THE SCIENCE WEEK SEMINAR – TUESDAY 14TH MARCH 2006

SCIENCE AND SOCIETY

The National Science Week Seminar is an annual event hosted by the Parliamentary and Scientific Committee and supported by the Department of Trade and Industry. This is an opportunity to bring together leading scientists and parliamentarians to discuss public policy in the development of science and technology in the UK. This year's theme is Science and Society and the subjects include the Government's programme for science funding, the use of animals in testing, the Royal Society MP-Scientist pairing scheme, public engagement with science, stem cells in research and sustainable energy. The speakers emphasised the importance of communicating the benefits of their work with the public.

The joint chairmen were Lord Sainsbury of Turville, Minister for Science, and Dr Ian Gibson MP, Vice-President, Parliamentary and Scientific Committee. The meeting was held in One Birdcage Walk, the Institution of Mechanical Engineers.

Report by Robert Freer, The Royal Institution of Great Britain

Introduction

Lord Sainsbury of Turville, Minister for Science

Lord Sainsbury opened the meeting, welcomed the audience and thanked the Parliamentary and Scientific Committee for hosting this event during National Science Week. Success in science is a key part of the Government's agenda and is vital to Britain's economic prosperity and in advancing its policy objectives such as health care, improving the environment and international development. The quality of UK science is a major national asset, and the Government has taken steps to increase the science budget from £1.3 billion in 1997 to £3.4 billion by 2008. Under the Government's 10 year programme for science investment the level of knowledge intensity, as measured by the ratio of R&D to GDP, will increase from 1.9% at present to 2.5% by 2014. It is important to communicate to people the opportunities that science is opening up today and to ensure that the safety, ethical and environmental issues raised by these new developments are debated publicly at an early stage.

Controversial areas of science to be discussed today include animal experimentation and stem cell research and these two areas illustrate the Government's approach. In new areas of science it is not for Government to restrict or restrain technical developments although the Government must respond to public concerns and engage with the ethical, safety and environmental issues they raise.

The Government is clear that animal research is necessary in key areas like drug discovery and is required to maintain the UK's position as a world leader. Effective scientific alternatives for animal models guided by the 3Rs, Refinement, Reduction and Replacement should also be investigated. The DTI have established a National Centre for the 3Rs and funding for this centre will rise to £1.3 million for the next financial year. The Government will continue to protect those doing this work by legal and democratic means and new powers were introduced on 1 July 2005 to strengthen significantly police powers to deal with harassment and those causing economic damage. A special police unit has been set up and these new measures have resulted in the arrest of seven individuals. The battle against the extremists is being won and it is encouraging to see young people taking a stand in favour of scientific progress. The Oxford animal house will be built.

Stem cell research is an exciting new area of science which has the potential to provide treatments to help many people with serious diseases for whom there is no cure at present. The Government has a long-term commitment to support stem cell research and the development of therapies. A UK stem cell initiative has been developed to bring all the players together to create a coherent UK funding strategy. The Government wishes to advance research using all sources of stem cells while ensuring that their use is safeguarded by a comprehensive regulatory regime while also recognising that there are many complex ethical issues which arise from this research. A liberal but carefully regulated system is now in place which allows embryo research for therapeutic purposes while reproductive cloning is banned.

The 3Rs- Ethical Principles for Animal Use in Science

Dr Vicky Robinson, Chief Executive of NC3Rs

The use of animals for scientific research and testing in laboratories is an emotional subject. Scientists use a balanced and ethical approach to animal testing recognising that there are a number of competing pressures such as science, medical research,

human health and new medicines on the one hand and the effect on animals on the other. The use of animals in testing is needed for the foreseeable future but it is also necessary to observe the framework of the 3Rs (Refinement, Reduction, Replacement), a concept first proposed in the 1950s and now enshrined in the Animal Scientific Procedures Act.

The National Centre for the 3Rs was set up in May 2004 by Lord Sainsbury with funding mainly from the Office of Science and Technology and also from industries and charities. The Centre funds research and other activities such as information and training and has made grants totalling £1.5 million for 3Rs research.

