THE FOUNDATION FOR SCIENCE AND TECHNOLOGY

DINNER/DISCUSSION SUMMARY

Threats and opportunities – scientific challenges of the 21st Century

Held at The Royal Society on 6th February, 2013

The Foundation is grateful for the support for this meeting from BP, Lloyd's of London, the Met Office, the National Physical Laboratory and the Smith Institute for Industrial Mathematics and System Engineering

Chair: **The Earl of Selborne GBE FRS**
Chairman, The Foundation for Science and Technology

Speakers: **The Rt Hon David Willetts MP**
Minister of State for Universities and Science
Sir John Beddington CMG FRS FRSE HonFREng
Government Chief Scientific Adviser, Government Office for Science
Dame Sally Davies DBE FMedSci
Chief Medical Officer and Director General of Research and Development, Department of Health
Sir Mark Walport FRS FMedSci
Government Chief Scientific Adviser Designate and Director, The Wellcome Trust

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THE RT HON DAVID WILLETTS paid tribute to Sir John Beddington, who is retiring from his post at the end of March, for his contribution to the delivery of the highest quality scientific advice to government. He looked forward to Sir Mark Walport, his successor, continuing to deliver such high quality advice in the future.

SIR JOHN BEDDINGTON opened his talk with reference to the National Risk Register[1]. There were three items which would require close attention by the Government Chief Scientific Adviser in the next five years - pandemic diseases, space weather events and the threat of terrorist attack. All three would need decisions to be dealt with on very tight time schedules. Pandemic diseases could affect plants and animals as well as humans, could spread globally quickly, and were likely to need new, demanding intensive research to determine how best to deal with them.

Determining the appropriate response to other items on the Register would need continuing support from the science network. Volcanic explosions in the next five years similar to the Eyjafjallajökull event were likely. Such events could cause not only temporary problems, such as those stemming from the Iceland volcanic ash event, but could create much more serious problems for health and the environment if they were effusive eruptions, which could emit material for six months.

Perhaps the greatest challenge was dealing with the effects of climate change. Fortunately, some of the scepticism which greeted scientific predictions and modelling ten years ago was lessening as data from 2006 to 2011 supplemented model forecasts, and it became clearer that climate change was impacting the global economy.

The insurance industry recognised this. Munich Re had shown that weather related loss incidents have increased and that, in particular, extreme natural catastrophe events (such as floods and wild fires) were increasing. Indeed, the variability of events each year was increasing at twice the rate of the increase in the mean. Unfortunately, although it was clear that something must be done to slow the rate of growth of CO_2 emissions, there was no likelihood that any international commitment to do so would work.

Further increase of CO_2 was inevitable with the growing demand for fossil fuels. This demand can be easily met from the global reserves of hydrocarbons and coal; particularly the new reserves of tight oil and shale gas recently added in the US. Shale gas and tight oil developments were already transforming the US economy; the rest of the world (including the UK) will need to learn how to exploit these new technologies safely and with environmental safeguards. Moreover we must accept that there is a 20 year lag before any reduction in emissions today limits temperature rise. Little can change before 2050. Geoengineering options, such as cloud generation devices, would be only a temporary fix, and Carbon Capture and Storage (CCS) development had far to go

[1] www.cabinetoffice.gov.uk/resource-library/national-risk-register

before it becomes commercially viable and safe. A particular consequence of climate change was the increasing acidification of the oceans. This could mean damage to fisheries and coastal areas, and destruction of coral reefs.

Global population growth was of great concern. Population would grow by 1 billion by 2025 and by then 65 to 75% of people would live in cities. The population would be increasingly vulnerable because of a shift of the age structure, malnutrition and basic shortage of water, food and energy. It was possible to increase food productivity through biotechnology, as we became able to target more precisely the means of support.

A particular problem was regulation that took no account of the scientific understanding of a specified risk. A good example was the regulation that specified aircraft should not fly through volcanic ash clouds. The EU based many regulations on a basis of hazard - i.e. a specification of harm, rather than risk, a combination of hazard and probability – a risk based approach. Thus some pesticides were banned because of the application of the precautionary principle without regard to the benefit they might bring. Scientists must work together to with regulators to make regulations risk based.

In summary (a) we have a fantastic science base in the UK and science output feeds innovation, (b) managing population growth is at tipping point – better education, welfare, and contraception may reduce the rate of growth but if not increased population levels may become impossible to support and (c) the demands for food, water, and energy with lower greenhouse gas emissions is a major challenge.

