



Select Committee on Science and Technology

Corrected oral evidence: Science and Technology and the Industrial Strategy

Tuesday 14 March 2017

11.45 am

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Members present: Earl of Selborne (The Chairman); Lord Borwick; Lord Cameron of Dillington; Lord Fox; Lord Hennessy of Nympsfield; Lord Hunt of Chesterton; Lord Mair; Lord Maxton; Baroness Morgan of Huyton; Lord Oxburgh.

Evidence Session No. 2

Heard in Public

Questions 12 - 19

Witnesses

Professor Richard Jones FRS, Sheffield University, The Industrial Strategy Commission, launched by Manchester and Sheffield Universities; Heather Jones, Chief Executive, Scottish Aquaculture Innovation Centre; Professor Robert Allison, Vice-Chancellor and President, Loughborough University.

USE OF THE TRANSCRIPT

This is a corrected transcript of evidence taken in public and webcast on www.parliamentlive.tv.

Examination of witnesses

Professor Richard Jones FRS, Heather Jones and Professor Robert Allison.

Q12 **The Chairman:** May I welcome our three witnesses for this second session? We are being broadcast so, for the record, perhaps you would like to introduce yourselves. If you would like to make an opening statement, please feel free to do so. Would Heather Jones like to start?

Heather Jones: Good morning. My name is Heather Jones and I am the chief executive of the Scottish Aquaculture Innovation Centre, which is one of eight Innovation Centres in Scotland that cover both sectoral and cross-sectoral areas of expertise, so they are similar to mini Catapults. Prior to setting up the Innovation Centre, I worked in Whitehall, and in Edinburgh for the Scotland Office and for the Scottish Government.

I would like to say how much we in Scotland welcome the strategy and the aspiration for balanced growth across the UK. In the comments I will make this morning, I consulted widely with Scotland's enterprise agencies and universities as well as the seven other Innovation Centres.

Professor Robert Allison: Good morning. I am Bob Allison, Vice-Chancellor and President at Loughborough University. We broadly welcome the consultation. Perhaps, Lord Selborne, I can give three examples of why I say that. Loughborough recruits more undergraduates into engineering subjects than any other university in the country. Indeed 62% of my students are studying STEM subjects. Perhaps more importantly, we have a unique partnership with a further education college that shares a site with us, and I believe, if you look at what the strategy is proposing and what I understand Sir Adrian Smith will be saying in his maths report due shortly, we can make a real difference to skills at all levels as a consequence of what is being proposed.

Secondly, my University is proud of some very strong links with industry around our research. You will have read in the Green Paper the investment the Government have made in the National Centre for Excellence in Gas Turbine Combustion System Aerodynamics on our site jointly with Rolls-Royce. We have a major strategic partnership with Ford, and the campus we have established on the Queen Elizabeth Olympic Park is the London home of the Advanced Propulsion Centre. I can later elaborate on why I think the Green Paper can promote the sort of work that universities such as Loughborough do with industry for both economic productivity and growth in the country.

Finally, at one end of my campus, we have the Science and Enterprise Park, which, through spin-out and spin-in, has created 1,500 jobs. A piece of independent work that was done and supported by our local enterprise partnership for the county council and our borough council indicates that in the next 10 to 15 years, we can grow that by a further 8,000 jobs. That would replace the jobs lost in Loughborough and the north part of Leicestershire through the demise of AstraZeneca, and in engineering in Brush, which in its heyday used to employ 10,800 people and now employs fewer than 2,000. The industrial strategy, if it comes

through as a consequence of the consultation, will allow us to make a real difference and unlock that potential and grow those jobs in a way we are finding difficult to do at the moment.

Professor Richard Jones: I am Richard Jones. I am professor of physics at the University of Sheffield and, until last September, I was PVC for research at Sheffield where I had responsibility for an extensive portfolio of research and knowledge exchange, including the Advanced Manufacturing Research Centre, which has been a very successful example of a translational innovation centre linked up to intermediate skills. I spent a long time working with the Sheffield City Region Local Enterprise Partnership to understand how innovation could help local growth.

I am also an EPSRC council member. That is not the capacity in which I am appearing here; I am appearing here because the Universities of Sheffield and Manchester have established the Industrial Strategy Commission, which I am a member of, which is bringing together, under the chairmanship of Dame Kate Barker, economists, political scientists, policy specialists and even the odd scientist like myself. To start with, we are very pleased that it now seems possible to talk about industrial strategy again. We think that is a positive development. I think lots of work remains to be done to create a strategy that will meet the aspirations that the Government rightly hold for it.

The Chairman: Thank you very much. You will have noted in the last session we ran out of time and I am quite certain we will run out of time this session, because you will all have a lot to contribute. I do urge all three of you not to feel you have to answer every question. If we can rattle through the questions, so much the better. Let me start with a very general one, which of course is an invitation to go on for ever. Given that we are going to have an industrial strategy, which is welcome after years when they were distinctly out of fashion, how do we make sure we can measure the impact in, say, 10 years' time? Professor Jones, would you like to start?

