ANNUAL LUNCHEON OF THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE

The Annual Lunch of the Parliamentary and Scientific Committee was held on Wednesday 31st October 2012 in the Cholmondeley Room and Terrace, House of Lords.

Lord Jenkin of Roding said he was delighted to see so many friends and supporters and extended a particular welcome to two of his predecessors, Lord Waldegrave of North Hill and Lord Soulsby of Swaffham Prior, and to former Chairman, Ian Taylor.

He said that it was no secret that the Committee had found it more and more difficult to attract MPs and Peers to meetings. One reason was undoubtedly the proliferation of other channels for engaging Parliamentarians with science and engineering: the increasing influence of Select Committees, the development of POST, and the huge expansion of all-party groups – many covering aspects of science and technology.

He continued, "All this has prompted the P&S to decide to take a good look at ourselves in this developing environment. We asked Lord Oxburgh to lead an inquiry, and he agreed his mission – 'how to improve engagement of Parliament in Science and Engineering'. Ron Oxburgh's report contains a lot of wise thoughts and recommendations and Council has been taking this forward."

He introduced Professor John Womersley, Chief Executive Officer of the Science and Technology Facilities Council – "a post he has held for exactly one year today. Prof Womersley is well known to many here as one of the UK's most distinguished scientists in the field of Particle Physics. Many here will have met him in September

Professor John Womersley

Lord Jenkin of Roding

when he spoke at the Parliamentary exhibition which gave MPs and Peers an opportunity to learn about the Large Hadron Collider at CERN, and to hear about the discovery of what he described as 'the Higgs-like particle' on July 4th this year. This event was well reported in *Science in Parliament*. Professor Womersley has been a key figure in the development of this branch of Physics for many years, and we are delighted to have him with us today."

PROFESSOR JOHN WOMERSLEY:

"Thank you for that warm introduction. Firstly, I would like to say a few words about what the Science and Technology Facilities Council is and what we do. STFC is one of the UK's seven

Research Councils and our particular remit is to support research in Particle and Nuclear Physics, Astronomy and Space Science. In addition we run major national facilities such as the Rutherford Appleton Laboratory – home to the Diamond Light Source – in Oxfordshire, and the Daresbury Laboratory in Cheshire. We are also responsible for managing the UK's involvement in major international collaborations such as the European Southern Observatory, the Institut Laue-Langevin (ILL) and the European Sychrotron Radiation Facility (ESRF) in Grenoble.

Perhaps the most well-known of these collaborations, of course, is CERN, the European Organisation for Nuclear Research, based in Geneva. You will all be aware that this has been a momentous year for CERN's Large Hadron Collider (LHC), from which on 4 July there was the announcement of the discovery of the Higgs Boson – or rather 'a particle consistent with that predicted by Professor Peter Higgs in 1964' – I have to be careful how I phrase this and my colleagues in CERN will be quick to admonish me!

What does this mean? Well, the Higgs boson is a fundamental particle responsible for the origin of mass. It is famously difficult to explain how this works in lay terms. I see Lord Waldegrave in the audience who is rightly acclaimed, when Science Minister in 1993, for setting the challenge to explain the Higgs particle when scientists were first seeking funding to build this £1bn experiment. The winner of that particular competition was as follows: Imagine a cocktail party of political party workers distributed across a room, all talking to their nearest neighbours. Mrs Thatcher enters and crosses the room. All of the workers in her neighbourhood immediately start to cluster round her. As she moves through the room, she continues to attract a knot of people always clustered around her and this has the effect of slowing her down, giving her essentially a greater mass. Once moving she is harder to stop, and once stopped she is harder to get moving again because the clustering process has to be restarted.

Without going too far into the details, the universe is filled with a field of Higgs particles which act like the party workers in this analogy – they are responsible for the creation of mass, and stop everything from just zipping around at the speed of light. This makes it possible to combine all the fundamental forces of the universe in a single unified mathematical framework which we call the Standard Model – a comprehensive and remarkably successful explanation of the basic building blocks that make up our universe.

