

Standing on the Shoulders of Science

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Introduction

When I was parachuted into Government in October 2000, very different time to now. 9/11 had yet to happen. Climate change was still being discussed as something that needed more research into and the Kyoto Protocol had yet to come into force. We had not had an outbreak of foot and mouth for over 23 years. Government was still dealing with the repercussions of BSE Outbreak. The science budget was still trying to recover from the cutbacks in the '80s and 90s and nanotechnology was a mere speck on the horizon

Fusion was only 35 years away from becoming a commercial power source..... some things never change.

Animal Health

In early 2001, foot and mouth began to grip the UK. John Krebs called a meeting of epidemiologists to discuss the outbreak. Subsequently I rapidly assembled a team of epidemiological modellers, virologists and logistics modellers. The team's models pointed to the need to cull all animals infected with the disease within 24 hours and all neighbouring farms once the virus was confirmed. I was called to attend a COBR meeting where I explained the basis of my advice to the Prime Minister and that if the models were followed, the outbreak would all be but eradicated by the middle of the

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year. It was then the PM got really interested as there was great speculation that he wanted to call a General Election for May.

Within a few days, this new strategy was being implemented throughout the country and the result was what had been predicted by the modellers. The PM then also called an election, for 6 June. Possibly the first time an election has been called based on scientific advice.

After eight years of experiments by scientists around the world the challenges of BSE were returned to when samples of sheep brains had apparently been found to contain BSE. Before any announcement was made to cull the UK's population of sheep I asked a simple question. Were we sure they belonged to sheep? Had anyone undertaken a DNA test? The answer was no. An additional sample was then sent for testing which showed absolutely no trace of sheep. Someone had mixed up the cows and sheep brains. A clear example if I ever saw one of the need to label clearly, and to check labelling with scientific tests.

The challenges of animal disease to the UK and worldwide are becoming more prominent. Avian Flu is becoming more widespread and not just being limited to those that live cheek-by-jowl with poultry. We have already seen a number of outbreaks in the UK and as avian flu becomes increasingly endemic we will have to look at ways of protecting our bird and poultry population.

But the biggest disease challenge in UK farm animals is TB in cattle. Over 20,000 cattle have been slaughtered for TB reasons in Britain each year since 2002, and is currently costing the taxpayer £80m a year.

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Earlier this year I produced a report which explained that badgers have now been conclusively shown not just to harbour bovine TB but also to pass it on to cattle. I therefore recommended that in those areas where TB is particularly rife in cattle, we should cull not just the infected cattle, but also a proportion of the badgers. Badgers are the major wildlife reservoir of TB in our farmland. Unless we do this the disease will continue to spread.

While many accepted the rationale, in other quarters I was accused of bowing to government pressure, being in the pocket of the farmers' union, in fact of being on the side of almost everyone except the poor badgers.

I concluded that selective culling of badgers in large areas with persistently high levels of TB in cattle could in fact make a positive contribution. TB testing in cattle would need to continue, and any infected animal should be slaughtered. But in addition a cull of a portion of the badger population would be an effective way to reverse the spread of the disease until better solutions, such as vaccines, could be found. This is my advice. The decision is of course for the Cabinet.

Human health

In 2005 there were three main BSE controls. The principal one is the removal of bovine organs and body parts most susceptible to BSE infection, such as spinal cord, to prevent them entering the food chain. This control removes over 99% of the infectivity in cattle and will remain in place. The second is the prohibition on mammalian meat and bone meal being fed to farm animals. This will also remain in place. The third control, the OTM rule, stopped cattle older than 30 months from going for human consumption.

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The OTM rule was introduced in 1996, following the establishment of a link between BSE and vCJD. The potential additional exposure arising from lifting this rule is extremely small and the OTM rule offered poor value for money in terms of public health protection (over £1 million per day). Its retention would have set a serious precedent for future government expenditure on a wide range of risk related matters. Maintaining the OTM rule would place the value on the cost of a fatality prevented equivalent to some £2400 million on the best estimate, and £480 million on the realistic worst case. The OTM rule was abolished in 2005, a clear case of government finally listening to the science.

Over the last couple of years I have worked closely with the Dept of Health, Cabinet Office and other departments to ensure that our preparations for an influenza pandemic are underpinned by robust science.

It was important to objectively challenge whether or not we were over-reliant on information from big pharma companies in preparing defences for the UK public – and getting good value for money in the process.

