HOUSE OF LORDS

Select Committee on Science and Technology

Corrected oral evidence: Science and Technology and the Industrial Strategy

Tuesday 14 March 2017

10.40 am

[Watch the meeting]

Members present: Earl of Selborne (The Chairman); Lord Borwick; Lord Broers; Lord Cameron of Dillington; Lord Fox; Lord Hennessy of Nympsfield; Lord Hunt of Chesterton; Lord Mair; Lord Maxton; Baroness Morgan of Huyton; Baroness Neville-Jones; Lord Oxburgh; Viscount Ridley; Lord Vallance of Tummel; Baroness Young of Old Scone.

Evidence Session No. 1 Heard in Public Questions 1 - 11

Witnesses

Professor Dame Ann Dowling OM DBE FRS FREng, President, Royal Academy of Engineering; Professor Iain Gray CBE FREng FRSE, Vice-President, Royal Society of Edinburgh; Professor Hywel Thomas, Pro-Vice-Chancellor, Research, Innovation and Engagement, University of Cardiff, Fellow of the Learned Society of Wales.

USE OF THE TRANSCRIPT

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

Examination of witnesses

Professor Dame Ann Dowling, Professor Iain Gray and Professor Hywel Thomas.

Q1 **The Chairman**: Could I, on behalf of the Committee, welcome our three witnesses to this first evidence session on the Green Paper on the industrial strategy? We thought it would be helpful to have a look at this during the consultation period, and we are most grateful to you for helping us by starting the inquiry. Welcome back to Dame Ann Dowling, Professor Iain Gray and Professor Hywel Thomas, all of whom have been in front of us before. Nevertheless, as we are being broadcast, perhaps you could introduce yourselves one by one and, if you want to make an introductory statement, please feel free to do so. I will try to make sure that we finish this session in exactly an hour's time, because I know that at least Professor Iain Gray has to leave at 11.40 am. Iain Gray, would you like to start?

Professor Iain Gray: Thank you very much for the opportunity to speak this morning. I am Iain Gray, the director of aerospace at Cranfield University. Today, I am wearing the hat of the vice-president of the Royal Society of Edinburgh. I chair the Business Innovation Forum on behalf of the Royal Society of Edinburgh, which is looking at the engagement of business, academia and government, and the industrial strategy, the innovation strategy, is a key part of our landscape.

It is also worth my saying as an introductory comment that I sit on a Horizon 2020 panel under Commissioner Moedas and led by Pascal Lamy, which is looking very much at what comes after Horizon 2020 framework 9. It is worth saying that the subject that we are talking about from a UK perspective is being talked about elsewhere; we are not the only country that is talking about the industrial and innovation strategy, and some of my remarks will bring some of those conversations to bear.

On behalf of the Royal Society of Edinburgh, we have welcomed the consultation. We will formally give a written submission. We very much welcome the fact that the title of the document is *Building Our Industrial Strategy*—the UK's industrial strategy—which we believe provides a very strong framework for us all moving forward.

Dame Ann Dowling: Good morning. I am Ann Dowling. I am here as president of the Royal Academy of Engineering and am a professor of mechanical engineering at the University of Cambridge.

Professor Hywel Thomas: Good morning. I am the pro vice-chancellor for research and innovation at Cardiff University, and I am here this morning representing myself. I am also a fellow of the Learned Society of Wales. I am very pleased to be here.

Q2 **The Chairman:** Thank you very much. I suppose, to start on a slightly cynical note, there have been strategies before; they come and go. The important thing to know is how you measure impact and success. First, what do you think the central purpose of this particular strategy is, what are we trying to achieve, and what metrics would you use, if any, to measure such success in, say, 10 years' time?

Dame Ann Dowling: The Green Paper sets out the motivation very clearly: to improve living standards and economic growth by increasing productivity and driving growth across the country. That sets out a framework by which success should be measured: economic growth, GDP, the balance of trade, global markets, our share of FDI, those sorts of things. However, the emphasis on regions is important here, so this is very much about the number of people employed, average salary, the number of companies, range of size and turnover, how those figures have changed during the 10 years, and tracking that growth, that progress, and the increase of productivity across sectors.

The Green Paper also highlights areas that will be instrumental to making a change in productivity, and one can think of direct metrics on those, too. There are things that we currently do well, and one would want to track if those were growing or being sustained: one thinks of the strength of the university research base and of our finance sector, and maybe the number of start-ups. There are areas where things need to change and where one would look to see that change had happened there: medium-sized companies innovating and the scale-up of our start-ups to companies of global standing. A big area that we need to do much better on is skills. Again, there are lots of metrics available for that. But it will be crucial to track whether we are preparing people in sufficient numbers for the highly paid, quality jobs that our companies need to fill. There is a need to match the workforce to the requirements of companies.