The Home Office statistics show that in 2004 2.85m animals were used in research, 83% were rodents but other animals were used as well. The numbers declined initially from the 1970s but have increased recently as more genetically modified animals are being used. The use of animals is necessary in many areas of biological and medical research but in practice animals do not always provide good models for scientific experiments. There are limitations to their usefulness and there is a scientific as well as an ethical need to find alternatives.

The welfare of animals is a matter of practical concern for scientists. For example, a study in Scandinavia on dogs designed to measure the effect of a low sodium diet on blood pressure produced variable results which were attributed to their poor environment which caused them to be stressed. When the dogs were provided with better housing and a more stimulating environment the research results were better. Transgenic mouse models were applied to Huntingdon's Disease. Mice kept in a complex environment developed the disease much more slowly; they mimic the human disease much more accurately than those kept in a barren environment. It follows that being humane to animals is essential, not only for the animals' sake, but it is also a requirement for good science.

The principle of the 3Rs is important for science and for public opinion. A survey of the public in 2005 by the Coalition for Medical Progress showed that the majority of people accept the use of animals in medical research provided there is no alternative. The Centre is also funding work to identify signs of pain in animals. This is not easy. Many animals including rodents can show signs of suffering, but if you cannot identify pain you cannot provide animals with the appropriate analgesia. The Centre has funded work to find out whether there are behaviour patterns which are specific to animals' pain. Arching of the back is an unique indication of an animal in pain. We are now looking for similar behaviour in animals which have tumours; this is important because in 2004, 11% of all procedures on animals in the UK were for cancer research. Animal tests are likely to increase in the future and there are many competing pressures in this work. It is important to balance these developments with increased investment in the 3Rs.

Scientific Interchange between the House and the Lab

The Royal Society MP-Scientist Pairing Scheme Members at work

Dr Brian Iddon MP

Dr Iddon presented two examples of the type of work MPs may undertake when they become involved with academic, industrial and educational activities. The first example is the Royal Society MP-Scientist Pairing Scheme which brings together MPs and academics to enable both to learn more about each other's work. This scheme is successful, it has been running for 5 years and is growing in stature. The selected academic shadows the MP during his week in Westminster and in his constituency and sees something about the development of science policy. As his first

Dr Brian Iddon MP and Dr Charles Eaton

example Dr Iddon introduced his own pair, Dr Charles Eaton, a mathematician from the University of Manchester.

Dr Charles Eaton, RS University Research Fellow, Manchester University

Dr Eaton said he had spent a week in Parliament, 12 hours a day from Monday to Thursday shadowing Dr Iddon. This was a fantastic opportunity to learn how Parliament works and is one of the best aspects of the scheme. He had been very fortunate that Dr Iddon had invited him to attend a meeting of the Science and Technology Select Committee, a session in the DTI and a meeting of the Parliamentary and Scientific Committee. Other participants in the scheme had attended a meeting where a Minister was being lobbied on bird flu and yet another had attended a meeting where Michael Howard was being prepared for Prime Minister's Questions.

Dr Iddon's second example was Paul Abbott, previously a teacher in a local secondary school but who had a dream to create a centre for scientists similar to a music centre which recognises that a child who wishes to excel at music cannot always do so in their own school. Dr Iddon said that many years ago in the 1970s he had helped to establish the Bolton music centre. Children usually excel far more when they are brought together in a specialist environment than they do in their own schools. Paul Abbott's dream is to do the same for science, engineering and technology, and with the help of Lord Puttnam and the North West Regional Development Agency, a fine new building costing £3 million called the Bolton Technical Innovation Centre has been built. Although the building costs are paid ongoing funds from industry are badly needed to pay the running costs. Ruth Kelly, a Bolton West MP and Secretary of State for Education, and her department have been particularly helpful, but funds from elsewhere are urgently needed to maintain it in future.

This centre provides close interaction between education and industry and could be a model for others to follow. Children are naturally innovative and designed and built a computer trolley which was much cheaper than the commercial alternative.

Paul Abbott, Director & General Manager, Bolton Technical Innovation Centre

In a music centre students have access to expert tuition and we are trying to do the same for science. Children love science and engineering if they get half a chance. It is important to link the natural creativity of children with the new technologies of today, and enable them to make things and not only to design them. A sense of wonder about science gives children the opportunity to pursue their dreams and to apply what they learn.