It is important to note that the United Kingdom has been at the forefront of this discovery – of course Peter Higgs is an emeritus Professor at Edinburgh, and UK scientists and engineers have also

Lord Jenkin, Dr Stephen Benn, Professor John Womersley, Andrew Miller MP

Philip Wheat

Lord Walton of Detchant and Stephanie Fernandes

Dr Stephen Keevil, Ms Rosemary Cook and Sarah Newton MP

Stephen Metcalfe MP and Lord Broers

been central to designing, building, operating and performing the experiments on the LHC. The UK is one of the leading nations in terms of volume of papers published in Nuclear and Particle Physics and we rank number one in quality as measured by citation rates.

Scientifically, then, this was a major breakthrough. However, it is very important – especially at a time of economic difficulty, and for a political audience like this one, that I also have a good answer to the question 'why should we care?' Aside from Mrs Thatcher's observation on the expense of the LHC 'isn't it interesting, though?' which is difficult to disagree with, the huge resonance of the general public to this year's Higgs announcements goes some way to answering the question. On the day of the announcement the news in the UK alone reached an audience of 12 million on TV and 14 million on radio. There were more than 1,200 stories in broadcast media within 24 hours and it was mentioned every 1.1 seconds on Twitter, with 8 of the top 10 'trending' topics being Higgs related. Internationally there were more than 4,500 print articles, it made the front page of major newspapers and even The Economist.

We understand that communicating discoveries such as the Higgs effectively is an obligation for scientists who are supported from the public purse – and just one aspect of this in recent months has been a small exhibition including a replica of a section of the LHC tunnel which STFC has been touring around the UK, including Westminster, the devolved administrations, and science festivals. The statistics I set out show that there is a real public hunger for science and this is supported by other trends: 90 per cent of physics graduates cite inspirational fundamental science advances in physics and astronomy as the reasons they decided to study the discipline. In the past year, University applications in physics have increased by eight per cent at a time when overall applications fell by eight per cent, so we may well be seeing an impact.

Attracting young people into STEM careers is hugely important for our future competitiveness in the global knowledge economy. However, the cover of The Economist gives us another hint as to why supporting science is so important. Aside from helping humanity gain a more complete understanding of our place in the universe, the technological innovation and skills that need to be developed to carry out this research feed straight back into the economies and the Governments which support it. The US Census

Past and present Directors of POST: Professor David Cope and Dr Chris Tyler

Dr Richard Worswick and Lord May of Oxford

Andrew Miller MP with Dr Tom Price, a Research Fellow at the Institute of Integrative Biology at the University of Liverpool, his pair in the Royal Society Pairing Scheme

Bureau estimated in 2002 that the value of a single science PhD student to the economy over their lifetime was an additional $2.2M, roughly £1.8M today. This is a tangible measure of what the 'knowledge economy' really means and I would like to expand on this.

George Bernard Shaw famously said that *'The reasonable man adapts himself to the world; the unreasonable one persists to adapt the world to himself. Therefore all progress depends on the unreasonable man.'* Fundamental research, like particle physics and astronomy, plays the role of the unreasonable man – it makes demands on technology and engineering which require new inventions, new technologies, new capabilities to be developed. These advances then feed back into the broader economy to the benefit of everyone.

For example, in order to collide particle beams at very high energies, physicists needed ways of generating very high magnetic fields. This led to a series of technology breakthroughs in superconducting magnets going back several decades. The large hadron collider magnets are based on this technology but so are the magnets used for Magnetic Resonance Imaging (MRI). Two and a half million MRI scans were performed in the UK in 2010, equipment manufacture contributes £100m to the UK's GDP each year and a further £100m is saved every year just through the improved treatment of spinal disc herniation – slipped discs. I am told that MRI scanners helped the TeamGB cycling team achieve golds in the Olympics through its application to their training regime!