Professor Richard Jones: Yes. I think the strategy ought to attempt to solve the big economic problems that we have. I would say there are two big ones: first, the productivity issue—the fact that productivity growth stalled in 2007 and has not resumed. This decade has been the worst decade for productivity growth since the 1890s, and that has translated directly into wage stagnation and difficulties with getting the public finances in order. The political consequences of that are being played out now. Addressing the productivity issue is the first priority. The second problem is the issue of regional economic disparities: the fact that across the country, for example, only two core cities outside London—Bristol and Aberdeen—are above average in GVA per capita. We would expect the core cities to be the drivers of economic growth. They are not; they are being drags on economic growth. That is not sustainable. I think the industrial strategy should aim squarely at those two big problems and it should be judged by whether there has been an improvement in the key statistics in those areas.

Heather Jones: I think the industrial strategy should be about increasing productivity, driving growth and supporting UK trade. That ultimately needs to lead to improving living standards across the whole country. Scotland's economic strategy talks about inclusive growth, and I think that concept is also encapsulated in the Prime Minister's foreword. The real measure of whether this strategy is successful or not is whether it manages to close the productivity gap that we have just heard about between our best-performing places, companies and people and, particularly, the productivity gap between urban powerhouses and the rural periphery.

The Chairman: Thank you. That is very succinct. Professor Allison?

Professor Robert Allison: There are two ways in which you can measure success. One is quantitative indicators; the sorts of things that the Office for National Statistics tells us. They are quite easy to understand because they are numbers—seven out of 10. Qualitative indicators are much harder, but I do not believe they are any less important. To give an example, we need to be in a position where we are seen as a country that is world leading. How we define that I would leave to other people.

The second one is delivering the skills agenda in relevant areas in a very different way. You can measure that, both quantitatively and qualitatively. The final one is looking at areas which are the mainstay of this country—in a sense, the industrial base—but with sufficient flexibility so that, when ideas come through that no one had thought about, those have the opportunity to grow and flower as well. Some of the biggest developments in my lifetime were things which arose as a consequence of serendipity as much as planning.

The Chairman: Thank you very much.

Lord Hennessy of Nympsfield: Can you cheer us up? What has eluded us over the past 70 years and the previous eight industrial strategies that springs off the pages and quickens your pulse about this one?

Professor Robert Allison: I think there are two things. Apologies, I have mentioned it three times. I want to come back to the skills agenda. That is important to my university in the context of this document.

Lord Hennessy of Nympsfield: That has been in all of them before.

Professor Robert Allison: It has. I can elaborate, but I think if the consequence of this, the final White Paper, is brave enough, it can allow us to break some glass ceilings around aspirations in young people who do not see a university education as an opportunity. Can I give you one example? I have a joint students' union with a college over the road. Students at the college are not seen in the town that I live in as second-class citizens. If they want to do so—many of them do not—because of the way in which we work with the college, we can fire them up and give them the opportunity to transfer into the University to continue their education, in a way that I believe no other university and FE college does in the country.

It is also about going all the way down into schools. Young children, I understand from my staff in the Maths Education Centre, get put off these subjects aged between seven and 11 because it is all about maths at that age. We could work with the college in a very different way if the industrial strategy outcome supports us. For example—and I have not read all of the previous ones you referred to, sir—the qualifications framework has to be much more flexible. The work that goes on in the Department for Education to support innovative ways of encouraging, for example, young women as well as men to see engineering as an aspiring career to move into—because engineering at undergraduate level across the entire country is male dominated—could be delivered in a different and innovative way.

Professor Richard Jones: I accept the premise of your question entirely. I think there is very little in the Green Paper that we have not seen in documents going back certainly to the 2004 Science and Innovation Investment Framework and beyond. I would make the observation that one has to look at the record of those previous industrial strategies as, essentially, a record of failure. Our economy would not be in the mess it currently is if these strategies had worked.

If I want to be more positive about it, I think the Green Paper confronts some of the failures in the economy in a more candid way than previous documents have. It is very upfront about the productivity difficulties; it talks about our R&D issues—the fact that R&D intensity is low—so I appreciate the candour in setting the scene. I also think the document reads as genuinely being open to consultation. It is a fair criticism to say it wraps up many things that we have seen before, but if I accept the Government's apparent willingness to be consultative, given the fact there is a new urgency, I think I can take positive heart from that.

Heather Jones: What I hope will be different about this strategy is that it needs to be led and have buy-in from industrialists. I think without that you risk government push rather than industrial pull, and all the evidence shows that it is industry that exploits changing market dynamics more quickly than governments. There are many references throughout this document to the opportunity for getting that alignment better between the academic base and the industrial base. The Catapults and the Innovation Centres are doing that, and I think it would be helpful for government to continue thinking about how to find those growth sectors. They may not necessarily be the big shiny new ones that are highlighted in this document, but there are growth sectors of regional importance delivering economic growth to rural communities and towns and coastal economies that also need to be featured.