DAME SALLY DAVIES summarised the main issues in her 2011 Annual Report - public health, dementia, infections, non communicable diseases, rare diseases and research. Key public health challenges were managing the consequences of excessive alcohol consumption and the rise in obesity in the population.

While alcohol consumption was reducing in the EU, it was increasing in the UK, particularly in the North East and North West, affecting the young and middle-aged, leading to liver disease and premature death. The cost to the NHS was around £2 billion a year, with lost productivity estimated to be £7.3 billion a year. Social science research is needed to understand why people drink, the elasticity of price in controlling demand, and proposed limits on alcohol strength in drinks. Teenagers were particularly vulnerable to health problems arising from excessive alcohol consumption.

Obesity is also becoming more challenging - one in four are obese, 60% are overweight[2]. Again projections show UK the rate of growth of obesity is higher than EU countries but lower than US. Again this is an area for new social science research – for example studying the impact of advertising on school children, and how sport and exercise is changing behaviour. New regulation would be difficult - there could be accusations that the UK is becoming a nanny state.

Dementia is a problem growing through both the increase in population and the growth in the elderly. Further research is needed on the multiple causes, how deterioration of mental capacity can be slowed and how care for dementia patients can be improved. A particular issue is the unwillingness of GPs to diagnose dementia, or to be frank with patients. Understanding what to do requires input from both the social science as well as the medical research communities.

On non-communicable disease, such as cancer, need both social science research, (for example how to reduce the propensity to smoke through campaigns such as the successful New Year anti-smoking campaign) and medical research are necessary.

A recent success has be the growth in the recruitment of participants in the NHS portfolio of cancer studies (now 22.9% of patients with cancer participate in studies). Research was also continuing on genomic technologies to bring bespoke treatment to individuals in the short, medium and long term.

SIR MARK WALPORT cited the words of Lord Zuckerman, the first Government Chief Scientific Adviser, on the moral neutrality of science. This was the crucial anchor for a scientific adviser. He must deliver the best scientific advice he can, regardless of policy consequences. Policy is for politicians to decide. They will have other issues to consider, but they must not be misled by an inaccurate or partial view of the science. An example was the criminal justice system, which has three objectives - preventing reoffending, deterrence and retribution. Science can provide advice on the first, and possibly the second, but Ministers' decisions must encompass all three.

Science is more than ever crucial to our cultural, industrial, social and economic policy. We have a good range of institutions - research councils, HEFCE, research associations and others to advise government and distribute funds, but there is still a great need for collaboration and cooperation between academia, government and industry. Interdisciplinary and efficient execution in some areas are still lacking.

[2] www.ic.nhs.uk/Article/1685

Harry Hoff wrote about this in 1952 (*The Struggles of Albert Woods*, William Cooper (Hoff's pseudonym)). Hoff also instigated a campaign to attract scientists from the world to come to the UK – to reverse the brain drain. He saw how important it was to allow free movement of scientists between countries.

Sir Mark emphasised the great work Sir John had done in embedding SAGE (the Scientific Advisory Group for Emergencies) into government civil contingencies procedures. His work in relation to Fukushima - which resulted in the advice to UK citizens not to leave Japan - was outstanding. He has extended a scientific approach to harder areas of uncertainty (the Black Swan Blackett Review) and reached out to the academies, business and the world for advice. Good examples were the report on the risks to the UK from shale gas development commissioned from The Royal Society and the Royal Academy of Engineering. The Foresight Project on the dangers of High Speed Trading broke new ground in building relations with the financial sector.

Resilience, security and well-being are key themes for the Government Office of Science. Population increase, food, water and energy deficiencies could create a perfect storm by 2030. Science and technology solutions may be the only way forward. This is not just a matter for secret meetings and discretion. It is up to us to use all methods to publicise the threats and opportunities and consider how the science community can contribute.

In the following discussion, speakers were concerned about the perverse effects of regulation, and the different attitudes towards science in different cultures. Why, for example, does GM food face resistance for the public in Germany and France, but not elsewhere, and why are other GM crops, such as Bt cotton, seen as more acceptable in some regions?

Why was so much pseudo science accepted? The problem was that it took a long time for public attitudes to change, once they had been set, and scientists were not good at challenging and dispelling public fears. Another problem was that the use of GM crops had not been specific enough. Work needed to be done on demonstrating the effects of GM work on specific crops in specific circumstances. The basic problem in public understanding was the desire to achieve perfect safety by invoking the principle of hazard, rather than risk (as Sir John had explained). This led to an over use of the precautionary principle. If something might conceivably cause harm, ban it.