Paul Abbott

Bolton South East is not a well-to-do area, there is no sixth form provision. The Centre is a home for new innovators with capability and not only in engineering. Europe's first high definition 3D colour printer is used here in printing software and the products have attracted commercial interest. It is intended to open the centre in the school holidays and Saturday morning science clubs have commenced. A Chemistry Day hosted 20 schools from across the region. A generation of highly motivated teachers is needed to inspire the next generation of children. Money is also required to run the Centre which exists at the boundary between education and industry, where innovation happens. It falls outside all the conventional funding mechanisms and it is struggling to exist, like a Rolls Royce with no fuel in the tank.

Public Engagement for a Better Quality of Life

Professor Kathy Sykes, Collier Professor for the Engagement of Science and Engineering, Institute for Advanced Studies, University of Bristol.

Since the 1980s there has been a huge increase in public engagement in science. There are now more science journalists, more science centres and festivals, more science books and the National Science Week. The House of Lords Select Committee report on Science in Society in 2000 recognised that the public are positive about science and recognise the need for research. They

identified a crisis of confidence and a need for better dialogue with the public.

For example, in 1996 tins of GM soup were available in shops, but by 1999 GM foods had become a contentious issue. The media then published complaints about GM foods rather than presenting an unbiased view. Protesters became more active and attacked a field of GM crops in 2001. Most countries have concerns about GM and have signed protocols to ensure biosafety and to undertake to engage with the public as part of the process. Success of science depends on dialogue with the public. Too many debates are driven by the media, discussions are seldom well informed. Research shows that groups insulated from outside information make bad decisions. Public engagement leads to a better quality of life, especially in a wealth creating society.

What is dialogue? The purpose is to explore issues when shaping policy, it is not about the public making the decisions. Dialogue is a structured process to try to engage a diverse range of different people with open minds. When should dialogue be undertaken? Scientists now acknowledge the need to talk to the public at the initial stages when thy are exploring aspirations and concerns. This is not about the public making the decisions.

The Sciencewise team within the DTI has a programme to improve public dialogue across Government departments and embed good practice therein. A number of topics and initiatives are being funded. The Council for Science and Technology has included nanotechnology as a topic for public discussion before it hits the media. Research Councils and others are finding ways to listen to the public, including the use of social scientists to work with the research workers. Considerable progress has been made with public discussions to ensure a better planetary environment in the future.

Stem Cells
What does human embryonic stem cell research offer for our future?

Professor Alison Murdoch, Professor of Reproductive Medicine, BioScience Centre, International Centre for Life, University of Newcastle upon Tyne

Stem cells and embryonic stem cells are both subjects that attract public concern. All life starts as a single cell which contains the total genetic code to make all parts of the finished structure. For instance, in a tree there are genes to make roots and different genes to make branches. The roots start to grow when the appropriate genes are switched on, and it is important to understand how these cells are switched on and off.

Work on stem cells is important because many human diseases are caused by the absence, for various reasons, of certain cells. For instance, diabetes is caused by the absence of the cells which make insulin. And although diabetes can be partly treated by medication it is better to make new insulin cells and put them back into the body. Another example is to use stem cells in the replacement of the liver; this is important in Newcastle where over the last twenty years alcoholism has become a problem among the young and there are several cases of liver failure. Developing new nerve cells would enable nerves to work again. Stem cells also have the benefit that they open up new ways of doing research. Research can now be carried out on the cells in the laboratory instead of on the patient. For instance, red blood cells can be grown in a test tube in the laboratory and if this process could be expanded to an industrial scale to produce blood of sufficient quantity and quality, it would replace the need for blood transfusions.

One problem is that embryonic stem cells might be rejected by the recipient. The solution is nuclear reprogramming where the nucleus is removed from a cell taken from a patient and put into a donated egg which has had its own nucleus removed, which the press refer to as therapeutic cloning. A stem cell colony will grow which matches the patient's nucleus and the patient won't reject it. This process is similar to pressing the reformat button on the computer. Disease-specific stem cells can also be made and then studied in the laboratory rather than in the patient. Newcastle is the only unit working on nuclear transfer and has the only published paper in the world on this topic. Stem cell therapies have been in use for 50 years, bone marrow transplants started in the 1950s. However, managing the expectations of this type of research is important because the public often expect too much too soon.