Q13 **Lord Oxburgh:** That last reply goes right into this sector. Obviously, the UK is very heterogeneous in all sorts of ways. The question is whether you see within the Green Paper sufficient acknowledgement of that and sufficient opportunity for different regions to develop their strengths in their particular ways. Of course, some of the relevant competences are devolved. There is another question we should link to this. You have all talked about the productivity gap, but I cannot believe that there is a

single national productivity gap. There are certain kinds of industry which are productive and some less so, and these may not be uniformly distributed geographically. I would be interested in any of your comments, please.

Professor Richard Jones: I think the comments about heterogeneity are really important. I have thought of another positive thing about the Green Paper. Pulling out this problem of the diffusion of innovation has been really important, and that development in thinking has happened in the last few years. The fact seems to be we have internationally leading companies that are at the technological frontier, but the gap between those leading companies and other operators seems to be widening. I think there is an important dimension about how you can spread innovation across from the leaders to the laggards, if you like. That is partly about translational engineering and it is very much about skills and the sorts of things Professor Allison was talking about. But a new focus on this issue is important.

The regional question is important too. I talked about the economic disparities that we have, so having a regional focus is important. It is good that that is pulled out in the Green Paper. I think it is slightly unfortunate that it is number nine out of 10 pillars. It would be better if it was an underpinning theme that ran right through the strategy and that any policy or intervention that was discussed started out by saying, "What effect does this have on the regional disparities?", rather than coming to it at the end.

Professor Robert Allison: I think there are opportunities for regional differences. Could I put to you what one of the challenges around that will be? We have been invited by 22 different organisations to contribute to their response to the industrial strategy, as well as submitting our own—more than we have ever been invited by before. For Loughborough University we have to do that in the context of the Midlands Engine Strategy, the strategy from our LEPs, of which there are nine in the Midlands Engine area, a Science and Innovation Audit, a City Deal and a number of other priorities set by other agencies that work on behalf of government in the area that my University is located in the Midlands.

Let me come down to our campus in London. I will not bore you by doing the same thing, but the point I want to make, and it will be obvious to you now, is that if these are not all joined up and aligned, there will be a much greater challenge around delivering anything, let alone the growth in industry that is relevant to a region, because we are having to respond to one agency over here and another organisation over here. If, as a consequence of the Green Paper, we can get all those organisations aligned in a way that is right nationally, on the one hand, but right for a region, on the other—that is what LEPs are about; they are delivering for their regions—I think there is an opportunity. It comes back to Lord Hennessy's point about what is different. If we can get those aligned—and that has not happened before in the same way—let us wait and see whether we can achieve that or not this time around.

Heather Jones: I would like to make the point that it is super to have the ambition for a UK-wide strategy, and we very much welcome and applaud that, but I think the bulk of the text talks about city regions in England, English-based industries and fairly exclusively English support systems. The aspiration to have a UK-wide strategy delivered needs to be co-created and it needs to recognise different educational training systems. The university and college base in Scotland is different and the economic delivery agencies are different. In similar ways to the Midlands, perhaps, and the Northern Powerhouse, Scotland is able to get people in a room, and get conversations going to articulate very clear messages about how we see things working, but for the moment the strategy is not terribly convincing that it truly understands the interests of all four parts of the UK. For example, there is no mention of Innovation Centres which are engaging with companies across key growth sectors, stimulating innovation within those companies, across supply chains and between sectors. That is the kind of aspiration that this strategy is trying to attain.

Q14 **Lord Hunt of Chesterton:** You talk about these regional variations. I am a visiting professor in the Netherlands where they have set up a network so that the people doing graduate work take their lectures all across the Netherlands. It is amazing. Therefore, by the end of their three years they will know all about, essentially, different centres in the Netherlands, the industries and some of the science. One of the problems we have in the UK is that, let us say, graduate students up in Liverpool or Manchester may never have been for a week to courses in Cambridge or at Imperial or other places, and vice versa. Although we now have these doctoral training schemes, they do not seem to me—and I would be interested in your comments—to be getting people to criss-cross the UK. That is going to be an important way of sharing different companies. You used the word spin—spin-in and spin-out. The United States has an organisation in the department of trade there which looks at all the science around the world and brings material into the United States. Our BEIS has never done that, significantly. Perhaps your spin-in is doing what BEIS should be doing UK-wide.

Professor Robert Allison: I broadly agree with what you say. The research councils have gone a long way with the doctoral training centres they have established. As they go into the second and third generation of those, they are evolving them, and I believe they are getting better but there is some distance to go.