There are lots of detailed metrics, but if I step back and say, "What would be a sign of success in 10 years?", it would be that this was the industrial strategy and we did not have to invent a new one every few years.

The Chairman: Continuity.

Dame Ann Dowling: What business needs more than anything is the ability to trust in longevity and continuity of purpose. That is very important.

Professor Iain Gray: I would like to add to what Ann said. Stability is massively important. You phrased the question in a slightly cynical way. It is not the first time that we have seen the launch of an industrial strategy, and most of them get prefaced with, "This is for the long term. This has to work across different Governments and across party politics". It is really important that in 10 years' time, as Ann said, the outcome of this strategy is still intact. For me, there are lead indicators and lagging indicators. In 10 years' time, the lead indicators should be company investment, private investment, seeing investment into the industries and the technologies that we have backed—and people. The whole industrial strategy is about people, and one of the long lead indicators is young children who are being attracted to work in our industries and our STEM subjects, whether it be through apprenticeships, degrees or just working in companies. Young people choosing to work in the industries that we are backing is a very important lead indicator.

Professor Hywel Thomas: I would like to see some changes in the diagrams in the report. You will not be surprised to hear me say, looking at where Wales is at the moment, that the challenge in the productivity of our UK region is clear. There are also challenges in where the R&D resources and spend are, so I would like to see changes in those headlines. Above all, I would like to see the productivity curves looking quite different at the end of all this.

Q3 **Lord Hennessy of Nympsfield:** I declare my fellowship of the British Academy, and I am a professor of contemporary British history at the Queen Mary University London. I have tried, as a historian of post-war Britain, to trace these industrial strategies. Indeed, I was one short, and Dame Ann, when we found ourselves in each other's company last year, reminded me of one that I had forgotten.

This industrial strategy is the ninth in my lifetime. The first was announced in the paper the day I sprang into the world in March 1947. What intrigues me, having looked at them all, is that the problems are almost the same, despite the tremendous change in our place in the world and the nature of British industry and technology. They are productivity and industrialising our research—the same problems. I do not want to sound cynical, because I am not—I always want these to succeed; I am Pollyanna-ish when it comes to these strategies—but what is it about this one that gives us hope that it will be seen as a lustrous breakthrough and a remarkable example of foresight when the PhD students go through it in the 2050s? Perhaps Dame Ann could lead on this question. What are the magic ingredients, the combination of these 10 pillars, that we have not seen before?

Dame Ann Dowling: It is very early to say, because this is a consultation rather than a policy document. There are good signs there. First, the Prime Minister's commitment to this is an important sign. The 10 pillars go right across government, and industrial strategy at this time is seen to be so important that it is actually in the title of BEIS, so there are signs that we had not seen before. The 10 pillars are spread wide. They are all the good things to do, and we should be doing them anyway. What would really make a difference here is a focus. I see the Green Paper almost as an invitation to business to work with government in these areas. It will work only if there is a real wish to have a partnership between government and business, including, since we are here, the strong research and innovation base that we have in the UK and therefore universities.

Why should it be different now? One could say that because of Brexit we cannot just continue to do things as we have done them before. We are at a transition point in life, in the country and in our economy, and this is an opportunity to grasp something and make it a real industrial strategy for the future. As I say, as it is a partnership, I see the Green Paper as purely an invitation. The next work will have to focus on things that really can make a step change.

Lord Oxburgh: You have mentioned skills, and I am concerned about the way the Green Paper discusses these. Right at the beginning, on the pillars and developing skills, it says, "build a new system of technical education to benefit the half of young people who do not go to university". That seems the wrong emphasis to me. It seems to me that to develop technical education as an alternative to university, where appropriate, carries the implication that somehow if you cannot go to university perhaps you should try technical education. Do you agree?

Dame Ann Dowling: I agree that we need to strengthen our technical education in this country. Business has great need of people with those skills, but what we need to do more than anything is increase the esteem in which such education is held. There is an element of this in the Green Paper, which talks about Institutes of Technology having prestige and esteem, but the phrase that you quoted tends to go in the opposite direction.

Lord Oxburgh: It is unfortunate.

Dame Ann Dowling: Yes.

Professor Iain Gray: It is an interesting observation and sometimes people say particular things to try to force a change without recognising the context it is in. For me, what is absolutely fundamental about the industrial strategy is that we attract, retain and develop the right kinds of people, regardless of where they sit within organisations. We have a great tendency in our language to produce silos, whether in sectors or around those who have been to university and those who have not been to university. We should look at this in a continuum sense. Leadership is an important thing and is not brought out in the skills section very strongly. Nor are entrepreneurial skills and some of the softer skills brought out very strongly in the report, and attracting the right kind of high-level capable entrepreneurial talent around technology is not brought out strongly enough. We are seeing a reaction to something that is trying to swing the pendulum in relation to technician support without regard to the broader context.