Adult stem cells are capable of further development but they cannot go in reverse. For example, bone marrow is an adult stem cell in human terms and can make all blood products but cannot make bones or skin. At present all the treatments relating to stem cells are in adults but the potential for embryonic stem cells is such that in 20 years' time most of the products coming from them will be the subject of investigation.

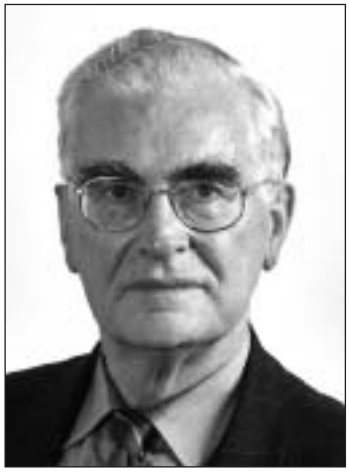
In IVF treatment egg and sperm are brought together. Some spare embryos can be frozen but others are discarded and could be used for

research. 85% of 500 patients surveyed agreed with this procedure, recognising that treatment is presently possible as a result of research in the past.

The UK leads the world in this field, based on the Human Fertilisation Act of 1990 which recognised research on embryos as a sufficient benefit to society. In 1990 no one had heard of stem cells, so the Act was modified in 2002 to include stem cells and also nuclear transfer. There is an opportunity here to lead the world on nuclear transfer, and more resources are needed or the lead will be lost. The work is undertaken in the Stem Cell Institute in a building in the middle of Newcastle which also houses a Visitors Centre. The public appear less intimidated by what is done here in the city centre and appreciate the work.

Sustainable Energy Sources Compatible with Climate Change

Diversity as the basis for future success



The Lord Oxburgh FRS FREng

Lord Oxburgh said the concept of sustainable energy has to be considered in relation to the increasing world population and the declining availability of cheap fossil fuels. The world population may eventually stabilise at about 9 billion people, compared with just over 6 billion today, and fossil fuels provide most of the world's energy, a situation which cannot be changed overnight.

The reserves of oil and gas are finite but will eventually become too expensive to extract. The reserves of coal are much larger and are concentrated in those countries where the energy demand is greatest, which are China, India and the USA. For China and India coal provides them with the capacity to become major industrial countries, and for the USA coal is a means of ensuring energy security. Fossil fuels will continue to be used for some years. China is building coal fired power stations at the rate of 1GW every five days which produce prodigious amounts of carbon dioxide, and in the UK it is therefore very important to develop ways of burning coal cleanly to set an example to the rest of the world. In an interesting recent experiment in Hawaii carbon dioxide from a power station was passed through a water tank containing GM algae which grow on the gas. When dried the algae can be made into bio-diesel.

Fuels for vehicles need to have a high energy density and petrol is ideal for this purpose. Synthetic alternatives for petrol can be made out of almost any organic material or bio-mass but growing crops especially for fuel is unlikely to be successful because the land will be needed for growing food. A better solution would be to grow a crop which provides both food and fuel. Municipal Solid Waste is another useful source of energy but wind energy and wave energy are intermittent sources which will need some form of energy storage.

Aviation fuel is particularly difficult to replace because aircraft engines have been designed to optimise their performance using kerosene as the fuel. Changing to an alternative fuel may require engines to be re-designed.

Modern nuclear power stations are much better than the earlier designs and there is no significant problem with safety, but the management of waste is still a social and political, rather than a technical, issue. It would be surprising if nuclear power was not part of our future energy mix.

In closing the meeting **Dr Ian Gibson** thanked all the participants and said the presentations demonstrated that we need to continue to discuss science strategy and to develop the prime role British science has in future in improving our lives and those in developing countries.

In discussion the following points were raised:

Increase in the use of animal models; the benefits of animal testing; long term effect of the RS pairing scheme; self funding the BTIC; media claim to represent the public; methods to engage the public; examples of change of opinion; effect of financial restraints; promotional agency for science; political process needs to be embedded; media neglect of benefits of GM crops; too many acronyms; influence of risk and probability; success of nuclear transfer; question of intelligent design; risks in nuclear power stations get disproportionate public attention compared with more serious problems in coal mining; pioneers in new energy technologies have difficulty getting funding.