Can I also add something? I do not think it is just about students going to work in different universities at PhD level; it is about students going to work in industry. If you take my undergraduate population, we have more students who do a placement in industry than any other university. If you do a placement in engineering or technology-based subjects at Loughborough of a semester or more—97% of those students have secured full-time graduate-level employment before they even have their degree result. It is one of the top three employability statistics in the country in higher education. That is partly because they are exposed to all the practices in industry, and not just in this country.

Right at this point in time, I have 12 students in civil engineering on placement in Kuala Lumpur for a year. It is about them bringing that experience back to this country, graduating and then seeking and getting employment in this country. Working in partnership with other universities—we do that with some of our PhD students with Lancaster, Leicester and Dundee, so a small group of universities where that subject mix is right—there are things we could do to promote that nationally, rather than universities getting together because there is a group of Vice-Chancellors who believe it is the right thing to do. The industrial context is absolutely critical as well. Giving those students opportunities that develop skills alongside the degree and the studies they are having in the lecture theatre, makes them some of the most employable people that this country and this industrial base might want.

Professor Richard Jones: If I can add to that, there has been quite a lot of change in this area. You are pointing to something that is quite important. Eight years ago in Sheffield very little of the PhD provision was collaborative; now pretty much all of it is. A lot of it is done through the White Rose collaboration, with the Universities of York and Leeds, through broader networks in the N8 universities, and with the more sector-specific networks that EPSRC supports. I think there has been a lot of progress on that.

On the question of spin-ins, I want to move away from university research to the important question of business-funded R&D. There is something very remarkable about the UK scene, which is that more than half of the business R&D in the UK is funded by overseas-owned companies. This is one of these very double-edged swords. It is very powerful in the way it links the UK innovation system into broader world networks, but it makes me deeply nervous, particularly in the current political climate, about how deeply rooted that is. That is more fragile than makes me comfortable.

- Q15 **Baroness Morgan of Huyton:** Can I move on to the sector deals? We talked about those in the previous session as well. We know five have been chosen at the moment. Do you think the right five have been chosen? Do you think it is a kind of “anything goes”? Obviously, within the consultation document it says, “Pitch if you want to join the club”, it seems to me. To what extent is that fine—that is, a sort of laissez-faire, “If you can get together, that is fine”—or to what extent should there be direction from the centre in both the sectors and the geographical spread of those deals?

Heather Jones: I start by saying that a strategy that does not prioritise is not a strategy, so there must be full recognition of the need for prioritisation. So far it has highlighted sectors that are big or new, or both. There is scant mention of niche sectors or sectors with particular regional importance. If I give you an example from my own area, aquaculture is an anchor industry in the Highlands and Islands. It is an industry that is investing tens of millions of capex in the UK economy. It is driving up productivity and skills through management and leadership training in business, facilitated by the Innovation Centre with a college. It

is a sector that is standing on its own two feet; it is not a subsidy-dependent sector; it is harnessing technological developments from robotics to satellites to sensors, and it is globally profitable. For example, did you know the spot price of a barrel of Brent crude at the start of this year was \$55? The spot price of a 6kg Atlantic salmon was \$59. A salmon is worth more than a barrel of oil. I am using it as an illustration, but the strategy also ignores other, what we might call old industries, such as food and drink, although aquaculture is only 50 years old. There is huge scope for productivity gains through innovation and skills, infrastructure and tech transfer in those agricultural technologies and in food and drink.

We have talked a lot about energy. We all need food as our energy for us to be able to use our digital skills and tools. Overlooking the opportunity for growing productivity in that sector is unfortunate. I would invite those drafting the next iteration of the strategy to consider the importance of rural and coastal parts of the UK and industries that anchor people, whether it is in Cornwall, Wales, Northern Ireland or Scotland.

Baroness Young of Old Scone: My experience of sectors is that where there is a good, strong industry-based leadership group, they get off their behinds and go for it, and have done without anybody needing to tell them. Where there is not, it does not happen. The question is, do we need to seek a stronger role for government in those areas where, for one reason or another—either absence of leadership or geographical disparity—there are sectors that ideally the UK should be strong in but they have not got their act together?

Professor Richard Jones: The one that leaps out to me is the chemicals sector. The chemicals sector is a very large part of the UK economy; it is a very high-value part of the UK economy, and it always seems remarkably invisible in all these kinds of documents. That is exactly a function of what you say. The aerospace sector has always been enormously well organised because of its connection to government anyway. The automotive sector is an example of a success of an existing industrial policy. The Government have done a lot to co-ordinate that. The sector argument is one I am a bit nervous about because it renders one open to lobbying and to rent-seeking behaviour. I think it is very important to ask: what are the sectors that do not have lobbying power now that might be important in 20 years?

