HOUSE OF COMMONS

Science and Technology Committee

Oral evidence: Science and Innovation Strategy, HC 958

Wednesday 21 January 2015

Ordered by the House of Commons to be published on 21 January 2015.

Watch the meeting

Members present: Andrew Miller (Chair); Dan Byles; Stephen Metcalfe; Stephen Mosley; Pamela Nash; David Tredinnick

Questions 1-76

Witnesses: **Rt Hon Greg Clark MP**, Minister of State for Universities, Science and Cities, Department for Business, Innovation and Skills, and **Professor Sir Mark Walport**, Government Chief Scientific Adviser, Government Office for Science, gave evidence.

Q1 Chair: Good morning, gentlemen. Thank you very much for coming in. We have been having a fascinating discussion about "Our plan for growth: science and innovation", published by the Treasury and yourselves. We want to try and explore some of that and get a feeling for it, because there are some apparent changes in direction that we were not aware of. The first one, Minister, is that I am curious about the definition that is used on page 9, which says: "This requires all of the sciences, what the Germans would call Wissenschaft, the natural, physical and social sciences, engineering, technology, the arts and humanities. From this point this strategy uses the word science to encompass all of the above." When did that definition come in?

Greg Clark: My ministerial portfolio is responsible for research funding generally, and universities, of course, contain all of these disciplines. It is incredibly important that we see the totality of the research base.

Q2 Chair: I can understand the application of science within the arts, but incorporating the arts and humanities as part of the definition is what I am curious about.

Greg Clark: It is the broadest view of what we mean by the research base and science in that sense. Let me give you an example, which is not, as it were, the application of science within the humanities. Ebola is a matter that concerns the world at the moment. One of the most useful contributions to the effort to eradicate Ebola has come from anthropologists, who have been studying, for example, how different societies treat dead bodies. Understanding the cultural norms in particular cultures has been very important in the medical and scientific efforts to eradicate Ebola. That is one example of where the

connections between disciplines are increasingly important, and it is why, in terms of the emphasis of this strategy, collaboration is one of the big themes that we concern ourselves with.

Q3 Chair: It still does not answer my question, with respect. I can understand arts and humanities being part of research and of the research base, but arts and humanities are not all sciences.

Greg Clark: They are. The reason why we used this definition at the outset is that to have a strategy that was narrowly about the physical sciences would underplay the importance of, the connections with, and the contributions of, academic research and its application in fields that may not be part of that but should not be separated from it.

Sir Mark Walport: The Arts and Humanities Research Council is part of the research base, so there is nothing new about including arts and humanities. They are part of the research base. I don't think that this is an argument about the semantic definition of science, but a science strategy should take in the totality. If we are to get the maximum exploitation of science, we need to understand human factors. Design is extremely important. I am not sure that dancing on the point of a pin as to the precise definition of science is important. There are the sciences. There are the physical sciences. There is engineering, which does not like to be called a science, but there are the engineering sciences. This is an inclusive strategy.

Q4 Chair: I am going to look back over some of your previous speeches, Sir Mark, because I suspect that I can find an exact opposite case, but there you are.

Sir Mark Walport: I don't think so. I have always been very careful about the inclusion of the social sciences.

Q5 Chair: No, no. So has this Committee. It is the phrase "arts and humanities" that we find odd—the Wissenschaft.

Sir Mark Walport: Is the history of science a humanity or a science? Understanding the history of science is extremely important if we are to understand the position of science in society and public engagement now.

Q6 Chair: Okay. What was the overall driver for producing this strategy? Was it delivering a quality science base or helping to develop science as a key engine for growth?

Greg Clark: It is both and all of it. It seems to me that you have a responsibility and an opportunity, in my position as Science Minister, to look forward, in this case in a 10-year forward look, to make sure that we can be confident in the future that our science base, our research base, is going to be as successful as it can be. It is based on a position of strength, and this Committee knows very well just what an important asset science is to the country.

It seems to me that that is going to become more important in the future. If any of us think about how the nation is going to earn its living in the future and how it is going to have influence in the future, you look at the things you are good at and then you ask yourself whether there is going to be a buoyant appetite for that.

When it comes to science and research, we are exceptionally good at it. We punch way above our weight in terms of excellence, influence, citations and the output. We know that as the world becomes, generally, more scientifically capable and the opportunities available around the world increase, these attributes and assets that we have are going to be more and more important. So the question is: do you just take things for granted, take a laissez-faire approach and assume that one doesn't need to consider the policy environment, or do you think, "What are the things that we need to reflect on"—that is we in government and the institutions in the research base—"to make sure we maintain that?" So we have identified some of the strategic principles that we think will be important. One is to cling very closely to excellence—it is the basis of our success—to recognise that now, but even more in the future, collaboration across boundaries, across disciplines and between institutions is going to be one of the bases of success, the agility to be able to respond to an increasing pace of new opportunities and new challenges, the importance of place, how the clustering of different institutions can aid success and influence and a degree of openness, which this Committee has long had an interest in.