Politicians often reacted to scare stories and it was increasingly important that scientists cooperated across Europe to ensure proper scientific advice was given. A hopeful sign was that scientific advisers in various countries were working more closely together, but it was unfortunate that Mr Barroso's science adviser (Professor Anne Glover) had limited resources to support her work.

One success story supported by science advice was the successful lobby to withdraw an EU directive on limits to electromagnetic radiation exposure to the public, which would have made it impossible to use MRI scanners in hospitals.

Speakers endorsed the view that social scientists were vital to dealing with problems involving public attitudes and behaviour. It was important that a Chief Social Science Adviser was part of the Chief Scientific Adviser's team. It was hoped one would be appointed shortly. Public attitudes could be altered through proper campaigns such as the anti-smoking and the anti-drink/driving campaigns. The methods used to achieve these successes should be more widespread

There were concerns that the National Risk Register might not encompass all the threats that might emerge in the next fifteen years, particularly the threat to energy security, and the consequences of global population growth. It was admittedly difficult to look fifteen years ahead, but the forecast scenarios attempted to do that. Energy security would inevitably be a risk, not only from foreign wars or other threats, but also because we needed more investment in generation and transmission. Nuclear was of great importance, but it needed to be properly regulated, and not burdened with regulations, based on the precautionary principle. Any risk on the Register was now the responsibility of a particular department, which would take the lead in further work. But we must not allow a silo mentality to develop.

Speakers suggested that there were two major problems in delivering scientific advice. First, there were so few politicians who had scientific training or understood scientific issues; second the gender imbalance in scientific posts meant that we were missing out on valuable talent from female scientists.

On the first, it was not true that politicians did not understand the importance of science or wish to understand the arguments (although they might not accept them). The difficulty was delivering advice in terms that they can understand (not in jargon) and in a timely way. A particular difficulty was where there was a fundamental disagreement between scientists. Both sides of an argument needed to be presented carefully in such circumstances. Where real disagreement surfaced in SAGE, judgement was needed in presenting material when decisions had to be taken very quickly.

Gender is an issue - 93% of men were still working in science three years after their PhD but many fewer women were. But, there are many opportunities for men and women who leave science professionally to work in promoting and delivering scientific understanding outside research.

The Panel, commenting on the discussion, said three issues stood out. First, that science was international, and we should be working to broaden our international contacts, and use them to produce sensible scientific policies and regulation, particularly in Europe. Secondly, scientists must engage in a constant battle against pseudo-science and alarmism. And, thirdly, scientists must deliver quality science, with a strong evidence base.

Sir Geoffrey Chipperfield KCB

Useful web links are:
BP
www.bp.com

Department for Business, Innovation and Skills
www.bis.gov.uk

The Foundation for Science and Technology
www.foundation.org.uk

Government Office for Science
www.bis.gov.uk/go-science

Lloyd's of London
www.lloyds.com

Met Office
www.metoffice.gov.uk

National Institute for Health Research
www.nihr.ac.uk

National Physical Laboratory
www.npl.co.uk

Research Councils UK (RCUK)
www.rcuk.ac.uk

Smith Institute for Mathematics and System Engineering
www.smithinst.co.uk

Technology Strategy Board
www.innovateuk.org

The Wellcome Trust
www.wellcome.ac.uk

Ahead of the debate participants were invited to pick three science and engineering challenges from a list of 33 or add extra challenges. Several respondents added an extra challenge of "limiting population growth". Comments and additions would be most welcome.

The results from 61 returns were:

Issue	Count
Feeding the world	21
Preparing for an ageing population	16
Balancing economic growth and resource consumption	13
Supplying low carbon energy to meet demand	12
Delivering an effective education system	12
Mitigating the results of and adapting to climate change	10
Advancing treatment for disease	9
Meeting the demand for potable water and irrigation	9
Protecting the environment	8
Responding to the threat of antibiotic resistant organisms	8
Managing risk and building resilience to threats	7
Reducing energy demand through energy efficiency	7
Making good use of knowledge of the human genome	6
Reducing conflict	5
Building the aviation, road, rail, shipping and IT infrastructure to support the economy	4
Improving well-being	4
Protecting biodiversity	4
Securing the web	3
Understanding marine ecosystems	2
Responding to natural disasters	2
Managing a stable banking system to support trade	2
Preparing for pandemics	2
Managing social breakdown in cities	2
Building effective global systems for communication	2
Meeting the demand for low cost housing	1
Creating globally competitive companies	1
Understanding how the universe works	1
Unravelling the physics of matter	1
Modelling the global ecosystem	1
Modelling mortality	0
Delivering cultural content to the home	0
Product life cycles - cradle to grave waste management	0

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