I have another nervousness about the whole idea of division of the economy into sectors, which is that, in a sense, it is taking a mapping that the ONS, or the statisticians, give us and trying to impose that on the real world. When we look at the complexity of a modern economy, an awful lot of it does not map so clearly into sectors. Even on the difference between service industries and manufacturing industries, which one might think is fairly fundamental, a lot of the trends in recent years about digitisation of industry and outsourcing of professional services act to erode those boundaries. Although it is very difficult and one is led into sector approaches because you can see how to do them and you can see what to do, they have some downsides that need to be thought about quite seriously.

Professor Robert Allison: I think you have hit on a real challenge. I can give two examples. The automotive sector is very strong in this country. The bit we actually lead the world in is powertrains; it is not the automotive sector as a whole. There is a focus on part of the sector as a whole in terms of us leading the world. I hope, as a country, we would not want to lose that.

If we take aero, 40% of the world's domestic aircraft have a Rolls-Royce Trent engine. There is a variety of different Trent engines slung underneath the wing. It is the total engine. It is, in particular, right here and right now because we are privileged to have a Rolls-Royce University Technology Centre on our campus. It is what Rolls-Royce is doing around emissions and fuel efficiency that makes those engines as popular as they are. If you come to the other end of things and look at the individual entrepreneur or the individual who has a great idea, they do not develop that idea because there is a sector, or because the Government are telling them to do so following this model. The real challenge is to work out where that gap is and how you bridge it. I do not think we do that particularly well, at the moment, but if we could get that sorted out that would be a very significant advance that this industrial strategy could deliver for the country.

Lord Cameron of Dillington: This is the first question I have asked in this inquiry so I have to declare interests as a farmer and landowner with interests at Rothamsted CEH and the Global Food Security programme, and I am the chair of a digital technology company.

In the earlier session Dame Anne said, for instance, that a Green Paper that tries to be all things to all people is not a strategy. Throughout the session we had with those three witnesses, I got the impression that this was exactly what we would seem to be getting. It is trying to focus on the Northern Powerhouse and the Midlands Engine Strategy; it has these five sectors and its 10 pillars but none of the strategies or the pillars is necessarily exclusive and nor are they siloes—all the right words are coming out. I feel this session is slightly more practical and we are getting more definitive, but you are still talking about your own favourite areas. Is there any coherence to this whole strategy? Is there something we can grip on to and take forward? I feel there is very little.

Professor Richard Jones: Can I answer that by saying what I think ought to be the strategy?

Lord Cameron of Dillington: Yes.

Professor Richard Jones: It is the job of government, I think, to articulate what its long-term goals are for the nation and the economy, and what its long-term challenges are. If you want to know what I think they are, it is pretty obvious: I think we have a health and social care system that is falling apart and will not be sustainable with demographic changes and the way the economy is unrolling in the next few years. We need to decarbonise the energy system, and the way we are approaching that seems to me to be, in many ways, suboptimal. If we look, for example, at the nuclear new-build programme, that is pretty much a case study about how to run an industrial strategy that maximises the cost to

the consumer and minimises the benefit to UK industry. If you want a case study in how not to do it, that is it. We need to do better than that; we need to work out how to drive down the cost of low-carbon energy so it is affordable and drive innovation in that direction. As always, it is the role of Governments to look after the security of their nation—that is old-fashioned security in making our armed forces effective and, also, all these newer threats about cyber security.

I would like to see an industrial strategy founded on the serious things government has to do. How can we get innovation to help us achieve those goals? How then can we bring together the private sector and the public sector to achieve that in a way that also grows the economy? That is how I would express it.

Professor Robert Allison: I agree with what you say, partly because this is not the strategy; this is the consultation document. That is the view I have taken on it. However, there are some things missing. I will give you one example. One of the ways in which you improve productivity is to have a healthy workforce—full stop. There is nothing about that in this. That also begins to deal with some of the chronic illness problems. We all know what they are: type 2 diabetes, obesity, and musculoskeletal problems because people are not exercising enough—I am bound to say that, from Loughborough, am I not? The whole point is that if we can begin to address that, not only do we solve the funding crisis in the NHS, or begin to solve the funding crisis in the NHS—I need to be very careful with my words—but we also produce a healthy workforce and, because of that, productivity goes up. It is nothing to do with which industries you are supporting, but it is absolutely fundamental. You can compare us with some other countries around the world which are ahead of us on that game. That is a good example of something that is not in here but I hope will come out in the final White Paper, because it is key to delivering whatever it is in whatever sectors we decide are the right ones for us.