Q4 **Lord Oxburgh:** The industrial strategy emphasises sector deals. Do you have any feeling for how and why these sectors were chosen? Would you have chosen them differently?

Professor Iain Gray: Drawing on my own experience over the previous decade when I was chief executive of the Technology Strategy Board, now Innovate UK, I played a part, albeit relatively small, in some of the industry leadership councils, and I thought the ones that had previously been established were a great model of how government, industry and academia can work together. In these five sectors, automotive is one for which there was a strong leadership council. I am slightly concerned that some of the other leadership councils that I would have seen as strong get less of a reference. I was part of the Space Leadership Council, which I thought made a very strong contribution. There was the Agri-tech Leadership Council, which Dame Judith Batchelar chaired with Lord Sainsbury, which made a really big impact. My own background is in aerospace and I would have expected to see aerospace play a slightly more prominent role, given that it led the way in the Aerospace Growth Partnership, which was industry, government and the public sector working together.

I cannot dispute the fact that the five themes that have been drawn out have very strong individuals leading them. Juergen Maier is respected throughout UK industry and the manufacturing industry and as a thought leader in Industry 4.0—a great person. In the Automotive Council, it is great to see that recognised really strongly in Richard Parry-Jones, who is a great leader, and John Bell is a great leader of life sciences. I do not have an issue with the people who are drawn out in the report per se, but for the report to convey the impression that these are five lead sectors ignores some of the very good work that has gone on in other industry leadership council activities.

Dame Ann Dowling: I did not see it as an exclusive list. The five on the list are fine and belong there. Aerospace was mentioned as an example. That is already running and showing the strength of the sector, so that is fine. I, like Iain, know aerospace well and have seen how having a sector focus such as aerospace can really help the OEMs work with their supply chain to raise their ambition, to have a good interaction and bring the universities into that, and to come together to address skills and to improve manufacturing and material capability. There is great strength in the sectors.

That section ends with the point that it is very much an invitation for other sectors to step forward. I do not think it is for government to pick winners in sectors; sectors need to organise. One of the things that we said in my review on the business-university research collaboration is that, if there were an industrial strategy for sectors, the government should expect the sectors coming forward to commit the businesses in them to increase their R&D spend in response to expecting something from government, whether that is co-funding of early-stage research and development, or addressing regulation, or other things that are barriers in that particular sector.

Aerospace, under the Aerospace Growth Partnership, came together with a shared view of a roadmap to develop technologies, a clearly identified market where there was a chance of the UK winning a great share of that market, industry coming together to decide what was needed for that to happen and, importantly, a willingness to put some R&D money on the table to work with government.

I read in this Green Paper an invitation for other sectors to step up and do the same.

Lord Oxburgh: One talks of industry, but in fact very few of these industries are totally UK or British; they are international industries.

Dame Ann Dowling: Yes.

Lord Oxburgh: I suppose there is a policy question with regard to those industries of the extent to which they put their effort behind what goes on in the UK and what goes on in other countries.

Dame Ann Dowling: Iain, as an ex-CEO of Airbus UK, can probably answer this better than me. It is important that we in the UK make offers that match what is going on in the rest of the world.

Lord Oxburgh: Absolutely.

Professor Iain Gray: That is a key point: we are not the only country doing this at this particular time. Investment in country is based on perceptions of what that particular country is doing in this regard, so the UK needs to be joined up.

Professor Hywel Thomas: The thing that strikes me from my experience is just how important industrial leadership is in all this—in answer to the last three questions. My experience has been that where that industrial leadership exists, and is real and fully committed, it is extremely positive. I would interpret the comments about the sector and the technicians in as positive a way as possible, and I definitely agree with Dame Ann's comments on that. If the industrialists are involved at an early stage in the planning and development of these ideas, that is the right way forward. That is the key to everything.

Professor Iain Gray: I have two sentences to add, if I may. It is important to distinguish between an innovation strategy and an industrial strategy. There are strong connections, but real innovation happens when things happen cross-sector and sectors bump into each other. I do not know whether that is sufficiently recognised when we talk about sector deals.

Lord Oxburgh: I neglected to declare my interests as a fellow of the Royal Society and the Royal Academy of Engineering, and the director of two small energy-related companies.

The Chairman: And I forgot to declare mine: a fellow of the Royal Society.

