because it is often viewed as the partner of choice: its scientists are seen to be good research managers.

The UK's reputation in science needs to be advanced in a number of ways:

- By increasing engagement and influence with current and future scientists internationally, through building sustainable networks which facilitate co-operation and enable the UK to position itself as a global hub;
- By ensuring that the "brain gain" of scientific and creative talent is balanced by a commitment to capacity building for education and research institutions in

countries which suffer the loss of academic and research talent;

- By sustaining the high quality reputation of UK education abroad in the face of increasingly aggressive competition from the education sectors of other countries so that it continues to be an attractive destination to high-achieving students from overseas.

Improved, broader acceptance internationally of advances in science, and of their potential application, is critical to the UK. Public perceptions about areas such as genetic engineering and fears generated by globally transmittable diseases in food products are two examples of where adverse economic consequences may flow from uninformed or unbalanced debates in other countries.

There will be an increasing role for trusted bodies such as the British Council, operating at arm's length from government, to facilitate informed and balanced debate between scientists and the public internationally, drawing on a plurality of views. As a non-governmental public body, we are able to do things that other UK stakeholders cannot, working with government and non-government organisations and agencies, the public and private sector, and voluntary bodies.

We currently have science programmes in 62 countries, with a global budget of £8 million. Science activity tends to be greatest in Europe, East Asia, the technologically advanced Commonwealth countries and Latin America, prioritised on the basis of research capacity, demand, potential impact and stakeholder interests. These interests come together through the Global Science and Innovation Forum, a cross-Departmental committee chaired by Sir David King.

The Science team delivers programmes that support the British Council"s purpose: "To build mutually beneficial relationships between people in the UK and other countries and increase appreciation of the creative ideas and achievements of the UK". We have a dual emphasis on professional partnership and social relevance.

The activity is organised under two interdependent areas: "excellence in international science", engaging and influencing scientific communities; and "understanding science in society", spreading awareness and appreciation of the UK with wider international audiences.

The first programme area sustains communications for innovation, stressing engagement and wealth creation, and is targeted at scientific communities, engineers and research managers around the world. The key outputs are scientific collaboration through exchange of ideas and knowledge, and sustained relationships and networks between young scientists. The main mechanism is a scheme to fund bilateral workshops, called "International Networking for Young Scientists".

The second area sustains communications about innovation, stressing cultural relevance and social well-being, and is targeted at the public, media, policymakers and other communities of interest. The key outputs are international awareness of the UK's role in scientific creativity, and collective debate about the impacts on science on people's lives. It includes major campaigns such as ZeroCarbonCity and mechanisms such as *café scientifique* and a web magazine.

ZeroCarbonCity aims to reframe the international climate change debate by exploring the energy challenges facing the world's greatest cities. Cities occupy a pivotal position, as major energy consumers, but also as centres of innovation and new thinking, and international links can be built between cities, even when states cannot agree. ZeroCarbonCity shifts the emphasis away from climate change impacts and inter-governmental negotiations, towards mitigation, adaptation, and practical measures that people can adopt. In so doing, it raises awareness of the UK as a country committed to tackling the problems.

How all this fits together at the policy level is illustrated by looking at the Barcelona 3% target (for EU Member States' percentage spend of GDP on research and development), which, if it is to be met, will require some 700,000 more scientists by 2010. However, the supply of researchers is low in comparison to this demand: the research population is ageing, the dropout rate in science at undergraduate level is high and increasing, and surveys show there is widespread disinterest in science among teenagers.

One solution is to import researchers from other countries to make up the shortfall. But "brain gain" fails to address the root causes: poor career prospects, society's negative perception of scientists and the value it places on them, and the resulting lack of interest in science on the part of young people.

Such an approach is also unsustainable in the longer term because it fails to recognise that foreign governments talk about the need for symmetrical co-operation, where each country has something to learn and gain from the other. Countries want to be part of the global knowledge economy and hold on to their skilled people in the pursuit of new knowledge. It is no longer about a one-way flow of experts or training in pursuit of capacity building, but an agenda based on mutuality.

The Council is working to address different aspects of the problem. One is to help visiting researchers from other countries settle temporarily in the UK and to help internationalise our own young researchers. To this end, we are setting up mobility centres and an online Association of Visiting Researchers, where former, current and prospective "mobile" researchers can help each other by sharing experiences.

Another is to raise awareness of researchers and their work with the public, through open talks and discussions about the impacts of science on society, science in schools, and youth conferences. This will change perceptions and show that researchers make an important contribution to the economic, political and social fabric of Europe and are an important part of culture and society.

Nuclear Power: What do MPs and the public think about it?

Report by Robert Freer

The era of commercial nuclear power started in 1956 when the output from the nuclear power station at Calder Hall in Cumbria was connected to the National Grid, but no new nuclear power stations have been built in the UK since Sizewell B was completed in 1995.

There is more activity overseas. Today there are more than 400 nuclear power stations operating around the world and 35 under construction with a total installed capacity of some 360GW and an output of more than 2700TWh. In some countries nuclear power has a dominant position. In France nuclear power supplies 78 % of domestic demand and their national CO_2 emissions from fuel combustion are 30% less than in the UK.

The declining production of indigenous fuels in the UK and the search for carbon-free generation has focused attention again on the use of nuclear power and the need to inform the public and engage them in the decisions to be taken.

To measure the attitude of the general public and MPs to nuclear power in the UK MORI has conducted a series of surveys on energy matters and the results were presented by Robert Knight, Research Director, MORI, at a conference in London on "Energy Choices" on 2 December 2004, in a paper entitled "Public and MPs' Attitudes to Nuclear Energy".

Mr Knight explained the need to focus on specific subjects and the questions asked were about:

Favourability towards nuclear energy

Support for replacement new build

Preferred choices of energy sources

The big issues: Environment, security of supply, radioactive waste

What should we be doing?

Whom should we trust in this matter?

The results of the latest MORI research in December 2004 showed that public favourability towards the nuclear industry is the most positive, on balance, for some years, with the favourables (28%) edging ahead of the unfavourables (26%). However, around half of those questioned continued to be undecided and did not give an opinion either way.

On the same question, MPs (when questioned last summer) were also almost equally divided in their opinions for and against except that only a quarter of those asked did not have an opinion.

The replacement of existing nuclear power stations by new build nuclear power stations is more popular than ever, though support remains almost matched by opposition. Thirty-five per cent support new build while 30% oppose it, with a further 35% undecided. The trend since 2001 has been for the opposition to new build to be decreasing and for support to be increasing. Those opposed to new build gave safety as their main reason.

Other recent MORI research showed that the "preferred choice of energy sources" are likely to cause problems to energy engineers because the preferred choice by a long way was the sun. And the second choice was wave energy. Unfortunately many engineers consider that neither of these sources are likely to provide reliable and economic energy on a large scale for some years to come.

The fourth question sought to identify what the public considers to be the Big Issues, and what factors should be taken into account in deciding the method of generating electricity. The main concern of the public in deciding the method of generating electricity was the effect on the environment, but some people did not understand what was meant by global warming. A third of those surveyed thought global warming was related to the hole in the ozone layer or acid rain.

When asked about the effects and consequences of specific sources of energy one half of those surveyed believed that nuclear power does not produce greenhouse gases, and two-thirds were concerned that by 2020 we shall have to rely on imported gas to generate much of our electricity.

The question of "What should we be doing?" and specifically what should we be doing to "keep the nuclear option open" was directed to MPs and popular views were to educate the public, improve the image of the industry or simply to take the decision now to build new nuclear power stations. Doing nothing was only a minority opinion, though one in four favoured closing off the option now.

The final question was intended to find out who is trusted to tell the truth. The result was that the public generally trust doctors, teachers and clergyman. At the bottom of the list those least trusted were business leaders, politicians and journalists. However, over half those questioned were at least fairly confident that the nuclear industry operated in the best interests of society.

In summary it appears that while the public is not unfavourable to nuclear energy, especially if the alternative is relying on imported gas, there is still a major task to be undertaken in informing and engaging the public to help everyone understand the problems facing the energy industry and the possible realistic solutions, but as Mr Knight concluded "deep rooted suspicions of bias disqualify many of the best candidates to lead this effort".