Heather Jones: I would like to pick up on the point about how innovation can help the public services. We have heard about the challenges facing us all demographically in the NHS. That is why there is a Catapult, and indeed an Innovation Centre, in stratified medicine. There is a digital health and social care Innovation Centre. I think the risk is that—and somebody picked this up earlier—we need to make sure that there is not competition within the UK among these different institutions. For me, the solution to that is making sure that the industrialists are telling us where they would put their money and seeing where they put their money. That is the distinction between a push-led solution and a pull-led solution. Companies follow the money. We heard before about the spectrum between invention at the one end, the ideas that come out of academia, and then invoices—how do you commercialise that?—at the other. Getting that gap in the middle sorted is very difficult and we have been trying to do it for a long time. That is why institutions such as Catapults and Innovation Centres can help. We need to listen to companies, not necessarily big lobby groups, and see people who are willing to put their own co-investment in with the public sector to achieve benefits. Many of the benefits that could come out of these stratified

medicine initiatives and others ought to be applicable to innovation within the NHS.

Lord Fox: Professor Allison, you singled out two areas: powertrain and aerospace propulsion. The examples you used are based on work that was done decades ago. Are you convinced that the things we see in the pillars here are going to deliver the next generation of propulsion systems, or their equivalent? If they are in there, what are they? It will not be all of them. What are the key parts that will deliver the things you were just praising, and their equivalents?

Professor Robert Allison: Let me give you two examples. I am not party to the detail, so I would offer an apology, but as Lord Selborne indicated at the end of the last session, I can provide some further detail if you wish me to do so. I am very proud of the partnership we have with Rolls-Royce. We are by far and away not the only university. I know it is now beginning to look at its next generation of engine. It is not just about saying, "We are going to carry on evolving the current engine". We need to look at the next generation of engines. Apologies—on the detail, I would consult our partners at Rolls-Royce, if you want that information.

Lord Fox: It is more in the general sense.

Professor Robert Allison: To give you the other one, as you mentioned it, I would assume that one reason why the battery technology is proposed at Warwick is partly because of the Warwick Manufacturing Group and Jaguar Land Rover. That is about the next generation of cars. The other thing that goes in parallel, of course, is autonomous vehicles. If one looks at some of the proposals, I believe that is a really good example of how we could be a sector leader in automotive, in a way no one is yet. It is very easy running a car round a track; running 10,000 cars around central London is a completely different proposition. No one has cracked that yet, and if we can do that then we would remain sector leaders. It is not just about the technology already there; it is about others.

Let me give you one other example in a very different area. If you look at the very significant changes that have occurred recently in the structure of the pharmaceutical industry and medical technologies—it is not my area of expertise but we have the EPSRC doctoral training centre in bioengineering on our campus—the real opportunities, such as the emerging technologies and the emerging next-generation drugs, are not necessarily going to be delivered by the big conglomerates. It is going to be a very different model involving SMEs which conglomerate and benefit from being next to a partner and, in particular, if they are working at high levels of technology readiness, being located in an environment where fundamental R&D is going on at low TRL levels which can feed into that.

Biotechnology, medical technologies and, to some degree, pharmaceuticals are really good examples of where we could get that further up the agenda. I will give you a specific example. This comes back to the point about getting down to the nitty-gritty. We all know and read in the press about producing heart valves or producing cartilage. That is fine if you are doing it in an R&D low-technology-readiness

environment where it is proving you can do it. Producing heart valves time and again—on an industrial scale—where cardiovascular surgeons can prescribe them as part of medical intervention, no one has grasped. No one is doing that, at the moment, anywhere in the world. That has to be an area where I would have thought this country could move in and make very significant advances. It is the link between what this strategy is all about—industry and technology—and aspects of medicine where we already lead the world. That is another very good example of something that is, perhaps, not in here that could come to the fore when the Green Paper turns into a White Paper.

Lord Hennessy of Nympsfield: Following on from Lord Cameron's and Lord Fox's points, this has been a fascinating session this morning. I thought I had some idea of all of this but the overlap, overload and over-complication is breath-taking. The way you see it, and we have not even mentioned HEFCE, you have to think about catapults, LEPs, powerhouses, power engines; we have 10 pillars and eight great technologies, which have not had a look in today. The only things missing today are the Four Horsemen of the Apocalypse. How on earth is it that you can do any work at all, in terms of innovation, with all this immense overload and over-complication? How on earth do you survive?

Professor Robert Allison: It is a real challenge. I feel schizophrenic at times.

Lord Hennessy of Nympsfield: You need help, do you not?

Professor Robert Allison: Yes.

Professor Richard Jones: The institutional landscape is a huge mess. That is the only way one can describe it. One needs to pull back to look at the whole landscape. You have different government departments. I think to start with we need different government departments to see eye to eye on strategy. Even before you leave Whitehall there are issues. Then we have the devolved Administrations, the various tiers of local government, we have stand-alone agencies such as the research councils, Innovate UK, and we have hybrid bodies such as the LEPs. For each of these we have to ask ourselves: what is their analytical capacity and what is their legitimacy? Organisations that do not have legitimacy, either democratic or representational, find it very difficult to prioritise, and prioritisation will be important. We have to look at the resources they have at their disposal and then we have to see how on earth they are joined up. I think there is a big, institutional question that sits over all this. The two things that ought to go through all this—I do not know if the pillars sit on them or they sit on top of the pillars—are the institutional landscape and the geographical nature. Tidying that up is going to be a major job.