Baroness Young of Old Scone: I should declare my interests as chancellor of Cranfield University and an extremely proud recent electee as honorary fellow of the Royal Society of Edinburgh.

Briefly on the sector strategy, the point was made that where the leadership from the sector already exists, things happen. My experience is that where we have strong sectors, the sector has got up on its hind legs and got on with it. This strategy kind of plays out a role for government as setting the climate and the enabling environment rather than doing anything about sectors that do not get up on their hind legs and do anything. Is that a problem? Is this the right role for government, or is there a kind of market failure role where sectors have not got their act together but are strategically crucial for the UK, so something needs to happen for government to take a stronger grip? I know that they are very much against picking winners, but should they attend to losers?

Professor Iain Gray: The terminology that I have heard talked about in the past, which is good, is that it is about picking races, not winners. You are quite right. The construction industry, for example, in which the UK plays a very strong leadership role, is a very fragmented industry, with lots of small businesses and lone workers, and there is a role there in bringing things together. The leadership council, government and industry working together to try to bring that together is important. I do not think you should ignore that role, even in sectors where there is the apparent ability to galvanise the different entities together. You should not ignore the role that the Government play in making the UK an exciting place and the right place for foreign investment, and there are a lot of people looking over our shoulder to see what the UK Government are doing, even in those successful sectors. It is a different role, with different sectors, different clock speeds, different cultures and different demands, so you need to respect both.

Viscount Ridley: Can I come back to the innovation point, which Professor Gray touched on a moment ago? How would one advise the Government to future-proof this list of priorities? I am acutely aware that innovation can crop up where you least expect it. The search engine is probably the most important innovation in my lifetime in terms of how many people use it every day, yet I bet it is not mentioned in any one of Lord Hennessy's nine industrial strategies. When I was working on the *Economist*, we produced a 16-page report on the future of telecoms in 1990, which did not have the word "mobile" in it. It is amazingly difficult to see where things are coming from sometimes. Is this list, and the way it is put together and built, sufficiently capable of coping with that sort of change?

Dame Ann Dowling: There are other elements of the 10 pillars where one would look to support those really disruptive breakthroughs and not necessarily through sector plans, other aspects such as encouraging the innovation base and supporting businesses to start and grow, for example. We come back to skills and making sure that we train people so that they are ready to be entrepreneurs and to innovate. We could do a lot more to encourage mobility between our strong researchers in universities and businesses, getting that exchange of people between companies and businesses that is not as common in the UK as it is in other countries. It is partly about making sure that we have the education practices to develop a workforce that is adaptable; innovators moving freely between small companies, big companies and universities; and government support and mechanisms to help. Some of the mechanisms might be through procurement and other levers that government has to support starting businesses and help them to grow.

Professor Hywel Thomas: The thing that interested me was the fact that there were 10 pillars and an implication at the very beginning that they might be made to work together. If that were the case and it could succeed, to support what Dame Ann has said, that would help. However, there is no pure foresight, no seeing the future.

Viscount Ridley: But is there not a danger of siloisation, that we will end up putting technologies into silos and preventing them cross-fertilising in the way that Professor Gray mentioned?

Professor Hywel Thomas: Well, it is a Green Paper and a starting point, so the invitation seems to me to be totally reasonable. There is obviously work to be done to avoid the difficulties that you have highlighted.

Dame Ann Dowling: Some of the things that are mentioned as sectors are not sectors at all. Digitisation and manufacturing really do span sectors, so even just with the examples suggested here, let alone what might happen when volunteers step up, we are already seeing things that move across traditional market-focused sectors.

Professor Iain Gray: There are good examples; battery technology, for example, is brought out in the report. They who command battery technologies in the future will command the automotive and other sectors. It is very important that we see these kinds of enabling technologies as the thing that will work across sectors. There are sufficient hooks in the report for people to come back, and it will come down to the implementation of it, but we need to recognise the importance of rapidly changing technology.

Q5 **Lord Fox:** I declare a financial interest. I am employed by, and have an interest in, GKN, and a financial interest in Smiths Group. Turning from the races to the racecourses, and taking up your point, Dame Ann, on driving growth across the country, should this strategy aim to provide help in every business of every sector? It is probably not practical to have an aerospace factory in every town, so what is the process of prioritising and on what basis is it done? How do you focus resources on the places where it needs to be focused, and, perhaps picking up on Professor Thomas's point, how do you get the leaders that you need in the regions, where that leadership is perhaps less prevalent?

Dame Ann Dowling: That is a big question. Of course, it is not a strategy if it tries to do everything in every sector.

Lord Fox: So how does it make choices?

Dame Ann Dowling: To be a strategy, it has to focus. On the other hand, there are enabling things that would benefit all sectors, and we have talked about some of them: skills, digitisation, and trying to raise ambition in mid-sized companies to grow and be innovative.

