to plan long-term research. A joined up approach between Government, charity and industry over the last few years was just starting to make it easier to translate research ideas into benefits for people who suffer from arthritis. If the Government stops doing its bit now, this will seriously reduce the impact we can have on the 10 million sufferers of arthritis and their ability to be independent and actively contribute to society.

Dr Allison Jeynes-Ellis, Director of Medical and Innovation at the Association of the British Pharmaceutical Industry said, 'Last year, the pharmaceutical industry invested £4.3 billion in R&D in the UK to develop new medicines – we are by far the largest private sector investor. Every year, pharmaceutical companies decide on where they wish to conduct research, and they are increasingly collaborating with academia. The UK must continue to be globally competitive to attract this level of interest, it must maintain public sector investment in science, and ensure that innovative medicines are valued appropriately.'

Dr Patrick Vallance, Head of Drug Discovery for GlaxoSmithKline, said: 'A strong science base takes years to build up – it's not something you can break up and then pick up again 5 years later. It takes a very long time to create the right environment, and to have sustainable investment. The UK's excellent biomedical research base is one of the reasons GSK locates around 40% of our pharmaceutical R&D in the UK.

'We know it will be a tough spending review, but we hope the Government will focus funding on research in centres that are world class and further encourage collaboration with industry. The areas of real excellence do need to be protected for current research and also for the future generations of scientists.'

Jon Sussex, Deputy Director of the Office of Health Economics, said, 'Research by the Office of Health Economics and others has shown that public investment in medical research offers exceptional economic returns and stimulates additional R&D by the pharmaceutical and life sciences industry. Strong, sustained Government support for medical science is a very good investment, enabling the UK to benefit from the economic prosperity produced by this vital sector as well as from the advances in health care that result.'

The Academy of Medical Sciences was one of seven organisations invited by Professor Adrian Smith, Director General, Science and Research, Department for Business, Innovation and Skills to provide advice on the science budget in the context of the spending review.

The independent Academy of Medical Sciences promotes advances in medical science and campaigns to ensure these are translated into benefits for patients. The Academy's Fellows are the United Kingdom's leading medical scientists and scholars from hospitals, academia, industry and the public service.
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SCIENCE, RESEARCH AND INNOVATION

The Rt Hon Dr Vince Cable MP. Secretary of State for Business, Innovation and Skills and President of the Board of Trade
8 Sep 2010, Queen Mary University of London

Over the next few weeks and months, major decisions will be made on Government spending priorities as part of a wider move to stabilise the country's finances and rebalance the economy. They will help to define what we value as a nation and the direction in which we want to head. Investing in science and research is a critical part of that. I cannot prejudge the outcome but I know that my colleagues, including at the Treasury, value the contribution of UK science.

I have been arguing for years my concern over the way the British economy was distorted. Money borrowed for property speculation rather than productive investment and innovation. Too many top performing graduates heading straight for high finance rather than science and engineering.

It was clear to me and my colleagues that the British economy was becoming increasingly unbalanced in the short term, as the mountain of household debt built up. We were also unprepared for a long-term future where we need to earn our living in the world through high-tech, high-skills and innovation.

One of the unhappy by-products of the burst bubble, banking crisis and recession is a massive budget deficit that we inherited. As a consequence, we face the tightest spending round

since post-War demobilisation.

My department is the largest department in Whitehall without a protected budget and science, alongside Further Education and Higher Education, is one of its largest components.

We know that the Labour Government was planning deep cuts of 20%-25% in the budget of that department. Economies on this scale are clearly a very major challenge.

There is a school of thought which says that Government commitment to science and technology is measured by how much money we spend. Money is important both for the quality and quantity. But it is an input, not an output, measure. The question I have to address is can we achieve more with less?

In deciding priorities, there is a limit to how much I can dictate the course of events. Nor do I wish to. Research priorities and technical priorities are set at arms length from Government, and through peer review. That is right. Yet the Government spends £6bn a year supporting science and research and it is right that I should speak about strategic priorities.

I feel I should start by registering a personal interest when it comes to science. I'm one of few MPs to have at least started a science degree – well, it began as natural science and ended up as economics.