I am pleased that the government's analysis of the current scientific evidence base has just been published by the Cabinet Office. This evidence base is growing all the time and we all of course hope that there will be plenty of time for science to contribute further advances before a pandemic strikes

GM

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The GM Science Review which I chaired reached a sensible conclusion - regulation of products case by case, not denial of the new technologies. But the GM Nation debate in 2003 concluded that there was general public unease about GM crops and food and little support for early commercialisation of GM crops. People already engaged with the issues were generally much more hostile. Those not so engaged were ambivalent; they recognised that GM crops had some potential benefits but were also very cautious with respect to the potential risks. They also had some doubt about whether the purported benefits would be delivered.

By 2050 we will need to feed over 9bn people on the planet - We will, I believe, only do this with the assistance of a third green revolution, and GM technologies will be crucial in delivery of this. British science, in particular molecular biology is a world leader and we should be producing companies that will lead the world in this green revolution.

To date the Government has taken a broadly neutral approach to GM issues, with its priorities being to protect human health and the environment and provide choice for the consumer over whether or not to purchase GM food. I believe that it's now time to revisit this issue.

Foresight

After the foot and mouth outbreak came the opportunity to show the practical, real-time application of science. While we had in place a system to look at how to identify and capture future wealth creating opportunities and to encourage greater interaction between science and industry, we needed a way not to do just this but to capture the interdisciplinary knowledge generated in universities and research institutions around the

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world, to relate this knowledge to risks and opportunities that might arise in the future, and to use for evidence based policy to the UK Government. Thus in 2002, new Foresight was created.

The first step in ensuring that politicians are ready to listen, and that scientists are able to speak, is to choose the right topics. A topic must either represent some important current issue that science, technology and the social and economic sciences could together help address (for example Flood Risk Management), or a current aspect of science or technology that is likely to have wider potential in the future (for example exploiting new aspects of the electromagnetic spectrum).

The subject must also be future-orientated; not duplicate work taking place elsewhere; have potential outcomes that can lead to specific actions; be multidisciplinary; and above all, it must have commitment from the potential beneficiaries that they are eager to hear the results and act on them.

When a topic is chosen A stakeholder group is set up to oversee the project, which I direct. This is composed of senior decision-makers and budget-holders from relevant government departments, research councils, industry, charities and other professional bodies. The group is chaired by the sponsoring Minister.

The project team, made up of civil servants and up to six external leading experts, sets about inviting between 90 and 120 natural scientists, social scientists, and economists onto the project. These participants will review the scientific literature extensively and look at relevant social and economic trends. They will also undertake “horizon scanning”, that is they will consider what developments lie in the near future through a series of workshops, seminars, brainstorming sessions and other conversations with industry and relevant professional organizations. As well as bringing together the results of existing research, the projects can also commission new research.

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The results are never simply extrapolations from the present day. Another product of each project is an agreed action plan which is widely circulated to all stakeholders and put in the public domain. The primary aim is that the outcome of Foresight projects will influence both policy and funding decisions made by government. There is little point in producing scientific reports if nobody on the political side has committed themselves to listening.

The Foresight and Horizon scanning activity has now been embedded into government thinking and is the best example of how government can use science in its broadest sense to look at the challenges of the future. The publicity given to the recent report on Obesities is a very welcome indicator that these programmes are going to the heart of issues of public interest and concern.

The Environment

As UK Government Chief Scientific Adviser for the past seven years, I have been actively involved in the science of climate change and in related issues around energy production, supply and research, in technology development and diffusion, and in climate change and energy policy.

The 10 warmest years on record have all been since 1990. Over the last century average global temperatures have risen by 0.6 degrees Celsius: the most drastic temperature rise for over 1,000 years in the northern hemisphere.

Extreme events are becoming more frequent. Glaciers are melting. Sea ice and snow cover is declining. Animals and plants are responding to an earlier spring. Sea levels are rising and are forecast to rise by up to 88cm by 2100 threatening 100m people globally who currently live below this level.

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The number of people affected by floods worldwide has already risen from 7 million in the 1960s to 150 million today.

In Europe alone, the severe floods in 2002 had an estimated cost of €16 billion.

Germany was particularly hard hit when the Elbe burst its banks. And the summer heat wave of 2003 killed over 30,000 people. On the basis of a constant climate baseline it has been calculated that such a summer is a one in about 1000 year event. However due to global warming the central European average summer temperature is now close to the hottest summer of the twentieth century, which was in 1947. By the mid-century, the average European summer temperature will be the same as that severe summer of 2003. None of these recent climate events came as a surprise to climate science community.

The public, in my view, do not understand the scale of the problem we face. A recent opinion survey in the UK showed that 94% of people are concerned about climate change.

There is an increasing consensus on the need for robust and urgent action, and competing ideas for how best to achieve this. The role of civil society is a major factor. Increasingly large and small private sector companies are involved in taking action to limit climate change.

The priority now is to take the steps required to turn the corner towards a low carbon global energy economy, using mechanisms such as emissions trading.