Lord Fox: How do you do that?

Dame Ann Dowling: Mobility is important. It is a part of education—in universities we now see clubs and indeed courses on entrepreneurship—and raising people's aspirations about what is possible.

Professor Hywel Thomas: It would be interesting to explore this also in the place-based context. It is all about the people and the places. My experience is that it can work if you have the right people and there are connections for them to make. There are absolute requirements. There is more to be said about energy and the energy supply, and as an underlying theme for the strategy, skills are obviously hugely important. Again, there is a place-based role for the skills agenda. If this strategy develops, as the industrial clusters develop in those regions and places, there are skills agendas that can follow on from that.

Q6 **Lord Hunt of Chesterton:** You mentioned Juergen Maier in relation to integrated manufacturing, but one thing that nobody has mentioned that seems to have gone out of the discussion—and I think about this because I used to run the Met Office—is the government laboratories. Interestingly, when Siemens were here they said simply that an essential part of the whole industrial approach in Germany is having these excellent Fraunhofer centres and so on. We have lost so many such organisations for building research and so on in Britain, and these are a core element. How do you feel? We had the Royal Aircraft Establishment in Farnborough, but now we have a kind of shared-out, distributed system, and I wonder whether we have the right structure to bring forward and support technology in the way they clearly do in Germany, France and all the other countries. America has tremendous government labs. Why do we not think that we should do that? How will we fill that hole?

Professor Iain Gray: First, let me come back very quickly to the question from Lord Fox, because the two questions are linked. We cannot invest and have the same thing in every part of the country. We have commissioned the science and innovation audits. We have not done it yet in every part of the UK, but there has been a first wave of audits and there is now a second wave.

Lord Fox: Who is funding that?

Professor Iain Gray: The Government. The Government have commissioned a body that is essentially a combination of academic-led or LEP-led or, in the case of the devolved Administration in Scotland, a devolved Administration kind of engagement. That will provide evidence of where the centres of excellence and expertise sit in the UK that can help to focus discussions. One thing that will come back from the science and innovation audit is facilities. You will recall that Hermann Hauser led a review of what were then called the technology and innovation centres and established a series of catapult centres around the UK that were seen as long-term commitments in the UK. The High-Value Manufacturing Catapult is now a key magnet for attracting businesses from outside the UK into the UK and is helping to develop capacity and encourage young people into manufacturing, so there are UK-wide facilities. The catapult network is one and we should back that. There is a hook in the consultation report for that.

The other point that you make, quite appropriately, is about getting universities to work more closely together in a network so that there is a proxy for a national research organisation through the university networks. Let us not forget that the UK is still respected throughout the world. Scotland is still very much respected throughout the world for its research and science base, so if we can get them networked and joined together we have a key attractor for overseas investment into the UK.

Lord Hunt of Chesterton: There is a new one, the EPSRC for fluid mechanics, which I know about, which also connects up to Europe, so you are right: it is happening.

Lord Maxton: Can I just ask a question that follows on from Viscount

Ridley's? How do you build in innovation that is not expected? Is there a danger in all this that government commits money to a particular strategy and then finds that it is overtaken by events and technology and therefore does not invest in that technology because it has already committed the money elsewhere?

Dame Ann Dowling: In this country there is, if anything, a danger of investing in the very earliest stages of research and not investing in the next stage that turns that great idea in the laboratory into something that can be commercialised and beyond that scaled up in its market penetration. If we have any problem in the way we look at research, it is in being interested in the next new shiny thing and being a bit sniffy when it comes to turning that into money. We probably tend to get out of investments too early rather than too late, which might be a different problem to have.

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

Q7 **Lord Mair:** My question is for you, Dame Ann, but I am sure that Professor Thomas and Professor Gray would also like to comment. Your report in 2015 was all about how to engage business and academia in a better way in research collaborations. In the context of science and innovation, do you think that UKRI will improve things? What are your thoughts, because one of the very strong comments that came in your 2015 report was that the co-ordination of innovation was not really that good and needs to be improved?

Dame Ann Dowling: It is such early days. UKRI has the potential to facilitate better support for innovation. One thing that my report identified as a major problem for a business trying to work with universities for the first time was how complex the funding system is. Innovate UK immediately responded by adopting a "no wrong door" policy, which meant that, no matter how a business contacted them, they would make sure that internally they got directed to the best place or scheme through which that company could get support for what it was trying to do in the innovation space.