Facing the Challenge of Change for a Safer Environment

A perspective from the new BNFL subsidiary, British Nuclear Group

Lawrie Haynes, Chief Executive Officer, British Nuclear Group

April 1st 2005 marked the beginning of a new era for the British nuclear industry. Following the 2002 White Paper, Managing the Nuclear Legacy, a review was undertaken by the Government and BNFL. Completed in December 2003, it predicated an entire re-structuring of the industry and British Nuclear Fuels. A new body was to be created to own the country's main nuclear sites, the Nuclear Decommissioning Authority (NDA). BNFL was to be transformed from owner of these sites to management and operations contractor. In due course the market for decommissioning and clean-up was to be opened up to competition. These arrangements were intended to ensure that the country's nuclear legacy is cleaned up as safely and cost-effectively as possible. They came into effect on April 1st 2005 with the formal inception of the NDA.

The work undertaken over the past two years by BNFL to prepare for these changes has been immense. The company is undergoing a period of transition to focus on remediation and clean-up, principally by means of the creation of a subsidiary, British Nuclear Group.

This new company employs around 15,000 people, with its primary focus on the management of eighteen sites in the UK. It draws its strength from an experienced and highly skilled workforce. This includes nuclear clean-up and decommissioning work that dates back 30 years, and remediation projects on no fewer than 50 nuclear sites around the world. At the same time, as the UK clean-up market is opened up to competition, change is inevitable. Adding to the considerable knowledge of the existing workforce, additional skill sets have been engaged from the gas, oil and construction industries. New financial control systems have been introduced and new IT systems designed and installed. Perhaps above all, a new culture has been developed within the organisation as the NDA rightly requires a fundamental change from the past. The new culture is competitive, commercially aware, and capable of rapidly tailoring its activities to the requirements of its new customer, the NDA, while continuing to deliver for existing customers. It is right, too, that it puts safety above all other considerations.

Generally, British Nuclear Group's results to date have been impressive. Electricity generation has been very close to target, some key clean-up milestones have been delivered ahead of programme, layers of bureaucracy have been stripped away and greater levels of responsibility and accountability throughout the organisation have been achieved. Moreover, the April handover to the NDA was smoothly managed, and near-term work plans have been fully agreed with the Authority. There have been three particular highlights. The Vitrification Plant at Sellafield – that converts radioactive wastes into a stable glassified product – achieved its best ever year of operations, exceeding its target to deliver 460 containers to storage; the discharges of the radionuclide Technetium 99 at the same site have been reduced by 90%, two years ahead of schedule; and the last of 71,000 fuel elements has been removed from Hinkley Point A power station four months ahead of schedule.

The real challenge, though, lies ahead. It is clearly incumbent on British Nuclear Group to place itself in prime position for the NDA's clean-up contracts when these are opened to competition. The company will achieve this by continuing to build a strong site management company in the UK that meets and – where at all possible – exceeds customers' needs. There is also an opportunity to grow and operate a vibrant, project-based company to address the nuclear sub-contractor market, both in the UK and in continental Europe.

At the same time, in the ongoing debate over the country's future energy supplies, British Nuclear Group has the opportunity to buttress the case for building a new and more efficient generation of reactors by showing that Britain's existing fleet of plants can be safely and economically decommissioned. This decision lies entirely with the Government. But by applying its exceptional experience in dealing with complex nuclear challenges, British Nuclear Group is committed to delivering a safer environment, both now and for future generations.

The Charities Bill and Learned and Professional Societies

Keith Lawrey
The Foundation for Science and Technology

Learned and professional societies are voluntary membership bodies concerned, in the first case, with the development of a subject discipline through research, meetings and publications, and, in the second, with the regulation of professional practice by setting standards to begin and to continue professional activity – including assessing continuing professional development, regulating practice according to a code of professional conduct, and operating a disciplinary code. In fact, many professional societies undertake learned society activities at the same time. Most societies are incorporated as limited liability companies by guarantee although some are incorporated by Royal Charter. Many are also registered as charities on the grounds that their objects are educational and that there is a considerable public interest in the regulatory and developmental work that they do.

The Charities Bill is intended to modernise the law and status relating to charities and to provide a definition of "charity". It followed the publication of the recommendations of the Strategy Unit and now includes:

- new forms of incorporation such as the CIO (the Charitable Incorporated Organisation);
- improved accountability and transparency;
- limited payment to trustees for special services over and above their trusteeships. (A recent survey has shown that three-quarters of those asked did not want trustees paid as trustees);
- power to be given to the Commission to relieve trustees of liability in appropriate cases – a power currently available only in the High Court.

Most of these matters do not concern learned and professional societies whose accountability to their educated (and often demanding) memberships has to be transparent, who regard election to trusteeship/council membership as a privilege, and whose democratic procedures are unlikely to countenance trustees being relieved of any liability, There is a view that the Bill, when enacted, will not much affect societies because they constitute a small and atypical sector of the larger charity world which is significantly concerned with fund-raising – an activity with which most societies are not greatly involved.

There is also a view which fears that proposed emphasis on the public benefit test for future charity registration might well affect societies. If the proposed legislation has independent schools in its sight, many might see societies as similar bodies charging high fees for services primarily provided for their own members. Larger societies have a high profile in respect of the public protection they give by codes of conduct and disciplinary hearings but smaller societies are often by-passed when complainants and employers deal with allegations of malpractice without reference to the professional society concerned. Furthermore, the public interest in the advancement of subject knowledge is not necessarily rated as highly as the benefits provided by the society to its members. The Foundation for Science and Technology has prepared a paper for discussion with the Commission about the fundamental roles of the learned and professional societies in respect of their contribution to public benefit and it is hoped that agreement on this issue will be reached in the near future.

In discussions with the Charity Commission about this issue so far, the matter of the application of the public benefit test – which is the point at issue – has been addressed as follows:

- there are three elements to this test: social value, poise, and accessibility. Social value is currently presumed in the case of educational, religious, and welfare purposes but, of course, that presumption could be rebutted (eg the presumption does not turn a school for pickpockets into an educational charity). The change contemplated by the Bill is that social value would not be presumed in the future in the case of any of the four (to become twelve) heads of charity. But learned societies should have little difficulty in demonstrating the social value of the work in which they are engaged;

- in respect of poise (the balance between public and private advantage), the predominance of public advantage would continue to be required. This is an issue which is of relevance to the charitable status of societies but there appears to be no change in the law here and there are precedents to show how the law has been applied in favour of the charitable registration of societies in the past;
- in respect of accessibility, the benefits of the charity would have to continue to be accessible by the public. No change is made by the Bill. The problem here – although not perhaps of any great concern to learned societies – is with the current law. Does the accessibility test depend simply on the breadth of the beneficiary class stated in the trusts of the charity? Or does the question of practical exclusion by cost of the services provided also have to be taken into consideration. (As Mr Justice Darling once memorably said : "the law, like the Ritz Hotel, is open to all!")

One area in which there would be an undoubted benefit is in respect of the proposed Charitable Incorporated Organisations (CIO) which would avoid the current problem of an applicant for charity registration having to register as a limited liability company before applying for charity status and then finding that the Charity Commission wanted changes to the objects thus requiring another general meeting to change the objects clause in the memorandum of association. There will also be the advantage of abolishing the dual reporting to, and regulation by, the Registrar of Companies and the Charity Commissioners.

Although there was no reference to the liability of members being limited other than in the event of a winding up, the Commission has confirmed that members' liability for the debts of the CIO would be limited probably on the lines of the present guarantee companies. The Bill provides that CIO would have to be in the charity's title yet current legislation provides for the omission of Ltd in titles of appropriate registered companies – a provision universally used by societies which are incorporated – and it is hoped that a similar exemption will apply (otherwise societies might have to adopt devices such as using the society's name as the banner and printing the fuller name in smaller type underneath). The position of societies incorporated by Royal Charter is not clear: presumably they will have to register as charities under the existing procedure (which will remain in being) because they cannot be incorporated twice – by Charter and as a CIO – and they are unlikely to want to surrender their Charters!

House of Commons Library Science and Environment Section
Research Papers

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

The Natural Environment and Rural Communities Bill

Research Paper 05/39

The Bill provides for the merger of English Nature with part of the Countryside Agency and part of the Department for Environment Food and Rural Affairs to form a new agency responsible for conserving, enhancing and managing England's natural environment, to be called "Natural England".

The Commission for Rural Communities, formed out of another part of the Countryside Agency, will take on the Rural Advocate role of ensuring that Government policies take rural needs into consideration.

The Bill contains various other measures relating to wildlife, to Sites of Special Scientific Interest, National Parks and rights of way for mechanically powered vehicles.

The Bill extends only to England and Wales except for a very few points.

Parliamentary Office of Science and Technology

Recent POST publications

Special publication: At the time of each general election, POST produces a special four page briefing on issues that it considers likely to appear on the parliamentary agenda during the course of the new Parliament.