Urgent action is needed now if we are to get any sort of agreement by 2009. The COP meeting in Bali early next month will be an important juncture in our climate negotiations.

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However, until agreement can be reached on four key areas at a G8 +5 level I believe we are still a long way off. The four key elements to such an agreement are:

- A global stabilisation level agreed (my view is that this should be set at 450 ppm CO₂ equivalent);
- Agreed national targets and timescales for all countries;
- World wide carbon trading;
- Technology transfer and adaptation strategy.

Through the science we are aware of the problem and, with the necessary political and collective will, have the ability to address it effectively and deal with it effectively.

However this is not a long-term problem. The time to act is now for the benefit of future generations.

Energy

Climate change does offer opportunities, particularly in developing a low carbon economy. If we are to see a step change in our energy production and supply we need to ensure that business can make the most of the opportunities that tackling climate change presents, and to develop effective and efficient policies. It is vital for business to engage with Government.

Companies must also think about how they will make the transition to a low carbon economy. There is much to be gained from helping shape these new markets on the back of this transition. The context for all businesses is set to change radically, with immense opportunities available to improve existing business practice and

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competitiveness, for example by increased energy efficiency. New products and services, from low carbon technologies to new insurance products represent great new business opportunities.

The opportunities for the UK should not be underestimated. If we can harness these new low carbon technologies we can really get a march on other countries in terms on technology transfer.

Considerably more resources will be put into research over the next 10 years, spurred on by two important developments. Firstly, we in the UK government are working with the Chief Executives of BP, E.ON UK, EDF, Rolls Royce, Caterpillar and Shell to develop a new Energy technologies Institute , a market facing public-private partnership which will invest £1bn into low carbon energy R, D,D & D over 10 years. A new Director has been appointed, David Clarke, and a location chosen for the hub of the institute at Loughborough University.

However, a word of sobriety. We are still investing only around the same amount on energy R&D as Belgium. While it is very good we are investing into initiatives such as the ETI, this funding must not be at the expense of other areas of energy research. A continued step change in investment will be needed. This is just the start.

Alternative technologies and energy-efficiency gains will certainly help the UK to achieve our target of reducing emissions by 60% by 2050. But we will also need to look at other low-emission ways of making energy. It is now the time to give the green light to nuclear energy. While I have high hopes for new zero-emissions technologies in the future, efficient nuclear-fission power stations are already available. (I am also hopeful that

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fusion power stations, without the problems of nuclear-waste disposal, will emerge over the coming three or four decades).

I emphatically do not believe in direct government subsidies for nuclear energy. The decisions about the economics will be made by the private utilities sector, guided by government considerations on the need to meet our emissions targets and to have a secure energy supply

We also need to explore further how the UK built environment can evolve to help manage the transition over the next five decades to secure, sustainable, low carbon energy systems that meet the needs of society, the requirements of the economy, and the expectation of individuals. Two of these areas have been the target for recent Foresight programmes, one on the development of intelligent infrastructures and the second is under way, on energy efficiency in the built environment. Lower energy usage is a must if we are to reduce our emissions.

Civil Contingencies

The UK is just one country that faces a continuing threat from those who believe they can advance their aims by committing acts of terrorism. Science and innovation are critical to our success in combating this threat. Both in terms of the immediate threat of violence from those terrorists and in terms of winning hearts and minds and in particular those young minds in our community. Our enlightened democracies have much to offer everybody and we need to get this message across.

The terrorist threat is ever changing; it can often be innovative and inventive. In order to counter it, we need to stay ahead of the terrorists, building and improving our capacity to

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combat terrorism. We have invested significant resources to make sure that the best people and organisations all over the UK and beyond are working to deliver cutting-edge science and innovation to do this.

There are two aspects to the role of science in countering terrorism. The first is about forging an environment that fosters creativity and innovation in order to generate the knowledge and technologies that can reduce the risk from terrorism. The second is about providing the best available science and innovation to provide support and advice both at the strategic/policy level (Government Departments) and at the end-user tactical level such as emergency responders and those involved in clean up and recovery.

The role social science can play in dealing with counter-terrorism is key. Understanding and developing a way of integrating people into societies by winning hearts and minds will be vital in preventing individuals from seeking to become involved in terrorism.

We also know that we must continue to evolve our thinking in order to deal with the threat of terrorism. We must ensure that Government departments work more closely together, and that science and innovation are deployed to maximum effect. We must clearly articulate the UK's requirement for new research, engaging established multi-national companies, imaginative entrepreneurs operating in small or medium sized enterprises (SMEs) and academia.