John Kingman has expressed the wish that that same "no wrong door" policy applies across UKRI, including the research councils as well as Innovate UK, so that no matter how an SME or a business might approach with a particular wish or idea to partner a university, they would be directed to the right place. If that can be achieved, that would be a great step forward in facilitating first users. The recent commitment that we see to increase the number of research studentships when they are collaborative with business again is the kind of thing we wanted: an easy first way to facilitate collaborations between business and the universities. Elements are there. It will all depend on how it operates.

Professor Hywel Thomas: I am very glad that you mentioned Dame Ann's report, because there were a couple of things there, or more than a couple of things, in the section on people being central to successful collaboration. It seems to me that we could, and should, be doing more to apply that. The notion that perhaps more account should be taken of this collaboration in the universities, in REF and performance review is important, and, equally, that there should be more recognition perhaps from the industrial side of the value of this. Is there a case for more joint appointments with some of the big stations, such as the ONS—you mentioned the Met Office—where we could do more on the HR side and in encouraging our technology transfer offices to concentrate more on knowledge transfer? Those are really important components in the report, which have been developed but that as part of this strategy could probably be pursued further.

With regard to UKRI, the dangers have been talked about, but I think it is a good idea to have all this under one umbrella as long as due care and attention are paid to it. From the Welsh perspective, I suppose you will know of some concerns expressed in the Welsh Government that it may be a little Anglocentric, and those worries would need to be addressed.

Professor Iain Gray: Sitting on the Horizon 2020 panel that Commissioner Moedas is chairing, I find it interesting that one of his big ambitions is to establish a new council, the European Innovation Council, alongside the ERC, the European Research Council. This new council will be as big and have the same kind of clout as the European Research Council. In one way, we are seeing other parts of the countries that we work with putting separate innovation activities in place. We have pulled it together through UKRI, the governance of which is still being worked through. The danger, as I think everybody knows, is that we dilute the science base and do not do what we are trying to do in the innovation base, so that we end up with the worst of both worlds.

However, you have to turn that into an opportunity. When I see small companies in Scotland, such as Optos and Touch Bionics, which have come through the science base and are struggling to get traction within UK and to get the NHS to procure their products, you have to say that something that is more joined up and can take those science ideas and turn them into real commercial opportunities is good to do, so we have to make it work. There are definitely risks and dangers, but from what I can see the intent is to make it work, and I do see the rest of the world starting to focus a lot more on innovation as well as research. We have to make it work.

Lord Mair: I have one more question, which is on the same subject. Science and innovation is the first of the 10 pillars, so do you feel that it is rather left behind in the rest of the Green Paper? We do not see much mention of it on the point about encouraging trade and inward investment, for example. What are your views?

Dame Ann Dowling: It is vital to a number of the pillars; you have mentioned one. Many of the small companies will come out of the science and innovation base, so the skills are crucial. Implicitly, these are not separate pillars; they need to work together as a continuum. In the drafting, they may not show the linkages as much as they might.

Professor Iain Gray: There are two pillars where it is really important that there are strong linkages. One is skills, as Dame Ann has said. The report is weak in what I would describe as the softer skills, the leadership and entrepreneurial skills on the culture side of things, which should be brought out more strongly.

The other is on the procurement side of things. We were slightly cynical about the industrial strategy—"What's going to be different this time?"—but the procurement agenda keeps coming up, and it is great to see the recognition of the role of procurement and the commissioning of the review of the Small Business Research Initiative under David Connell, but what is he going to say that is different, and what are we going to do differently this time? The whole procurement process and the non-financial kind of support for research and innovation are really important to draw out, but we need to do it. We need to act on it.

Q8 **Baroness Neville-Jones:** I declare an interest in that I am a member of the EPSRC. I want to ask you about two of the strong themes that emerge in the government consultation document—and it is still only a consultation document. One is obviously the importance of the science research base in this country. The other is a preoccupation, which I certainly share, with what they call "place": that is to say, spreading the seeds of wealth creation more widely and deeply in the country.

The science research base tends to benefit from the areas in which it is located, which tend to be the golden triangle that both creates and benefits from the wealth in that area, and does not get out very much into the areas that one wants to try to help. On the other hand, it seems fairly clear that if you are going to create and to plant new seeds of wealth creation, you have to have an academic intellectual centre that helps to generate local innovation, skills and apprenticeships. There has to be something indigenous.

How do we square this problem of investing in our science base, as we must, which will be a source of wealth that we have to commercialise, as you rightly say, but where you have to rely on excellence, because it is only excellence that will win and it is only there that you have world-beating capabilities? How do we get from having these very important centres of real research excellence into something that is more widespread but that is equally capable of competing?

Professor Hywel Thomas: For me, the answer is in your question; it is based on excellence.

Baroness Neville-Jones: How do you do the planting in the first place? You can recognise excellence when it is there, but how can you help to create it?