My constituency, Twickenham, is one of the major centres of scientific enquiry. It contains the National Physical Laboratory, a world-leading centre; the Laboratory of the Government Chemist; and a wide variety of companies involved in science, research and innovation.

I recently discovered one accidentally as a result of a parking dispute with local residents: FT Technologies which is one of two major companies in the world making wind monitoring and airflow measurement applications, much of its production being exported to China.

And one of my constituents is inventor Trevor Bayliss, best known for inventing the wind-up radio. He constantly reminds me of the parlous status and minimal support given to inventors whose ideas so often fail to find commercial application in the UK but are used overseas.

I would add that my youngest son, Hugo, is a very theoretical quantum physicist – based in Singapore.

You could say that a little knowledge is a dangerous thing. But I am familiar with the language of science and the sorts of difficulties faced by scientists, researchers and inventors.

It is apt that I am giving this speech at Queen Mary, University of London, one of the UK's leading research-focused higher education institutions and home to 16,000 students.

The Mile End campus is historically the home of Queen Mary College, which began life in 1887 as the People's Palace, a philanthropic endeavour to provide east Londoners with education and social activities.

It was an innovation then, and continues to be innovative today.

I know that it collaborates with a Chinese university, plus it has a good record of producing spin-out technology, most notably a company called ApaTech, which eventually sold for some $330m. Indeed, Queen Mary was called "the biggest star" among research intensive institutions by Times Higher Education.

And that leads me to set out a central question for the future of science and research in this country: how far should policy be driven by economic impact?

I fully accept that scientific enquiry, like the arts, has its own intrinsic merit. It is a public good. It helps to define the quality of our civilisation, and embeds logical scientific thinking into the decision-making of Government, businesses and households. Superstition and irrational prejudice about the natural world are rarely far from the surface and scientists help inoculate society against them – a far from risk-free task as Simon Singh and others have discovered.

The big scientific ideas that changed the world were often far removed from practical, let alone commercial, applications. I suspect Newton and Darwin would have struggled to attract venture capital investment, or justify an R&D tax credit, for their work in gravity and natural selection. Newton in particular was hopeless with money and he lost a personal fortune investing in the South Sea Bubble.

More recently, Tim Berners-Lee did not develop the World Wide Web in an IT company but as a way to share information about work on fundamental physics (at CERN). Indeed, Lord Sainsbury in his 2007 report described a high correlation between successful commercial spin-offs and high-quality fundamental research.

So I regard the old debate about common room versus board room as tiresome and unproductive. We need a wide spectrum of research activity.

That said, it is reasonable to ask the question: how does Government spending in scientific research contribute to the economy?

There is a lot of evidence of the connection between innovation and economic performance.

Innovation, the introduction of new or improved products, processes or methods – has been shown to be the key driver of economic growth in advanced economies.

The 2010 OECD innovation report shows that investment in intangible assets helped account for between two-thirds and three-quarters of labour productivity growth. It also suggested that innovation is also a key source of future growth for emerging economies.

It concluded that "Governments must continue to invest in future sources of growth, such as education, infrastructure and research. Cutting back public investment in support of innovation may provide short-term fiscal relief, but will damage the foundations of long-term growth."

Some countries are acting on that advice. The US is doubling basic science spend between 2006 and 2016. China has seen a 25% increase in central government funds to the science and technology sector. In Sweden, central government funds for R&D will increase by over 10% between 2009 and 2012. And in 2009, Germany announced it was injecting €18 billion into research and higher education during the coming decade.

The OECD adds, crucially, that "there is considerable scope to improve the efficiency of government spending."

We in the UK are severely financially constrained. I want to pose the question to you: how do we economise without damaging science?

The lazy, traditional way to make spending cuts is to shave a bit of everything: salami slicing. This produces less for less: a shrinkage of quantity and quality – I have no intention of going there.

Another approach superficially more attractive would be to specialise, to say there are certain branches of science and technology that we should do or not do. My response to this is two-fold.