Science in the new Parliament

May 2005

How will the UK meet its energy needs in the future? How can raw human genome data help to understand and treat disease? What is the best way to combat internet crime? Will there be a shortage of science graduates in some subjects? All of these are science and technology (S&T) based issues that the new Parliament may face. They show how deeply embedded S&T has become in public policy. This briefing highlights issues that could be topical in the coming years. It covers those with a largely national focus such as public health, new technology, security and science policy, as well as those with a more global focus such as energy, climate change and development.

Early warnings for natural disasters

May 2005 ***POSTnote 239***

Sudden natural disasters, such as hurricanes, floods, and earthquakes, can strike in minutes. Although they cannot be prevented, some can be forecast. Their effects can be reduced if communities are warned and prepared. Although the UK does experience natural disasters, this note addresses its role in Early Warnings (EWs) in developing countries, where sophisticated EW systems may be difficult to implement and maintain. The UK Department for International Development (DFID) and others, emphasise that EWs should be integrated in a wider disaster risk reduction strategy, rather than be a "stand alone" solution.

Gene therapy

June 2005 ***POSTnote 240***

In 2003 the Government pledged £50 million over three years to harness the potential of developments in genetics for the benefit of NHS patients. £10 million of this has been earmarked for gene therapy research and development. This briefing introduces gene therapy, outlines the potential benefits for patients and examines current regulatory and technical issues.

Fighting diseases of developing countries

June 2005 ***POSTnote 241***

Better drugs and vaccines are needed to fight HIV/AIDS, tuberculosis (TB), malaria and other tropical diseases. Pharmaceutical research has typically focused on developing drugs, vaccines and other strategies for which there are commercial markets. Research has thus centred on diseases prevalent in developed countries, where people can afford to buy treatments, and has tended to overlook those disorders that predominantly affect developing countries. This briefing outlines the extent of the problem, describes a number of recent initiatives to stimulate research and development (R&D) focused on diseases of the developing world and examines the UK policy issues associated with funding such research.

Open source software

June 2005 ***POSTnote 242***

Open Source Software (OSS) is computer software that has its underlying "source code" made available under a licence. This can allow developers and users to adapt and improve it. Policy on the use of OSS in Government has recently been updated. This briefing explains how OSS works, outlines current and prospective uses and examines recent policy developments. It discusses its advantages and disadvantages and examines factors affecting uptake.

Ethical scrutiny of research

July 2005 ***POSTnote 243***

Recent legislation such as the Data Protection and Mental Capacity Acts, and the Human Tissue Bill and Act emphasise the importance of ethical scrutiny of research on human participants. Despite this, the process of ethical review is controversial. The UK system is complex and varies between different types of research. A recent review of NHS research made a number of recommendations for changing the process. This note describes the various systems for ethical review of research involving humans and outlines key issues with the existing system.

Binge drinking and public health

July 2005 ***POSTnote 244***

Alcohol misuse, in the form of binge drinking (BD), is prevalent among young people and seems to be a characteristic of the British drinking culture. Over the last two years the Government has reformed licensing laws and proposed a strategy aimed at reducing alcohol-related harm. This briefing describes the extent of BD in the UK, examines the current legislation and analyses the policy implications.

Rapid climate change

July 2005 ***POSTnote 245***

A growing body of evidence suggests that even gradual increases in global temperatures could trigger abrupt and irreversible changes in the climate system. These could produce significant shifts in global weather patterns in only a few decades. The likelihood of abrupt changes in

this century is thought to be low, but uncertainties remain too high to make robust conclusions. There are concerns that unless there are significant reductions in greenhouse gas emissions in the next few decades, some critical thresholds may be exceeded by the middle of this century. This POSTnote summarises current knowledge of rapid climate change and overviews possible future policy implications.

Changing role of pharmacies

July 2005 ***POSTnote 246***

In 2003, the Department of Health (DH) set out its intention to increase the public's choice of when, where and how to get medicines. The introduction of the new community pharmacy contractual framework in April 2005 will help to achieve this. This POSTnote examines the changing role of pharmacy and the availability of medicines by prescription, over-the-counter and remotely by mail-order or the internet.

Current work

POSTnotes in preparation on:

Biological sciences - UK preparedness for an influenza epidemic and healthcare acquired infections.

Energy and environment – materials in housing construction, recycling household waste, sustainable fisheries and household energy efficiency.

Physical sciences – 3G mobile phones, the 24-hour Society, wireless technology, space weapons, ICTs in developing countries, criminal justice system IT and e-science and the grid.

Staff changes

In May, Dr Stephanie Baldwin took maternity leave and was replaced by Ingrid Holmes.

Seminars

POST is holding a joint seminar with the Wellcome Trust on drug resistant pathogens on July 20th 2005.

Fellows at POST

Since Easter POST has welcomed another British Psychological Society fellow, Joanne Lawson (Sussex University), the first Engineering and Physical Sciences Research Council fellow, Oliver Tearne (Warwick University), an Economic and Social Research Council fellow, Thomas Malony (University of Edinburgh), and two Natural Environment Research Council fellows, Karina Drif (Heriot-Watt) and Nicola Patmore (Imperial College London). POST has also welcomed an intern, Jawad Masood, (from the University of Cambridge MSc on Technology Policy).

International Activities

Drs Theresa Squire and Chandrika Nath attended the European Commission-sponsored FISTERA (Foresight on information society technologies in the European Research Area) conference in Seville in June, representing the "Privacy and ICT" research group formed by several of POST's sister organisations in the European Parliamentary Technology Assessment network, including POST itself. The conference theme was "IST at the service of a changing Europe by 2020: learning from world views".

Additional information can be obtained from POST, House of Commons, 7 Millbank, London SW1P 3JA (020 7219 2840).
Also available on the internet at http://www.parliament.uk/post/home/htm
Members of either House can obtain free copies of all published material. Others may purchase copies from the Parliamentary Bookshop (020 7219 3890). There is also a subscription service: details from POST.

Science and Technology Select Committees

The House of Lords Science and Technology Select Committee was appointed on 6th June 2005. The members are:

Lord Broers (Chairman), Baroness Finlay of Llandaff, Lord Howie of Troon, Lord Mitchell, Lord Patel, Lord Paul, Baroness Perry of Southwark, Baroness Platt of Writtle, the Earl of Selborne, Baroness Sharp of Guildford, Lord Sutherland of Houndwood, Lord Taverne, Lord Winston and Lord Young of Graffham.

At the time of going to press the House of Commons Select Committees in the new Parliament had not been appointed.

Debates and Selected Parliamentary Questions & Answers

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

A full digest of all Debates, Questions and Answers on topics of scientific interest from 17th May to 26th May 2005 from both Houses of Parliament appears on pages 38 to 39.

Extracts from the Debate in the House of Commons on the Queen's Speech

Tuesday 17 May

Robert Key (Salisbury) I want to thank my constituents for returning me and for lending me their trust in my sixth Parliament. They wanted to talk about our party's main points, but they also wanted to discuss a great deal else that simply did not feature in the national campaign. They wanted to talk about climate change and the environment, waste and recycling, housing, science – my constituency has a large science base – education, the rural economy and farming. They talked about Europe, our cultural heritage, Stonehenge, transport. However it is about science that I wish to speak now. The wreckage of science policy is strewn across the political landscape of this country. The problem is that we have an anti-science culture. We have to tackle the problem and as a member of the Science and Technology Committee in the last Parliament, I have no doubt that the right place to start is in education. – in primary education right at the bottom of the ladder. We have to grasp the nettle of science if we are to maintain our position as the fourth largest economy in the world and our nation's prosperity in the face of competition from China, India and the Pacific economies.

The problem facing any Government is that they are frightened of science, the public are frightened of science and, with honourable exceptions, journalists know little about science. The result is a lot of gesture politics in science. We try to deflect blame when things go wrong due to a misunderstanding of risk, and nothing is risk free. One way to tackle that problem is to create new demand for openness and transparency.

There is one point that I shall address head on: our energy sources and how we intend to produce base-load electricity in future. It is extraordinary that the British debate on nuclear energy has been tainted for so long by the defence legacy of the past 70 years and continues to distort our perception today. Nuclear waste is now being tackled through legislation introduced by the Government in the last Parliament. We must not be deflected by self-appointed pressure groups opposed to nuclear energy for various reasons that have skewed public opinion by exploiting fear, prejudice and ignorance about nuclear power. I have seen the future in Finland and how they are handling the issues of climate change, waste management and security of supply for base-load capacity. This is based on the creation of a new financial consortium, with a 60 year business plan for new nuclear build, reliant on funding by major consumers and without need for government finance.