Professor Hywel Thomas: I would argue that in the various places and the various regions it is important to build on the excellence that is there. It is obviously not as strong as in the golden triangle, as you said, but I would not want to see, certainly from my perspective, any dilution of the need for it to be based on excellence. The criteria for the industrial side would also need to stay at the same level.

There are already examples in my part of the world, such as the compound semiconductor initiative, which is now receiving strong support from the Welsh Government, the Westminster Government and Innovate UK. We need to replicate those sorts of successes. It may be worth exploring a little further the question of skills and where the EPSRC, for example, allocates its doctoral training centres, as well as the criteria used for the allocation of those centres and whether there is a case for some sort of place-based dimension to be added to that, because those are also seeds of growth.

As opposed to basing the industrial strategy just on excellence, you should also introduce the fact that it would make good sense for some of these skills issues to be more located in a region with industrial and academic interest in that area.

Professor Iain Gray: The science and innovation audits are a very good exercise and will show that there are science centres of excellence around the UK with real capability, such as in Scotland with fintech and digital health. I live in Bristol, which is establishing itself as the cloud computing centre of the world. It has a global position. The science and innovation audit shows that research centres of excellence are growing up. This consultation exercise needs to look at how we take that, commercialise it and create economic benefit out of it. That, for me, is still where the big issue is.

Dame Ann Dowling: I agree with my colleagues' comments. I would just like to add a bit to them. The science and innovation audits can help us to identify areas of excellence and their geographical distribution. However, it is important that we do not end up with different parts of the UK competing with one another. Technology areas will be identified as excellent and will be scattered, which is fine, but we need to find ways in which they work together to the good of the whole country and do not end up competing with each other. I have in mind, if we go back 15 years, how many different RDAs thought it was a great idea to have a nanotechnology centre.

There is a limit to how many centres one needs in the same area in our country, and they can be geographically separated as long as they work as an integrated whole. Catapults have shown how one might do that by having different sites within one catapult that work together as an integrated whole. Professor Thomas mentioned doctoral training centres. I am the director of one, and we involve three universities under it. The students are co-located for a year and then go off to do their research elements in three different universities. There are ways where one can have geographic spread while still keeping an entity that has a unified policy strategy and benefits from the combined expertise and makes the whole bigger.

Q9 **Viscount Ridley:** I want to follow on quickly from exactly that point. Before I do so, I should have declared my interests. I am a fellow of the Academy of Medical Sciences, I have various shareholdings in technology companies, and I own land in the north-east of England.

That brings me to the north-east of England, which has already, under the industrial strategy, begun to talk about a free trade zone on Teesside as a way of differentiating from other things. In identifying this place or regional issue, can we start to talk about regulatory differentiation between regions? We already do it. Scotland bans genetically modified crops and nuclear power stations in a way that England does not. Why can we not do it in a positive way, too? For example, the north-east of England might say, "We are going to try to make sure that gene editing is regulated more positively in the north-east of England". That came off the top of my head, by the way. It is not a proposal.

The Chairman: Can we leave that question unanswered for a moment? It is a contribution to the Green Paper.

Baroness Morgan of Huyton: I am slightly losing the plot, and I am sure that is my fault. On the one hand, we have heard quite a lot about a thousand flowers blooming, that we must not be too controlling, that we must make sure that wherever there are good people they are working together and that the really good people flourish. On the other hand, we are hearing quite a lot of, "Let's do our audit and then stuff must happen". Could you be a bit more granular about what you think the role is for government in getting that balance right? I take your point that it is a Green Paper, a consultation, but the danger is that the next stage ends up with lots of ideas but nobody really moving it forward.

Dame Ann Dowling: It needs to be leadership in the technology sector that moves it forward and not government. Audits can be done, technology areas of expertise can be found, and there can be geographic separation, but one needs leadership in them in order to co-ordinate.

Baroness Morgan of Huyton: You are talking about industrial sectors, really.

Dame Ann Dowling: Or technology sectors. We saw how robotics and AI came together as a community and worked out how they would work together and what their roadmap was.

Baroness Morgan of Huyton: Did that help the geographical issue?

Dame Ann Dowling: Yes, some of it has strong Scottish representation.

Professor Hywel Thomas: I am sorry to complicate matters even further, but, on the geographical issue, we already have city deals. I would point to how important it is for the industrial strategy to tie in with devolved government and then to tie in a city deal in the devolved region. There is one already in Wales, and a second one is hoped for. The space is quite busy, and it seems advisable for that to be done in a co-ordinated way.