First, we should not politicise choices of this kind. Treasury and BIS ministers and officials, working under pressures of time as well as money, are not the people who should be making arbitrary, far-reaching decisions such as whether Britain should or should not "do" nanotechnology or space research.

Moreover, many of the suggested choices are not choices at all because disciplines interact. I recently went to Professor Bhattacharya's outstanding centre at Warwick and the whole point about his centre is innovation depends on lateral thinking between apparently different disciplines.

And my son tells me that some of the most interesting quantum work is closely linked to disciplines such as neurosurgery and optics.

There is however a strong case for identifying broad problems. For example, the challenges thrown up by an ageing population – the increased prevalence of Alzheimer's for example – need people working across biology, medicine, biochemistry and the social sciences in order to better address needs.

So too for environmental challenges, such as providing clean water or alternative energy sources, pooling different disciplines to get a better understanding of low carbon.

There is also a case for identifying and building up the areas where the UK truly is a world leader.

This includes stem cells and regenerative medicine, plastic electronics, satellite communications, fuel cells, advanced manufacturing, composite materials and many more.

There is inevitably a process of selection and choice. So, how to prioritise?

My preference is to ration research funding by excellence and back research teams of international quality - and screen out mediocrity – regardless of where they are and what they do.

Its is worth noting in the last RAE 54 per cent of submitted work was defined as world class and that is the area where funding should be concentrated.

Even a rationing of this kind presents problems. How do we allow room for new, unknown but bright people? How do we reduce, not increase, the time spent on applying for funding in a more competitive market?

There is a separate but critically important question of how we maximise the contribution of Government supported research to wealth creation.

I support, of course, top class "blue skies" research, but there is no justification for taxpayers money being used to support research which is neither commercially useful nor theoretically outstanding.

As I said earlier, it would be wrong to measure this in monetary terms alone. There are wider questions, regarding the UK's openness as a society and its attractiveness as a destination for the brightest scientists, researchers and engineers from all over the world.

It is well known that the United States first leapt ahead of other scientific nations when it welcomed the brightest thinkers from across Europe, both before and after the Second World War. Enrico Fermi, Albert Einstein, Niels Bohr, John Von Neumann and many others formed the foundation stone upon which American scientific leadership was built.

Despite considerable pressures, the US continues to garner huge benefits from the talents of immigrants. Over 25% of US high-tech start-ups in the last 10 years had at least one immigrant founder. The list of great American companies started by entrepreneurial immigrants is long. Google is the most famous recent example, but also DuPont, Intel, Proctor and Gamble, eBay and even US Steel, started by that great Scotsman, Andrew Carnegie.

I am determined that we continue to benefit from our proud history of openness in this science.

Take the Faculty of Engineering at the University of Leeds. This is ranked 7th in the UK for the quality of its research, and over 75% of its output is rated as internationally excellent. It produces work in vital areas like civil engineering; computing and electronic and electrical engineering.

One third of its students are from outside the UK, representing over 90 nationalities. Many of those students may even go on to work within the UK, lending vital skills to industries that desperately need such talent if they are to grow and innovate – passing on immeasurable benefits to the whole economy.

And openness has reciprocal benefits. UK researchers already have an excellent record of working across borders. Almost half of more than 90,000 research articles published by UK researchers in 2008 had a co-author from another country. Co-authorship with non-UK collaborators tends to produce significant impact gains: e.g. papers with USA, Germany and France have impact 50% higher than the UK research base average.

What other reforms are needed to help us achieve more with less? One approach is to break down barriers to collaboration. There is already a fair degree of international collaboration between UK and overseas institutions and companies. International collaboration is an important way for us to stay at the cutting edge of research whilst reducing the cost to the UK taxpayer.

Singapore, for example, a country with global ambition in terms of science, sends some 75% of its top scientific scholars to UK universities for their undergraduate studies. Partly due to these strong links, Imperial College announced its first overseas footprint on 29 August – a joint Medical School with Nanyang Technological

University in Singapore.

Brazil has established a laboratory in agricultural sciences in the UK (at the Rothamsted Institute) to undertake research into sustainable agriculture.