Science in the Civil Service

In the early 80's there was a coordinated campaign to encourage Civil Servants to know when they should seek to use legal advice in their work. The Campaign was called "the judge over your shoulder". It was incredibly successful and ensured that government was a more legally minded organisation. During my tenure as GCSA I have worked hard

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to integrate science in good policy making and ensure that scientific advice has been used for all policy decisions. I have been impressed with the quality of people in the Civil Service but its clear that we do need to raise the bar in ensuring we have a scientifically literate civil service and there able to make the right decision based on the very best evidence. This does not always happen and we must not get into a situation where Civil Servants try and second guess Ministers wishes and try and fit the evidence to the answer.

The UK should be well placed to take advantage of the new markets opened up by globalisation. We have an excellent record of scientific discovery and a rapidly growing share of high-technology manufacturing and knowledge-intensive services in the UK. The amount of knowledge transfer from British universities has increased significantly and we are beginning to see the growth of exciting high-technology clusters around many of our world-class research universities. The problem is and one that I have tried to tackle is how do we grow the next IBM or Nokia? We are very good at growing small to medium sized companies but when it comes to the next stage, we struggle.

We need better leadership and guidance - whether its through the Technology Strategy Board Working, the RDA's the Research Councils and government departments in order to co-ordinate public sector support for technological innovation, leverage public sector resources and simplify access for business.

We also need to improve procurement capability. Government currently spends over £120bn on procurement. I would like to see a small percentage of that, say 1-2%, ring-fenced to assist in pulling through new promising technologies. This risk procurement

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policy would not only pull through new technologies of direct use: It would also stimulate the development of more R&D companies in the UK, large and small.

International activity and science in the developing world

In the summer of 2004 a group of scientists went to Indonesia and Bangladesh to warn the government of the possibility of a potentially devastating earthquake hitting the region and for the establishment of an early warning system, at a cost of \$30 million to save thousands of lives in event of an earthquake hitting the region. This request was not acted upon and less than 2 months later an earthquake in the Indian Ocean caused a massive tsunami killing almost 300,000 people and causing billions of pounds of damage.

What does this tell us? Ignore scientific advice at your own risk!

This is an extreme example of not taking on board scientific advice; however it is and should be a clear and stark message that science and a good evidence base is integral to tackling the challenges of the 21st century, whether it's the environment, resources, food production, water resource, terrorism and wealth creation.

We are now, probably more than ever before - living in a global age; we can access vast quantities of information from all around the world and interact with a far greater diversity of people than ever before. Advances in science, engineering and technology have provided much of the knowledge, underpinning the changes we have seen and the ability to innovate, adapt and use this knowledge has changed the way all of us live, work and communicate. Equally, world poverty and sustainable development remain serious challenges where science and technology have a critical role to play.

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Recognising the importance of science is key – the UK government in 2004 asked me to set out a long term vision and commitment to invest in this area in the Science and Innovation Framework 2004-14. The Global Science and Innovation Forum (GSIF) was formed as a result. Recognising that science and innovation are international endeavours where the UK must be an effective and active global player.

The GSIF strategy was based on four priorities; research excellence; excellence in innovation, utilising our global influence and development. We need to use our own research and innovation progress to assist developing countries and to help meet international development goals.

You will know that I am a clear advocate of investing in science, technology and innovation – and, befitting the new Department for Innovation, Universities and Skills, the skills development agenda more widely – for the sustainable economic development of the poorest countries. Whilst the Millennium Development Goals have focused on primary education for all, I have passionately argued for a more holistic approach to education, so that it encompasses primary, secondary and tertiary education as well as professional training.

The Commission for Africa articulated this well – after much lobbying - in its 2005 report, calling for significant investment in centres of scientific excellence and in higher education institutes. The Commission's report was used to inform the G8 Summit at Gleneagles, during the UK's G8 (and for that matter EU) Presidency. Indeed, 2005 was a year that saw, I believe, a real turning point in our attitudes towards African development as one of partnership with Africa.

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Nevertheless, still little attention is being paid to the need for highly trained scientists, engineers, medical practitioners, and agriculturalists as a developmental priority. This is a recipe for disappointment, and a challenge that I hope will continue to be taken on – with UK leadership - by science policy and research communities alike. I believe we have the framework now.

We, as a society are facing a number of challenges that we have never faced before: the sustainable use of natural resources, reversing environmental degradation, defeating infectious diseases and tackling climate change. The questions we ask come from our scientific understanding of risks and opportunities. It is science and technology that will provide the answers, provided the political climate is right.

Tonight I have set out the journey we have been on. We have had successes, we've had challenges and the occasional crisis, but I believe that if we are to continue and maintain our capability we need to build on what's been achieved so far, we need the best scientific advice and we need to take governments and societies with us.

Thank you.