Q10 **Lord Borwick:** To an extent, this is the same point that Viscount Ridley introduced. Tax and regulation have a significant, mainly negative, influence on science and innovation but are not really mentioned in this Green Paper. Should we have some competition among the regulations to reduce regulation in various areas to encourage more science and innovation in that sector?

Professor Iain Gray: First, you can look at the industrial strategy in terms of technology, skills, supply chain and procurement, and in terms of the fiscal, regulatory and non-financial matters. That is underplayed in the document and should probably be represented more strongly. Regulation can actually promote technology and innovation when we start to look ahead at autonomy and new materials. A good example is the Building Research Establishment. The UK has led the way in putting BREEAM standards of excellence in place, which are helping to promote and encourage innovation. Regulation in that sense can be a real promoter of innovation.

In the whole fiscal environment, you need to look at how to encourage large corporates to invest in the UK and how to encourage start-ups in the UK. A forgotten part of the document is the mid-sized companies. A lot of the German industrial strategy it is focused on the Mittelstadt. I do not see very much mention of what we do to support mid-sized companies, so I hope for a lot more input into the consultation.

Dame Ann Dowling: I absolutely agree that tax and regulation are really important levers, and they are not mentioned sufficiently in the Green Paper. It might be because the Government reviewed the R&D tax regime fairly recently. That has a crucial role to play in encouraging innovation, and the Office of Tax Simplification is currently undertaking a review on that.

One thing that one might hope for in relation to the flexibility that we have following leaving the European Union might be VAT on shared buildings, for example. It has been a bugbear with universities that if more than 5% of the building is occupied by an industrial partner, they have to pay VAT on the whole building. There are elements where things could be tidied up. Having regulation competing across the UK is very dangerous.

The Chairman: This goes back to Lord Ridley's question.

Dame Ann Dowling: As a country, our expertise has played a major role in setting EU regulation, and if we want to access the global marketplace we need to comply with that and not start setting our own. Whether we set local tax advantages is a different matter.

The Chairman: I am grateful to you for answering Lord Ridley's question, which I thought we were going to have a very long discussion about, and he has the answer.

Q11 **Lord Vallance of Tummel:** I declare an interest as a director of Amsphere Limited, which is a small IT company, and as chairman of the Edinburgh Business School. Frankly, I think that getting a coherent strategy across all these 10 pillars and across all sectors is boiling the ocean. It is doomed to failure, it has always failed before, and I get the sense of that there. Germany does it, and I have had a lot of experience in Germany, but that is societal. It is how things are done in Germany. Alles ist in Ordnung. Things are not like that here, which is one of our great strengths. I would in a sense prefer it if out of this could come six or 10 really fresh new ideas. That would be a desirable end to the strategy rather than pretending that we can organise the whole of the economy of the UK, which is really what this is about. You will not have time to answer this question, but I would love to know what other half a dozen fresh new ideas you think would be worth while coming out of this.

Dame Ann Dowling: I will answer only part of that, because there is a point I have not managed to make so far, which I am dying to make, and I might be able to manipulate it to be a response to this question. We talk about a country and an economy that works for everyone, and we have been talking about skills, but what we are really missing is diversity. There is no mention of diversity here. In the highly-skilled physical science, engineering and technology well-paid jobs, women and ethnic minorities are underrepresented. Let us have the whole of our population aspiring to and succeeding in the high-productivity jobs where we have companies wanting to employ people right now and where there will be increasing needs in the future. That may address one point, and I will let my colleagues answer with the other five.

Professor Iain Gray: One of the objectives of the Industrial Strategy Challenge Fund is included in the consultation and is to draw out the very small number of technologies that we can get behind. As I said earlier, it draws out battery technologies. The battery is a game-changer across a lot of our sectors, and if the UK can get that right that would be a good thing to do.

Professor Hywel Thomas: I would have to say something in the clean technology area, but I do not know what yet.

Lord Vallance of Tummel: I would love to have the answers afterwards.

The Chairman: We are always delighted, if you feel that you have been suppressed, as Lord Ridley was, and that you had little opportunity to answer a question, if you would like to send to our clerk some supplementary evidence on the things that you did not have a chance to answer in our limited time, do please feel free to do so.

We will all take away from this fascinating session our own three bullet points. If I were to be asked what I have taken from this session today, just at random I would say: building on excellence, which seems a very sensible strategy; identifying and addressing the skills gap, not least diversity; and the procurements agenda, which I would like to follow up. We would be enormously interested to hear the answers to some of the other ideas. I am not saying that everyone would agree with me. I am certain that around this table there would be three alternatives from each Member.

Thank you very much indeed for a stimulating morning. It has got our inquiry into the Green Paper off to a good start, and I have absolutely no doubt that at the end of the next session I will have completely different priorities.