The UK Government have a double lock on progress in nuclear energy. The first is the need for a licence to build a nuclear power plant, and the second is the need for a licence to operate it. Unless the Government are prepared to concede that when everything else needed is in place, they will unlock the double lock, industry will not be prepared to make the first move or take the financial risk.

Thursday 19 May

Andrew Miller (Ellesmere Port and Neston).I know that the Secretary of State will take seriously the contribution that the DTI has made in promoting world-beating science. Effective innovation is central to the continued competitiveness of the United Kingdom. Lord Sainsbury has made a remarkable contribution to Britain's science policy from his seat in the other place. We also need to find ways to promote better debates in this House about the way in which the Government intend to continue to champion science and innovation through new technology. Britain's scientific base is the key to our future and this House should do more to promote the work of our scientists and engineers. I hope that the Secretary of State for Trade and Industry (Alan Johnson) will pay close attention to the work of the Parliamentary and Scientific Committee and the Parliamentary Information Technology Committee (PITCOM) over the next few months. Those are unique vehicles, bringing together representatives of academia, industry and Parliament in an unusual way. Many countries envy the bodies that we have created in the House. I hope that the DTI will use those bodies to greater effect because they enable rational debates to take place about some of the difficult long-term problems that we face. We must concentrate on some of the issues around energy and climate change as well as productivity and the future of manufacturing.

Early decisions are needed on how we generate power for electricity and create the fuels of tomorrow. Security of supply and price are at risk. There needs to be several sources to create a mixed and balanced policy and part of the solution lies in new nuclear build because of the loss of capacity from the closure of the early phase nuclear power stations. Much more needs to be done with wind and solar power – we

need to promote all those technologies. It is now possible with the right leadership from Government to put together a financial consortium that would back new nuclear build. That is needed for a balanced policy.

Wild Flowers

Debate in the House of Commons on Wednesday 18 May

Bob Russell (Colchester) asked "Where have all the flowers gone?" In the case of Britain's wild flowers, one in five species is on the brink of extinction - 345 out of a total of 1756 according to "The Vascular Plant Red Data List for Great Britain" which was published recently by the Joint Nature Conservation Committee. That is an appalling indictment of those who have allowed this environmental doomsday to occur. The 20th century – the most destructive 100 years since man first walked on earth – was a disaster for our indigenous wild flowers, with Nature Conservation in Britain reporting 20 years ago that more than 97 per cent of the nation's wild flower meadows had been destroyed or degraded since 1945. There are several reasons for that: the continuing urbanisation of the countryside; changes in agricultural practices, not just the use of chemicals, pesticides and fertilizers, although those are major causes; contradictory farming policy directives from successive Governments and from the European Union; and climate change. The compilers of the Red Data List come from English Nature, the Countryside Council for Wales, Scottish Natural Heritage, the Centre for Ecology and Hydrology, the Botanical Society of the British Isles, Plantlife, the Natural History Museum, and the Royal Botanic Garden, Edinburgh. They and the 1,000 volunteers – members of the Botanical Society of the British Isles – who undertook the two-year surveillance are to be commended for the quality of their research and for drawing attention to the deteriorating situation.

All who love our countryside want to hear today what action the Government will take in the light of the environmental doomsday account that has been brought to their attention. Action is needed now ahead of legislation. Will positive action emerge from the review of the Government's biodiversity action plan? This plan seeks to conserve all threatened species. Can the Minister give an assurance that all new additions to the red list will be included in an updated United Kingdom biodiversity action plan? Can the Minister give an assurance that adequate funds will be made available for conservation work?

The Parliamentary Under-Secretary of State for Environment, Food and Rural Affairs (Jim Knight): The future of wild flowers is very important. This is the first time that an analysis has been carried out of the entire British flora. We have a three-pronged approach to help reverse any further decline and improve abundance of our rarer plants; robust legal protection; promotion of different farming methods to encourage wildflowers; continuation of the action plan for biodiversity. The Natural Environment and Rural Communities Bill will be introduced soon to establish Natural England by January 2007. The other relevant legislation is the Common Land Bill which will be important in enhancing sites of special scientific interest. More than half of common land is made up of SSSIs, but over 40 per cent of those are not up to adequate standards. If we are to meet our target of bringing 95 per cent of SSSIs up to a proper standard by 2010, we must take action in respect of common land and the Bill will allow those sites to be more easily managed and thereby prevent the overgrazing that has caused so much damage to species such as the field gentian.

The second prong is the use of the agri-environment schemes that fund farmers and land managers in England who deliver effective environmental management on their land. One key objective is the conservation of wild flowers.

The third prong is the biodiversity action plan published in January 1994. The Government recently announced funding worth nearly £2 million from DEFRA's environmental action fund in the form of grants for 30 biodiversity projects. A full review of the UK biodiversity action plan will take place this year and a provisional list of priorities will be published in March 2006 with a suite of conservation implementation measures in place before the end of 2006.

Health

Antibiotics

Question and Written Answer on Tuesday 24 May

Mr Robertson (Tewkesbury): To ask the Secretary of State for Environment, Food and Rural Affairs what assessment she has had made of the impact on human health of the use of antibiotics on farms; and if she will make a statement.

Mr Bradshaw: There is increasing scientific support for the view that the increase in antimicrobial resistance affecting human health is primarily the result of the use of antibiotics in human rather than veterinary medicines. Nonetheless, we take this issue very seriously and in June 2000, published a cross-Government strategy to address the issue. In 1999 the Defra Antimicrobial Resistance Co-ordination (DARC) Group was established. Details of the work of this group, together with other information about antimicrobials and links to related websites, are available on the VMD website (www.vmd.gov.uk). We recognise that veterinary medicines, including antimicrobials, are required to ensure healthy food animals in the UK, but we believe that their use should not replace good farm management and animal husbandry systems. We believe that antimicrobials should be used responsibly in food animal production and have issued guidelines in the Code of Practice on the Responsible Use of Animal Medicines on the Farm, produced by the Veterinary Medicines Directorate (VMD). We also support the industry's Responsible Use of Medicines in Agriculture Alliance (RUMA), which has also published responsible use

guidelines for antimicrobials that have been adopted by assurance schemes for the five major food-producing species. Also, as a precautionary measure, the use of antimicrobial growth promoters in the EU will be banned from 1 January 2006.

The VMD annually collates and publishes figures on the UK sales of all veterinary antimicrobials. These are likely to reflect usage of antimicrobials in animals. The figures illustrate that, whilst sales of some groups of antimicrobials have increased, others have decreased or remained relatively constant over time. The VMD, in collaboration with the Department of Health, has prepared and published a list of all antimicrobial therapeutic ingredients authorised for use in animals and humans. This illustrates that many antibiotic substances used in human medicine are not used in animals.

A number of research projects designed to provide scientific data to inform further consideration of relevant issues are also under way. These range from investigating the mechanism of antimicrobial resistance transfer in organisms, to investigating the husbandry factors on farms which might lead to reduced antimicrobial usage, thereby reducing the potential for the development of antimicrobial resistance. Details of these projects can be found on the VMD website.

Energy

Carbon Abatement Technologies Strategy

Question and Written Answer on Thursday 26 May

L**ord Mason of Barnsley** asked Her Majesty's Government: In the context of their carbon abatement technology strategy, to what extent the fluidised bed experiments carried out at Grimethorpe in South Yorkshire have been under consideration.

The Parliamentary Under-Secretary of State, Department for Trade and Industry (**Lord Sainsbury of Turville**): The carbon abatement technologies (CAT) strategy for fossil fuel power generation, which we plan to publish in the next few weeks, aims to encourage the development of carbon reduction technologies. The strategy does not identify specific technologies for reducing carbon emissions as industry is best placed to select these to meet environmental requirements and the needs of the market. Pressurised fluidised bed combustion (PFBC) is seen as a high efficiency power generation technology that offers significant environmental benefits and the capability to burn a wide range of fuels including coal/waste and coal/biomass mixtures. PFBC is therefore considered to be a feasible technology among other technologies for contributing to the objectives of the CAT strategy.

UK Parliament - Digest of Parliamentary Debates, Questions and Answers 17th May – 26th May 2005

The references are to Hansard, giving first the date of publication, either HoC (House of Commons) or HoL (House of Lords), and finally the column number in Hansard.