We have had some progress, in the sense that UKRI is about to be formed, and I think the research councils have a particularly important role in looking to the future. There is a lack of predictability about the future, which means that having a very strong science base that supports outstanding people who can come from left field with fantastic ideas is important, but we also need to understand all the difficulties with taking

things from the lab into the market. A lot of that is about how this fits into international supply chains—where the customers are, in a sense. I use that not meaning the final customers but the intermediate customers: the people who are making electronic devices, for example. Having a very sophisticated understanding of the international landscape is important. This is a very, very hard problem.

Lord Maxton: Perhaps I could direct my question, to some extent, directly to Heather Jones. Quite rightly, Professor Richard Jones raised the issue of devolved Assemblies. This is called the UK industrial strategy, but large parts of what is involved are devolved. Education in Scotland is entirely a devolved matter, including the universities. Parts of the industrial strategy, particularly in the public sector, are devolved. To what extent does this matter? A question was asked earlier about the University of the West of Scotland, I think, which includes Bell College, which offers degrees and also the lowest levels of apprenticeships. How do the devolved Assemblies matter in this industrial strategy?

Heather Jones: It matters in that there is a risk of twin-tracking, of duplication. It matters because there is a risk that an undue focus on a particular anchor of expertise in parts of England might obscure the opportunity to maximise the excellence of research and capability in Scotland and other parts of the UK. For example, the Green Paper talks about biotechnology as one of the five priority areas. There is a life sciences industry leadership group in Scotland that is full of industrialists, and they were not consulted on that. There is, obviously, the opportunity for things to diverge, and I think that would be exactly the wrong thing to come out of a UK strategy.

The Chairman: We need to move on to science and innovation.

Q16 **Lord Mair:** My Lord Chairman, I should apologise. In the last session I should have declared my interests. I am professor of civil engineering at Cambridge University, a fellow of the Royal Academy of Engineering and a fellow of the Royal Society. Professor Jones, you have just been speaking about innovation and UKRI. Science and innovation underpins the whole industrial strategy. Although it is given in the Green Paper as number one of the pillars, it should pervade all the way through. Specifically, the Green Paper says, and I quote, "UKRI will develop and deliver a clear strategy from fundamental research through to business innovation". In light of what you have just been saying, do you feel positive about that? What do you think UKRI will be able to achieve in terms of a clear strategy?

Professor Richard Jones: There will be some positives. I think the link between fundamental research and more translational research is really important. Some interventions made in the translational space have not been as successful as they might have been; in many cases, that has happened because they have not been closely linked to the research base. If I am allowed to advertise my own institution, our translational manufacturing centre has been particularly successful as an example of a branch of the High Value Manufacturing Catapult. I think it has been exemplary as a catapult because it is as connected to the academic base

as it is to industry. That is a characteristic of successful innovation centres everywhere.

On the division between the research councils, the Nurse review was correct in pointing out that this made some interdisciplinary research difficult, and I think you see that in discussions between research councils. They often do not see eye to eye on things that they perceive to fall out of their individual remits. They are not always totally comfortable with things that cross the boundaries, and in the modern world many, many things cross those boundaries. The boundary between physical sciences and life sciences is very important, for example. There is scope for this to improve with UKRI in place.

To come back to the broad strategy, there needs to be a stronger connection between the Government's big goals and how UKRI will meet those. If I look back, for example, at how Innovate UK worked—and when it was TSB—they had a very innovative programme. They had a programme called "Innovation Platforms" whereby they identified big important challenges for government and society, started with companies and said, "How can you help us sort this?" That did not always get as much traction as it deserved because it did not have the complete buy-in of the departments in question; they might have to go off to the Department of Health and convince them to be interested in a healthcare-related programme. UKRI could be very valuable in joining up disciplines, in joining up fundamental, basic research to the really important translational research, but it needs to have a very good interface with the rest of government.

We agonise about the Haldane principle a great deal, about politicians interfering with science. I think it is absolutely right that government sets the broad directions for science. The problem we have is when government tries to micromanage the things it should not micromanage, and does not give a strong enough steer about the big, strategic issues. I hope that UKRI will help us do that.

Lord Hunt of Chesterton: The Haldane principle was okay.

Professor Richard Jones: I went and read the Haldane report the other day. It is a very interesting thing. It was written in 1917 and it was utterly clear what the Government's big, strategic priority was: it was to defeat German militarism. There was a sense of clarity about it.

Lord Hunt of Chesterton: There was a big picture.

Professor Richard Jones: There was a big picture. Within that, if the government needed to understand "the toxicity of TNT", or "certain urgent practical questions concerning the preservation of fish"—to give examples from the original document—they would go and find the experts to find out how to do that.