The same particle accelerator technology used in the LHC is what drives the Diamond Light Source and ISIS neutron source at the Rutherford Appleton Laboratory. The ISIS machine – still on a vast scale and housed in a hangar sized facility – is used to create neutrons which are uniquely valuable in analysing the internal structure of materials. ISIS has many collaborations with industry. One recent example has been work done with EDF where we looked at the integrity of the welds and materials within nuclear power stations. These studies showed that the materials were sound and gave confidence that the safe working lives of the plants could be extended by five years, leading not only to continued security of energy supply but also deferment of £3bn decommissioning and replacements costs.

I am also pleased to see Richard Worswick in the audience. This gives me the chance to mention Cobalt Light Systems, an extremely promising spin out company from STFC's Central Laser Facility. Cobalt uses a technique known as spatially offset Raman spectroscopy which was developed for scientific analysis; Cobalt has been able to commercialise the application to the stage where prototypes are now being used at airports to scan containers of liquids to identify if they contain illicit or dangerous substances. This technique can lead to a lifting of current restrictions for taking liquids onto flights. Cobalt is just one example where STFC's development of Science and Innovation Campuses at our Harwell and Daresbury locations, and the innovation friendly ethos at the STFC's national facilities has helped enable such a successful development. In fact we are now collaborating with both CERN and with the European Space Agency to operate business incubation centres at Harwell and Daresbury. These centres are specifically designed to help support small, UK-based businesses to commercialise the technologies coming out of these projects.

WHAT ARE THE BIG SCIENCE PROJECTS OF THE FUTURE THAT WILL BRING MORE SUCH ADVANCES?

Let me start with what's next for the LHC. During 2013 the experiment will cease operations to undergo a major new upgrade that will see its energy doubled and the rate of data acquisition increased. This will enable us to investigate the properties of the Higgs boson in detail, and also allow us to extend the search for new physics, for example, to address the nature of dark matter, which is thought to constitute 84 per cent of the Universe. Fortuitously, this year-long shutdown will allow visitors to enter the tunnel 100 metres beneath Geneva once again and STFC is particularly keen to encourage UK policy makers and general public to do this. If you are interested in taking this opportunity please contact my office.

The next big new fundamental project that we hope will capture everyone's imagination and inspire future generations is the Square Kilometre Array, or SKA. This is a radio telescope consisting of around 3,000 dishes distributed over a huge geographical area across South Africa and Australia. Mapping the sky precisely with this huge array and bringing together the data collected on this enormous scale will allow us a completely new view of the universe. We will be able to look back in history to a time before the first stars formed, investigate the nature of gravity and challenge the theory of general relativity, study magnetic fields in space and even search for extra-terrestrial signals that might be broadcast from other civilisations.

SKA is a global project but we are particularly proud that Jodrell Bank in the UK hosts the SKA's international headquarters which will be inaugurated in 2013. The initial stages of work on this decades-long project demonstrate clearly how the experiment will drive the need to develop new technologies that will bring benefits across the economy. Key to the design of SKA is the acquisition and processing of vast quantities of data from the thousands of distributed telescope dishes – more information than is currently transmitted across the entire global internet today. Supercomputing and e-Science teams from Cambridge, Oxford and Manchester universities and from STFC's Hartree Centre at our Daresbury Laboratory are already working on how to solve these challenges, in collaboration with companies like IBM and Intel who can see how this science is going to drive innovation in their sector.

I hope my talk has demonstrated that there really should be no distinction between 'basic' and 'applied' research – even the most fundamental research about the nature of the universe has a huge impact on everyday life, both in terms of attracting people into STEM careers and in creating new inventions because of the way that it makes 'unreasonable' demands on technology. Organisations such as the Research Councils work hard to maximise these benefits to the economy through encouraging spin out companies and collaboration with industry. Most importantly there is very exciting science and many more challenges ahead with projects such as the Square Kilometre Array, in which the UK is privileged to be playing a leading role."