**Denotes selected Debates and Questions and Answers of particular interest which are reproduced on pages 36 to 38.*

Animal Health and Welfare

Badgers – 26.5.05 HoC 179W
Veterinary Services – 24.5.05 HoC 52W

Biodiversity and Conservation

Whales – 26.5.05 HoC 183W
* Wild Flowers – adjournment debate – 18.5.05 HoC 259

Climate Change

Climate Change – 24.5.05 HoC 45W
Climate Change Levy – R&D tax credit – 26.5.05 HoC 863

Crime Prevention

Identity Theft – 23.5.05 Hoc 410

Energy

* Carbon Abatement Technologies Strategy – 26.5.05 HoL WA19
Coal Mining – 24.5.05 HoC 345
Crude Oil – 26.5.05 HoC 174W
Energy Policy – 23.5.05 HoC 20W & 25.5.05 HoC 458
Fluidised Bed Combustion – 26.5.05 HoL WA20
Hydrogen Energy – 25.5.05 HoC 109W

Environment

Air Transport (Emissions) – 26.5.05 HoC 179W
Fuel Emissions – 24.5.05 HoC 79W
Marine Environment – 26.5.05 HoC 181W

EU Meeting

Employment, Social Policy, Health and Consumer Affairs Council – 26.5.05 HoC 27WS & HoL WS18

Fisheries

Quota Fishing – 26.5.05 HoC 181W

Food

Food Poisoning – 24.5.05 HoC 77W
Food Products (Para Red) – 19.5.05 HoC 6WS & HoL WS4
Free School Meals – 24.5.05 HoC 48W
Hydrogenated Vegetable Oil – 25.5.05 HoC 120W
School Meals – adjournment debate – 23.5.05 HoC 526

Health (Cancer)

Breast Cancer – 24.5.05 HoC 76W
Cancer – 26.5.05 HoC 216W

Health (General)
Complex Regional Pain Syndrome – 26.5.05 HoC 218W

Health (International Development)
Tuberculosis – 25.5.05 HoC 687
Yemen (Smallpox) – 26.5.05 HoC 164W

Health (Service)
Haemophilia: Creutzfeldt-Jakob Disease – 25.5.05 HoC WA8
Hospital Beds/Food – 26.5.05 HoC 224W
MRSA – 24.5.05 HoC 83W, 25.5.05 HoC 121W & 26.5.05 HoC 229W
NHS Bodies (Review) – 23.5.05 HoC 31W
NHS: National Programme for Information Technology – 26.5.05 HoL WA21

Information Technology
e-Government Unit – 26.5.05 HoC 166W

International Development
Millennium Review Summit – adjournment debate – 26.5.05 HoC 1WH

Medicines and Drugs
* Antibiotics – 24.5.05 HoC 43W
Beta Interferon – 23.5.05 HoC 13W & 30W
Bird Influenza – 25.5.05 HoC WA8

Nuclear and Radioactive Substances
Nuclear Industry – 24.5.05 HoC 50W
Thorp Reprocessing Plant – 23.5.05 HoC 22W

Space
Weapons in Space – 25.5.05 HoC 461

Telecommunications and Broadcasting
Analogue Switch-off – 26.5.05 HoC 170W
Electronic Compatability Regulations – 26.5.05 HoL WA20
Mobile Phones – 26.5.05 HoC 229W

Transport
Alternatively Fuelled Road Vehicles – 23.5.05 HoC 7W
Retro-reflective Tape – 26.5.05 HoC 166W
Road Humps – 23.5.05 HoC 11W

Progress of Legislation before Parliament

Government Bills
Charities Bill (HL) – 2nd Reading 7.6.05; Committeee Stage begun 28.6.05

Commons Bill (HL) – provisional date for 2nd Reading 20.7.05

Identity Cards Bill – 2nd Reading 28.6.05 – Committee stage begun 5.7.05

Merchant Shipping (Pollution) Bill (HL) – 2nd Reading 14.6.05 – provisional date for Committee stage 11.7.05

Natural Environment and Communities Bill – 2nd Reading 6.6.05 – Committee stage begun 28.6.05

Private Members' Bills
Breast Cancer Bill – introduced under the ballot by Mr Shailesh Vara MP – provisional date for 2nd Reading 20.1.06

Children's Food Bill – introduced under the ballot by Mary Creagh MP – provisional date for 2nd Reading 28.10.05

Climate Change and Sustainable Energy Bill – introduced under the ballot by Mr Mark Lazarowicz MP – provisional date for 2nd Reading 11.11.05

Fishery Limits (United Kingdom) Bill (HL) – introduced by Lady Saltoun of Abernethy – 2nd Reading 16.6.05 – Committee 5.7.05

Management of Energy in Buildings Bill – introduced under the ballot by Dr Alan Whitehead MP – provisional date for 2nd Reading 11.11.05

Regulation of Laser Eye Surgery Bill – introduced under the ballot by Mr Frank Cook MP – provisional date for 2nd Reading 21.10.05

Euro-News

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

"Europe most competitive economy in the world by 2010"
The Lisbon agenda with this primary intention was relaunched with the objective of increasing research investment to 3% of GDP. Increases from the private sector will be driven by tax incentives, leverage from public investment and better management of research institutions and universities. MEPs also want more funding for research and innovation (R&I) to be channelled via the EU to improve the competitiveness of the European Research Area, with the EU budget for R&I significantly higher than 1% of GDP. This would involve a doubling of contributions from Member States as a proportion of GDP, compared with their current contributions to the FP7 budget.

The Seventh Framework Programme (FP7)
The Commission proposes a seven year programme (2007-2013) with a budget of €72.73 billion based on four areas: Co-operation, Ideas, People and Capacities.

"Co-operation" refers to transnational research activities; "Ideas" covers basic research implemented through a European Research Council (ERC). "People" includes Marie Curie and other initiatives; "Capacities" includes support for research infrastructure, the knowledge base, and SMEs. The Science and Research Commissioner, Janez Potočnik, emphasised that these proposals are doubling the EU budget for research and development on an annual basis and, more importantly, are also sending out a message that the Member States should increase their national research budgets.

Competitiveness and Innovation Framework Programme (CIP)

The European Commission has outlined how it intends to boost Europe's competitiveness and innovation through a new programme, to run from 2007 until 2013 with a budget of €4.2126 billion. This is the Commission's response to calls for greater coherence and synergy between the Community programmes and instruments relevant to the Lisbon strategy, bringing together the Commission's current activities in these fields. It will comprise three sub-programmes, the Entrepreneurship and Innovation Programme, the Information and Communication Technology (ICT) Policy Support Programme, and the Intelligent Energy – Europe Programme.

European Research Council (ERC)

The ERC Identification Committee has set out the first stage of its work including the main criteria for selecting future members of the body's governing council. These are published in the committee's interim report, which is available on the Commission's new European "Basic Research" website. The second stage is the selection process itself. Both stages involve close consultation with the main organisations representing the research community at European level. MEPs want the European Research Council to be set up swiftly with adequate funding and minimal red tape.

European Institute of Technology (EIT)

The Commission has published an information note outlining its initial thoughts on the establishment of a European Institute of Technology (EIT), arguing that a network of existing institutions would be preferable to the creation of a new one.

Café Scientifique - Promoting UK Science abroad

2005 is a big year for the UK on the world stage, with the country holding the G8 Presidency, as well as the EU Presidency for the second half of the year. With all eyes on the UK, the Government and other bodies wish to create a positive image of the country, and one way of doing this is through promotion of science according to Lloyd Anderson, director for science at the British Council. The Café Scientifique scheme will have succeded if the British Council can show that more young people have been encouraged to take up science and that it has improved perceptions of the UK from abroad.

Charter for Researchers

The European Commission has drafted a European Charter for Researchers and a Code of Conduct for the Recruitment of Researchers, both of which are intended to contribute to the development of an attractive, open and sustainable European Labour Market for scientists, where conditions are conducive to high performance and productivity.

Gender equality in Science

The European Commission has drafted a staff working document outlining the main challenges that must be addressed in order to increase gender equality in science. These include boosting the number of women in leading positions through the adoption of quantitative and qualitative targets at European, national and institutional level. The proportion of women in leading positions should increase to at least 25% by 2010 and women should make up 33% of new recruits by the same year.

Internationalisation of R&D

Companies that carry out research can now establish facilities in any part of the world, and are more likely to base their decision on local capabilities and the availability and cost of qualified researchers. Europe's response, according to the European Research Commissioner Janez Potočnik, must be to maximise its attractiveness as a location for private research investment, encompassing fiscal incentives, improved framework conditions, qualified human resources, intellectual property regimes, with basic and applied research infrastructures.