The Chairman: I know Professor Allison wants to come in, so come in briefly, but we are again running out of time. I am going to ask the next three questions to come quite quickly.

Professor Robert Allison: There are two other quick examples of where I think UKRI could make a difference. There are a number of research funders in this country: Wellcome, Leverhulme and Joseph Rowntree. One of the things, as the lead of all the research councils, UKRI could look at doing is to somehow develop greater synergy across that landscape, which could be beneficial for the country. There is another thing which I believe UKRI could do, which is fundamentally important and has not been mentioned at all so far in this session. One of the questions Lord Selborne asked earlier was: how will we know in 25 to 30 years' time if this has been successful? One of the reasons we will know is that we have recruited from around the world the very best minds as the next generation of academic PhD students and research fellows, some of whom will stay in your university or my university and some of whom will go into industry. One of the things we always have to remember, whether it is at low or high ends of technology readiness, is the reason you lead the world in an area is that you have the leading minds and people in the world. If we forget that and we turn the tap off, it does not matter how many pillars you have: they all become irrelevant.

The Chairman: I have questions from Lord Fox, Lord Borwick, Lord Cameron and indeed Lord Hunt. We are going to have to squeeze those in in just a few minutes. As I said earlier, if all three of you felt you did not have to answer every question we might just get through it, but I do not think we have achieved one question yet where all three of you have not answered. I just make that observation.

- Q17 **Lord Fox:** On the question of stimulating business investment in R&D, does the consultation strike the right balance between stimuli—tax credits and the Industrial Strategy Challenge Fund—delivered at a UK-wide level, obviously recognising the distinctions of regional and devolved areas and funds?

Professor Richard Jones: I think policy has been too focused on supply-side measures—things such as tax credits. This is a very expensive policy and it certainly has some good aspects, but it arguably has some dead-weight cost. It needs to be looked into. I would like to see much more emphasis on the demand side. How do you create the demand for innovation?

Professor Robert Allison: I have nothing to say.

- Q18 **Lord Borwick:** Again on tax and regulation, which is terribly important in this, do you think we should have had an entire chapter on this subject—reducing tax and regulation, increasing it or changing it?

Professor Richard Jones: Regulation is always said to be a dirty word, but one ought to recognise that good regulation is a source of competitive advantage. Classic high-value sectors, such as medical devices, are high value because they have a high regulatory barrier around them, which indeed they ought to have. Getting regulation right is important but one ought to recognise that there is a positive side to it, as well as a negative side.

Q19 Lord Cameron of Dillington: There seems to be very little on environmental sustainability within the Green Paper. It looks at the opportunities of renewable energy but outside that it does not talk about the risks from the pressures on water, timber, minerals and other natural resources. There is also the possibility of UK science conducting the research and setting the sustainability framework for the economic growth it is proposing. I feel there is a hole in the report. Would you agree with that?

Professor Richard Jones: It is good there is an energy and clean growth section. I think that ought to focus much more on the use of innovation to drive costs down and to increase the scale of the uptake of clean technologies. I agree with you that that section should be developed more, and the other areas of sustainability are also important.

The Chairman: Do not be inhibited by me being such a bully.

Professor Robert Allison: I am fine, Lord Selborne.

The Chairman: I am conscious that I have curtailed the discussion, inevitably, but we have at least kept you for the hour. We could have gone on very much longer. I said at the end of the last session that I would take away three points, and I was sure that at the next session there would be quite different points. You have not changed the perspective but I think you have been enormously helpful in addressing the much wider issues. I like the concept that we need to tease out quite separately the roles of government, innovation, the public sector and the private sector, and we must ensure that industry is up there leading. The new technical education provides an opportunity for industry to lead, as opposed to being told what to do, with the simplification of vocational qualifications. I was enormously impressed to hear from Professor Allison how he is blurring the interface between technical and higher education, and, not just that, he is going back to seven year-olds. I am sure he is on to something there—that primary schoolchildren get turned off maths. That leads to the skills shortage and the diversity and gender issues that I referred to earlier. It complements very much what we heard before.

I certainly take the very loud message, which indeed Heather Jones has made very clear—and I think it is absolutely appropriate—that if it is to be a UK industrial strategy it has to recognise the realities of all parts of the United Kingdom, which are of course completely different. That is a point that my colleague, Lord Maxton, never ceases to remind us of. It is a very important point, and I am sure there are many other lacunae which, as the paper emerges—from Green to White—will have to be addressed. The nature of these sessions is quite exasperating at times, in that we cannot allow you enough time to answer the questions as fully as you would wish. Again, I repeat the offer that if there are additional points you would have made if I had not been so acerbic, please send them into the clerk. We would be absolutely delighted to circulate them to Committee members. Thank you, again, to all three of you for a very helpful and enjoyable session.

Lord Hunt of Chesterton: Thank you for talking about the Haldane principle and the big picture. Nobody has said that in all our discussions.

The Chairman: The session is closed.