When I was in Brazil last week there was great interest in collaborative research, building on networks which have led to Britain becoming second only to the USA in science collaboration.

The key is to find ways of transforming research into innovation. The UK has a strong record but we need to do more. This involves building stronger links between the UK's science and research base and the business community; to create more spin-out companies; and to provide a magnet for attracting overseas investors to the UK.

On the last point, the fact that the UK is home to some of the leading universities in the world, and has such a strong research base, undoubtedly helps us attract overseas investors.

Examples include Tata near Warwick in the West Midlands, Boeing at Sheffield, Pfizer in Kent, IBM and Microsoft at Cambridge, and Hewlett Packard at Bristol. Research Councils work directly with over 2900 companies.

UK universities have an improving track record in terms of commercialising knowledge derived from science and research. Between 2003 and 2010, 37 university spin-outs were floated on the stock exchange with an IPO value of £1.7 billion, while 24 university spin-out companies were acquired by other business for a total value of £2.4bn.

Solexa, a Cambridge University spin-out, was sold to a US-based company in 2007 for $600 million. And NovaCem Ltd, which produces "carbon negative cement" that could potentially revolutionise the construction industry, was spun out of Cambridge and Imperial College – and the R&D for this product was supported by the Technology Strategy Board, which is one of the key government institutions in this field.

The important point from a national economic perspective is that we continue to increase the level of economic interactions between business and the research base, including spin-outs, licensing, consultancy and commissioned research.

This leads us on to the wider question of intellectual property and how we deal with it. Universities make only 5% of their externally earned income from patents and licensing. There are some striking exceptions, notably Imperial, Cambridge and Manchester, who have developed a strong professional capacity in the commercialisation of research, but more needs to be done.

Part of this revolves around intellectual property protection. UK business invests around £65 billion annually in creating IP, which is about 30% of total business investment in tangible and intangible assets.

ONS data indicates that knowledge-based services make a substantial positive contribution to the UK balance of trade. And a recent CBI survey shows 60% of UK businesses believe that IP has gained importance over the last five years, 70% believe it would continue to do so in the next five.

There are some tricky issues around IP. I have some understanding of the issues – I was responsible, in 2002, for pushing through a private members bill to strengthen copyright. We do need to look in more detail at how we strengthen IP arrangements in the UK.

The final question is how to encourage academics to collaborate with industry to maximise the benefit of their research.

The Hauser review suggested a sensible approach – establishing a network of Technology and Innovation Centres, based on international models such as the Fraunhofer Institutes in Germany. Both science minister David Willetts and I agree that it is a good way forward, and I am looking closely at the recommendations in the review and the value of investing in these in the context of the Spending Review.

But we should not simply be copying overseas models. The key point is that what works are business driven high technology clusters with academic links. We already have several: such as the Research Council campus at Harwell, and others such as Cambridge and potentially St Pancras – and we are working at how to develop this model further.

Under the previous Government we invested in over 60 of these centres, but as highlighted by Hermann Hauser, the funding was thinly spread resulting in activity that has largely failed to achieve a national impact in areas of leading UK capability such as nanotechnology.

If we are to establish a national network of technology centres we should look to drive this number down and establish well-funded centres with long-term vision, focused on areas of clear technical leadership and commercial promise. Opportunities identified by Hauser include high-value manufacturing, composites, low carbon energy, plastic electronics, space, stem cells and regenerative medicine.

Public sector procurement is another area where we can improve. Across many sectors, from health and transport to education and defence, the public sector can play a vital role as a first customer for innovative products and services.

Programmes such as the Small Business Research Initiative, managed by the Technology Strategy Board, helps to drive innovation and ensure that this takes place in areas where there is real future demand from the public sector. I am committed to making greater use of this programme to facilitate economic growth and innovation.

To summarise, I think I have made it clear that science, research and innovation are vital to this country's future economic growth. But we have to operate in a financially constrained environment.

I want to lay down a challenge to the science and business communities today. That we come together, work together and plan a future together that makes the most of this country's competitive advantages in financially difficult circumstances for the benefit of us all.