Climate Change

Parliament welcomed exploration of options for action after 2012, including a 15-30 per cent reduction in emissions from developed countries by 2020. Global emissions need to be reduced by half by 2050 to restrict the global warming peak to a maximum of 2ºC above pre-industrial levels.

Hydrogen Economy

As a source of energy from which the only waste emission is water, hydrogen is unquestionably a more environmentally friendly option than, say, diesel or natural gas. The problem is that hydrogen is not a primary energy source and must be produced using other forms of energy. The use of fossil fuels for this purpose would generate CO_2 and a move to alternative energy sources is required to minimise environmental impacts. The main barriers to the hydrogen economy are no longer economic, technical or related to the development of infrastructure, but rather a lack of commitment and co-operation anong the key stakeholders according to industry representatives. A high uptake scenario would have 6.1 million hydrogen-powered cars on Europe's roads by 2020, being served by 2,800 filling stations with total infrastructure costs of around €3.5 billion.

Eco-design of energy-using products

A legislative report on a new framework directive on the eco-design of energy-using products was approved for speedy introduction. These products consume 30% of primary energy in the EU and produce 40% of CO_2 emissions. 80% of the environmental pollution arises at the manufacturing stage which is therefore subject to design criteria which could be optimally managed to prevent the emission of 200 million tons of CO_2.

Dangerous substances

Parliament resolved to restrict the use of dangerous substances such as lead and mercury in electrical and electronic equipment and opposed the Commission's use of the comitology procedure in this area, which grants executive power to the Commission and expert committees of Member States. Parliament fiercely criticised exemptions that are being given to an existing directive on this issue where there are substitute products available.

Green tea as cancer inhibitor

A European Union funded project involving Spanish and UK scientists has established for the first time why drinking green tea can protect the body against certain forms of cancer. A naturally occurring polyphenol (EGCG) isolated from green tea leaves inhibits the growth of cancer cells when present at the low concentrations found in green tea drinkers. Its structure is very similar to that of the successful anti-cancer drug methotrexate. It was discovered that EGCG can kill cancer cells in the same way as methotrexate. However because ECGC binds to the target enzyme less tightly than methotrexate, it should have decreased side effects on healthy cells.

The Sinapse project

The European Commission has launched the Sinapse project (Scientific INformAtion Policy Support in Europe) as an online tool aimed at making scientific advice more accessible for policy makers, and encouraging scientific debate between different sections of the scientific community. It will provide an interactive library of scientific opinions and advice, as well as an early-warning system for better detection of potential crises, for example in relation to food safety or animal health and will also help to reduce duplication of research. The project can be readily accessed for further information by visiting http://europa.eu.int/comm/research/science-society/science-governance/sinapse_en.html

European Union - Digest

The references are to the Official Journal of the European Communities (OJ), Adopted Legislation from the L Series (OJL) and Proposals and Opinions from the C Series (OJC).

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Association of the British Pharmaceutical Industry

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The Association for the British Pharmaceutical Industry members brings together companies in Britain producing prescription medicines both through manufacture and supply as well as research and development (R&D).

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;
- avoids unfair commercial returns

Association of Marine Scientific Industries

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AMSI is a constituent association of the Society of Maritime Industries; the other associations are:

Association of British Offshore Industries (ABOI)

British Marine Equipment Association (BMEA)

British Naval Equipment Association (BNE**A)**

Ports and Terminals Group (PTG)

Academy of Medical Sciences

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

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AIRTO represents the UK's independent research and technology sector - member organisations employ a combined staff of over 20,000 scientists and engineers with a turnover in the region of £2 billion. Work carried out by members includes research, consultancy, training and global information monitoring. AIRTO promotes their work by building closer links between members and industry, academia, UK government agencies and the European Union.

Association of Medical Research Charities

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The Association of Medical Research Charities (AMRC) works to advance medical research in the UK and, in particular, aims to improve the effectiveness of the charitable sector in medical research. There are over 100 member charities within the Association: in 2003/2004 their combined expenditure on biomedical research in the UK was £634 million. AMRC provides information, guidance and advice to medical research charities and information and data on the activities of the charity sector in medical research to government, the media and decision-formers.

Biotechnology and Biological Sciences Research Council

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British Association for the Advancement of Science - the BA

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The BA is the UK's nationwide, open membership organisation dedicated to connecting people with science, so that science and its applications become accessible to all. The BA aims to promote openness about science in society and to engage and inspire people directly with science and technology and their implications.

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British Ecological Society

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The BES is an active, successful and independent scientific society. It aims to promote the science of ecology worldwide. It supports the ecological research and education communities to ensure that they remain vibrant and productive, thus generating new knowledge, skilled people and a greater appreciation of the science of ecology in the wider community. The Society publishes internationally renowned journals, organises Europe's biggest annual meeting of ecologists, provides advice to policy-makers and opinion formers, has an active programme of educational initiatives and provides grants.

British Pharmacological Society

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The British Pharmacological Society's 2,500 members are trained to study drug action from the laboratory bench to the patient's bed-side. Our members come from academia, industry, hospitals and regulatory authorities and government bodies. Our aim is to improve the quality of life by developing new medicines to treat and prevent the diseases and conditions which affect millions of people and animals. Inquiries about drugs and how they work are welcome.

The British Psychological Society

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The British Psychological Society is an organisation of over 34,000 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

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

British Veterinary Association

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CABI *Bioscience* is a new breed of international organisation specialising in sustainable agriculture, the conservation of biodiversity, invasive species management and industrial and environmental bioremediation. Globally the work of CABI *Bioscience* focuses on the farmer and his need to adapt and respond to the changes and challenges of the markets - these may be for organic produce, a route to transgenic production, or dealing with the effects of climate change or alien invasive species in a safe and sustainable way.

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Cavendish Laboratory

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

Engineering and Physical Sciences Research Council

Contact: Lucy Brady,
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Website:www.epsrc.ac.uk

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

English Nature

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English Nature
Northminster House, Peterborough,
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E-mail: keith.duff@english-nature.org.uk
Website address: www.english-nature.org.uk

English Nature is the Government's wildlife agency working throughout England. With our partners and others we promote the conservation of wildlife and natural places.

We commission research and publish scientific papers which underpin the development of policies and programmes to maintain and enhance biodiversity

Environment Agency

Contact: Prof Michael Depledge,
Head of Science
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Tel: 01454 284433
Fax: 01454 284301
E-mail: michael.depledge@environment-agency.gov.uk
Website: www.environment-agency.gov.uk

The Environment Agency is responsible for protecting and enhancing the environment in England and Wales. We contribute to sustainable development through the integrated management of air, land and water. We commission research to support our functions through our Science Programme that is based on a 5 year plan developed through consultation.

Freshwater Biological Association

Contact: Dr Roger Sweeting,
Chief Executive.
The Freshwater Biological Association, The Ferry House, Far Sawrey, Ambleside,
Cumbria LA22 0LP.
Tel: 015394 42468 Fax: 015394 46914
E-mail: info@fba.org.uk
Website: www.fba.org.uk

The Freshwater Biological Association is an independent organisation and a registered Charity, founded in 1929. It aims to promote freshwater science through an innovative research programme, an active membership organisation and by providing sound independent opinion. It publishes a variety of specialist volumes and houses one of the finest freshwater libraries in the world.

Fund for the Replacement of Animals in Medical Experiments

Contact: Professor Robert Combes,
Scientific Director
FRAME, Russell & Burch House
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E-mail: bob@frame.org.uk
Website: www.frame.org.uk
Registered Charity No.: 259464

FRAME considers that the current scale of live animal experimentation is unacceptable, but recognises that the immediate total abolition of all animal experimentation is not possible. FRAME advocates the Three Rs approach, with the long-term aim of eliminating the need for live-animal experiments altogether, through the proper development, validation and acceptance of replacement alternative methods.

Health Protection Agency

Radiation Protection Division (formerly NRPB)

Contact: Dr Michael Clark
Radiation Protection Division Scientific Spokesperson
Chilton, Didcot, Oxon OX11 0RQ
Tel:01235 822737 Fax: 01235 822746
Email: pressoffice@hpa-rp.org.uk
Website: www.hpa.org.uk/radiation

The Radiation Protection Division was formed on 1 April 2005 when the National Radiological Protection Board merged with the Health Protection Agency, under the provisions of the Health Protection Agency Act 2004.

As part of the Centre for Radiation, Chemical and Environmental Hazards, the Division carries out the Agency's work on ionising and non-ionising radiations. It undertakes research to advance knowledge about protection of people from the risks of these radiations; provides laboratory and technical services; runs training courses; provides expertinformation and has a significant advisory role in the UK.

Human Fertilisation and Embryology Authority

Contact: Tim Whitaker
21 Bloomsbury St
London WC1B 3HF
Tel: 020 7291 8216
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

Contact: Prof Alan Malcolm, Chief Executive
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The biological sciences have truly come of age with the new millennium 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.

The Institute of Mathematics and its Applications

Contact: Lisa Wright, Personal Assistant to Executive Director
Institute of Mathematics and its Applications
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Tel: 01702 354020
Fax: 01702 354111
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Website: www.ima.org.uk

The IMA is a professional and learned society for qualified and practising mathematicians. Its mission is to promote mathematics in industry, business, the public sector, education and research.
Forty percent of members are employed in education (schools through to universities), and the other 60% work in commercial and governmental organisations.
The Institute is incorporated by Royal Charter and has the right to award Chartered Mathematician status.

Institute *of* Physics

einstein year

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

2005 is Einstein Year, part of an international celebration of physics to mark the centenary of the publication of Einstein's most famous theories. The Institute of Physics (IOP), the learned society and professional body which represents physics and physicists, is co-ordinating a range of activities designed to show the diversity and importance of modern physics today and to enthuse and inspire young people to study physics.
The IOP supports physics in schools, colleges and universities and provides policy advice and opportunities for public debate.

Institute of Physics and Engineering in Medicine

Contact: Robert Neilson, General Secretary
Fairmount House, 230 Tadcaster Road,
York, YO24 1ES
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Website: www.ipem.org.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

IChemE is the qualifying and professional body representing chemical and process engineers in the UK. In 2002, we published *Energy at the Crossroads* in response to the UK government consultation on energy policy; a report that seeks to improve the engineering and scientific input to policymaking. IChemE has also published a set of sustainable development indicators for the chemical & process industries. *The Sustainability Metrics* provide a valuable tool for the measurement of progress towards sustainability.

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www.icheme.org

heart of the process

Institution of Civil Engineers

ice

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External Relations Manager
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London SW1P 3AA, UK
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E-mail: Neal.Weston@ice.org.uk
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ICE aims to be a leader in shaping the engineering profession. With over 70,000 members, ICE acts as a knowledge exchange for all aspects of civil engineering. As a Learned Society, the Institution provides expertise, in the form of reports and comment, on a wide range of subjects from energy generation and supply, to sustainability and the environment.

LGC

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Website: www.lgc.co.uk

Setting standards in analytical science

LGC is Europe's leading independent analytical laboratory providing chemical and DNA-based analysis, diagnostic services, reference standards, R&D, method development, consultancy and training to both the public and private sectors. LGC operates in a diverse range of markets including foods, pharmaceuticals, biotechnology, environment, chemicals and petroleum.

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

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

University of Leeds

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Website: http://www.leeds.ac.uk/rsu

The University of Leeds is among the largest research universities in Europe. We have some 3000 researchers, including postgraduates, and an annual research income of more than £70m. Research activity extends across nine faculties representing most core disciplines and often crosses traditional subject boundaries. In the last Research Assessment Exercise, we had 35 schools rated internationally or nationally 'excellent'.

London Metropolitan Polymer Centre

Contact: Alison Green,
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The London Metropolitan Polymer Centre provides training, consultancy and applied research to the UK polymer (plastics & rubber) industry. The training courses are delivered through a programme of industrial short courses and customised courses and these, together with distance learning and other flexible delivery methods, lead to qualifications ranging from technician to Masters level. Recent successes include a WRAP sponsored programme to develop new commercial applications for recycled PET and several technology transfer projects with companies.

Marks & Spencer Plc

Contact:
David S Gregory
Waterside House
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, Financial Services and Home.
Over 400 stores in 30 countries worldwide. Employing 66,000 people.

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

Medical Research Council

Contact: Elizabeth Mitchell
20 Park Crescent, London W1B 1AL.
Tel: 020 7636 5422 Fax: 020 7436 2665
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elizabeth.mitchell@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.

Merck Sharp & Dohme Research Laboratories

Contact: Dr Ruth M McKernan

Neuroscience Research Centre
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Tel: 01279 440426
Fax: 01279 440178

E-mail: ruth_mckernan@merck.com

www.msd-nrc.co.uk

Drug discovery for brain diseases.

The National Endowment for Science, Technology and the Arts

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Policy & Public Affairs Manager
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Website: www.nesta.org.uk

NESTA (the National Endowment for Science, Technology and the Arts) is all about innovation. Through a range of pioneering programmes, we invest in talented people and ground-breaking ideas. On a wider scale we work to improve the climate for change in this country, acting as a catalyst for change and helping the UK to fulfil its potential.

National Physical Laboratory

National Physical Laboratory
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E-mail: enquiry@npl.co.uk
Website: www.npl.co.uk

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

Natural Environment Research Council

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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, Southampton Oceanography Centre and Proudman Oceanographic Laboratory

University of Newcastle upon Tyne

Contact: Dr Douglas Robertson
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Tel: 0191 222 5347 Fax: 0191 222 5219
E-mail: business@ncl.ac.uk
Website: www.ncl.ac.uk

The University of Newcastle is a member of the Russell Group of research-intensive Universities and is enjoying substantial growth in student numbers and research income. The University has a well balanced portfolio of research funding across all sponsor groups and has one of the highest levels of research projects funded by UK Government Departments and EU activity. It was recently identified in a national survey as one of the top Universities in the UK for technology transfer.

Particle Physics and Astronomy Research Council

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The PPARC is the UK's strategic science investment agency that directs and funds research in national and international programmes in fundamental physics.

It is this research into fundamental physics that lies behind some of the major technological advances of the 20th Century, and delivers world leading science, technologies and people for the UK.

Prospect

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Prospect is an independent, thriving and forward-looking trade union with 105,000 members. We represent scientists, technologists and other professions in the civil service, research councils and private sector.

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

Queen Mary, University of London

Contact: Caroline Quest,
Innovation and Enterprise
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Email: c.quest@qmul.ac.uk

Queen Mary, University of London, incorporates the St Bartholomew's and Royal London School of Medicine and Dentistry. Queen Mary's outstanding research strengths cover the spectrum from Electronic Engineering to Preventive Healthcare. It is home to world-renowned specialist centres including the Centre for Commercial Law Studies, the Interdisciplinary Research Centre in Biomedical Materials and the William Harvey Research Institute.

RIO TINTO

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Rio Tinto is a leading international mining company which focuses on exploration for first class ore-bodies and the development of large, efficient long-life mines capable of sustaining competitive advantage. Principal products (aluminium, borates, coal, copper, gold, iron ore, titanium dioxide, uranium, nickel, talc, salt, diamonds and silver) provide the materials necessary for economic progress and prosperity in the developed and developing world.

The Royal Academy of Engineering

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Founded in 1976, the Royal Academy of Engineering promotes the engineering and technological welfare of the country by facilitating the application of science. As a national academy, we offer independent and impartial advice to Government; work to secure the next generation of engineers; pursue excellence; and provide a voice for Britain's engineering community. Our Fellowship - comprising the UK's most eminent engineers - provides the leadership and expertise for our activities, which focus on the importance of engineering and technology to wealth creation and the quality of life.

KEW GARDENS

PLANTS PEOPLE POSSIBILITIES

WORLD HERITAGE SITE

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

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SAVING THE WORLD'S PLANTS FOR LIFE

Royal College of Veterinary Surgeons

Contact: Jeff Gill, Policy Officer,
External Affairs Department
Royal College of Veterinary Surgeons (RCVS)
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London SW1P 2AF.
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+44 (0)20 7222 2001
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E-mail: j.gill@rcvs.org.uk
Website: www.rcvs.org.uk

"Promoting and sustaining public confidence in veterinary medicine". The Royal College of Veterinary Surgeons (RCVS) is the regulatory body for veterinary surgeons in the UK and is responsible for the registration of veterinary surgeons, for monitoring standards of veterinary education and for professional conduct. The Government regularly consults the RCVS on a range of legislative issues including animal welfare, control of animal disease and veterinary certification.

The Royal Institution

Contact: Dr Gail Cardew
Head of Programmes
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Tel: 020 7409 2992 Fax: 020 7670 2920
E-mail: ri@ri.ac.uk Website: www.rigb.org

The Royal Institution has a reputation established over 200 years for its high calibre events that break down the barriers between science and society. It acts as a unique forum for informing people about how science affects their daily lives, and prides itself on its reputation of engaging the public in scientific debate. The Royal Institution has a range of activities all under one roof, from programmes for schools and a forum for the general public, through to a heritage programme, an arts–science initiative, a media centre and state-of-the-art chemistry labs.

The Royal Society

Contact: Dr David Stewart Boak,
Director Communications
The Royal Society, 6-9 Carlton House Terrace,
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Website: www.royalsoc.ac.uk

Founded in 1660, the Royal Society is an independent academy promoting the natural and applied sciences. It aims to:

- strengthen UK science by providing support to excellent individuals
- fund excellent research to push back the frontiers of knowledge
- attract and retain the best scientists
- ensure the UK engages with the best science around the world
- support science communication and education; and communicate and encourage dialogue with the public
- provide the best independent advice nationally and internationally
- promote scholarship and encourage research into the history of science

Royal Society for the encouragement of Arts, manufactures and commerce

Contact: Susie Harries
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Website: www.theRSA.org

The RSA's Forum for Technology, Citizens and the Market – a group of science-based companies and their principal stakeholders – aims to promote the flow of new technologies into society by enabling companies to sharpen their understanding of public concerns around new science and engage with these concerns early on as part of their routine product development process.

The Royal Society of Chemistry

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Parliamentary Affairs
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Website: http://www.rsc.org
http://www.chemsoc.org

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

The Royal Statistical Society

Contact: Mr Andy Tope
External Relations Officer
The Royal Statistical Society
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Fax: +44 20 7614 3905
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Website: www.rss.org.uk

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

The Science Council

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Chief Executive Officer
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Website: www.sciencecouncil.org

The Science Council has a membership of over 25 professional institutions and learned societies covering the breadth of science and mathematics. Its purpose is to provide an independent collective voice for science and scientists and to maintain standards across all scientific disciplines. We are active in science policy issues including science in education, health, society and sustainability. In 2003 the Science Council was granted its Royal Charter and in 2004 it launched the Chartered Scientist (CSci) designation as a measure of high standards in the practice, application, advancement and teaching of science. We now have over 10,000 Chartered Scientists.

SEMTA

Technology Skills For Productivity & Performance

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Website: www.semta.org.uk

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

Our **Mission** is 'to ensure that our sector has 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 two million people employed in about 100,000 establishments in the core Science, Engineering and Technology sectors, currently contributes over £74 billion per annum – about ten per cent – of total UK GDP.

Society for General Microbiology

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Website: http//www.sgm.ac.uk

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

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

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

Society of Chemical Industry

SCI
where science meets business

Contact: Mr Richard Denyer,
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Website: www.soci.org

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

University of Surrey

UniS
University of Surrey

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The University of Surrey is one of the UK's leading professional, scientific and technological universities with a world class research profile and a reputation for excellence in teaching and learning. Ground-breaking research at the University is bringing direct benefit to all spheres of life - helping industry to maintain its competitive edge and creating improvements in the areas of health, medicine, space science, the environment, communications, ion beam and optoelectronics technology, visual multi media, defence and social policy.

Universities Federation for Animal Welfare

UFAW
Established 1926

Contact: Dr James Kirkwood,
Scientific Director
The Old School, Brewhouse Hill
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Tel: 01582 831818. Fax: 01582 831414.
Email: ufaw@ufaw.org.uk
Website: www.ufaw.org.uk
Registered Charity No: 207996

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

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

Science Diary

The Parliamentary and Scientific Committee

Contact: Annabel Lloyd
020 7222 7085
www.scienceinparliament.org.uk

There will be meetings on the following dates in the autumn:

Monday, 17th October
Monday, 14th November
Monday 12th December

Subjects and speakers to be confirmed.

The Royal Institution

21 Albemarle Street, London W1S 4BS
For further information visit www.rigb.org or telephone 020 7409 2992
Events held at the Royal Institution
Unless otherwise stated tickets cost £8 (£5 concessions)

Thursday 29 September 19.00
Ri/Sense panel debate (Deafblind horizons and our ageing world)
Speakers include Prof Janet Askham

Tuesday 4 October 19.00
Science Graduate of the Year Award
Alex Weir, Department of Zoology, University of Oxford. Chaired by Baroness Susan Greenfield.

Wednesday 12 October 19.00
Science Today Health Tomorrow (Child development day)

Thursday 13 October 19.00
Science meets politics
Speakers include Baroness Susan Greenfield

Thursday 20 October 19.00
Ri/Kew Gardens event (Plants and pharmaceuticals)

Thursday 27 October 19.00
Headline debate
Speakers include Mary Riddell (the Observer)

Friday 28 October 10.00-16.00
Ri/Novartis Foundation event (Empathy and fairness)

The Royal Society

6-9 Carlton House Terrace
London SW1Y 5AG
All events are free, though pre-registration is required for the two-day conferences.Events held at the Royal Society unless otherwise stated.
For further information visit www.royalsoc.ac.uk/events; email events@royalsoc.ac.uk or call 020 7451 2575.

Monday 26 to Tuesday 27 September
Discussion Meeting
Major steps in cell evolution: evidence, timing and global impact
Leading earth scientists and biologists will discuss multidisciplinary evidence for the historical interplay of cell evolution and earth history.

Monday 17 to Tuesday 18 October
Discussion Meeting
Evolution of the Antarctic ice sheet: new understanding and challenges
In order to predict future sea-level changes this meeting will discuss how theoretical analysis, numerical modelling, satellite observations and field measurements can be best combined.

Wednesday 26 to Thursday 27 October
Discussion Meeting
Extreme natural hazards
The meeting will assess the role of the international scientific community and how these efforts can be better co-ordinated, integrated and funded to improve the ability to anticipate and mitigate the effects of extreme events in the future.

Thursday 27 October 18:30
Prize Lecture
Optical science in the fast lane
Wilson Sibbett will introduce some of the underlying concepts that have enabled us to develop practical ultrafast lasers and a selection of applications that range from the fundamentals of chemical bonding to weapons decommissioning.

The Royal Society of Edinburgh

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

Friday 5 August
Artificial Intelligence: In your life today
Professor Aaaron Sloman and Professor Wolfgang Wahlster

Monday 31 October
Optical Science in the Fast lane
Professor Wilson Sibbett

British Association for the Advancement of Science

www.the-BA.net

Tuesday 26 July
The x-change, Dana Centre, London
Audience-led panel discussion, focusing on climate change
Speakers include Sir David King, Chief Scientific Advisor to the Government, and Charlie Kronick, Chief Policy Advisor for Greenpeace
www.the-ba.net/x-change

Saturday 3 – Saturday 10 September
BA Festival of Science, Dublin
For further information visit www.the-ba.net/festivalofscience.

Thursday 15 & Friday 16 September
Holmes Chapel, Cheshire Northwest
Thursday 22 & Friday 23 September
Ettington, Stratford-upon-Avon, Midlands
Thursday 29 & Friday 30 September
Dorking, Surrey, London
DISC residential workshops
2-day residential training courses, jointly for science communication and BME groups, made possible due to funding from Office of Science & Technology.
For further information visit www.the-ba.net/disc

SCI

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

Sunday 4 – Wednesday 7 September
Electrochem 2005
In Northumbria

Thursday 20 October
Introduction to Process Chemistry
At GlaxoSmithKline site, Stevenage

Thursday 27 October
Airfields

Friday 28 October
Vector-borne exotic diseases

Royal Pharmaceutical Society

Contact: Judith Callanan
020 7572 2261
science@rpsgb.org

Monday 26 - Wednesday 28 September
British Pharmaceutical Conference
Linking science with practice
At Manchester International Convention Centre

Wednesday 12 October
Tumour-selective medicines
Royal Pharmaceutical Society and Academy of Pharmaceutical Sciences
At Royal Pharmaceutical Society, London

Monday 24 to Wednesday 26 October
BioInternational 2005
Royal Pharmaceutical Society and FIP
At Royal Pharmaceutical Society, London

Institution of Mechanical Engineers

Sunday 4 – Thursday 8 September
10th International Conference on Environmental Remediation & Radioactive Waste Management
At SECC, Glasgow
Contact Madeline Willis 020 7973 1260; m_wukkus@imeche.org.uk

Tuesday 6 September
Integrated Safety Systems in Buildings
Contact Georgina Shaw 020 7973 7973; g_shaw@imeche.org.uk

Wednesday 19 October
The Economics of Reliability
Seminar at SCI, London
Contact Georgina Shaw 020 7973 7973; g_shaw@imeche.org.uk

Wednesday 19 October
Fluid Machinery for Wave and Tidal Energy: state of the art and new developments
Contact Helen Quinn 020 7973 1261; h_quinn@imeche.org.uk

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