Q7 Chair: So the document could have been a lot stronger on economic delivery.

Greg Clark: No. The fact that it says right at the beginning "Our plan for growth" establishes, just as I said—in terms of thinking about our future as a nation, including its economic future—that science is absolutely at the heart of it, and this plan looks forward to what we need to do to make sure that we can count on that to give all of the benefits that it is capable of giving.

Q8 Chair: Can I ask about the proposed Paul Nurse review? We have got the triennial reviews operating virtually back-to-back. You have got the Paul Nurse review and, indeed, the Cabinet Office review of the research councils. What is the difference between the Paul Nurse review and the Cabinet Office review?

Greg Clark: The triennial review?

Q9 Chair: No; the Cabinet Office review of research councils.

Greg Clark: It seems to me that, coming out of the triennial review, a number of recommendations were made, including, for example, recommendation 1.5, which was looking at whether interdisciplinary research was adequately expressed in the work of the councils. When reflecting on writing the strategy, there are some action points arising from that review. The question was: do you get on with them straight away at the beginning of the strategy, or do you defer them? We thought the best thing was to get on

with them. Mark discussed the opportunities with the institutions and the research councils.

Sir Mark Walport: In a sense, the Nurse review follows from a series of questions that were set out as a result of the triennial review. At the start of a 10-year strategy, it makes sense to tackle those questions.

Q10 Chair: We are not doubting that.

Sir Mark Walport: In terms of the questions themselves, we discussed them in the Council for Science and Technology as well. So there was a fair amount of discussion.

Q11 Chair: But what is the difference between that review and the review that is currently being conducted by the Cabinet Office? You are looking curious, Sir Mark, as if you don't know of a review being conducted by the Cabinet Office.

Sir Mark Walport: To be honest, I am not specifically aware of the review to which you are referring.

Q12 Chair: I suggest, before you finalise your evidence to this Committee, that you double check what the Cabinet Office is doing and reflect on that, because there does seem to be a massive overlap between, precisely, the Minister's response and the questions being posed by the Cabinet Office.

Sir Mark Walport: We will come back to you.

Q13 David Tredinnick: How confident are you, just following on from the Chair's question, that other Departments are going to play ball with you in terms of coming up with this science and innovation strategy?

Greg Clark: I was very keen—in fact, insistent—that this was not just a strategy that was, as it were, a BIS strategy, but that it should engage the whole of Government, as indeed its predecessor strategy did. When David Sainsbury was in office 10 years ago, he published, as the Minister, a forward-look strategy that engaged other Departments, so we have been very closely engaged in this. Let me give an example of that. Take the Department for Education. The first substantive chapter of the strategy is about developing new talent. That is absolutely written closely with the Department for Education, and they have been very warm in their involvement in and enthusiasm for it.

Q14 David Tredinnick: It has been put to us that this whole strategy could, possibly, be better driven by the Cabinet Office, which has a better record of cross cutting, of drawing other Departments together. Despite the fact that this is science innovation and that you are

the Minister, really, in this instance, what is needed is for that Department to draw this together. What's your view on that?

Greg Clark: I agree with you. The individual Departments are there for the conduct of Government business, and the whole of Government needs to come together to address the priorities that we have, and science is a good example of that. That is why I was insistent that this should involve the whole of Government, so it was discussed across Government, it was published jointly with the Treasury, and Sir Mark, as the chief scientific adviser, and his colleagues in all Government Departments, contributed to this. What we have here and what you see here is something that represents the Government view.

Sir Mark Walport: May I comment as well, because we have had a previous discussion here about the location of the Government Office for Science and some debate as to where it should sit? My view is that function is prime. The network of chief scientific advisers that comes from across Government is going to be very important in this as well. So BIS, working with the Government Office for Science and with colleagues across different Government Departments, is perfectly capable of taking on this challenge.

Q15 David Tredinnick: There has been a lot of talk in this Parliament about joined-up thinking. In fact, it stretched back to the previous Administration. Sir Mark, if I may say so, in your response to the Chair just now—I am trying to avoid the use of the word "astonished"—I, personally, was very surprised that you should come to this Committee without, apparently, an awareness of the interest that the Cabinet Office is taking in science and innovation, and, in particular, a report that they are preparing. I say, in your defence, that one can't come to the Committee briefed on every subject, but I am, to say the least, a little surprised that they have not informed you or you have not sought information from that Office.

Sir Mark Walport: I will inquire after this, but I work very closely with the Cabinet Office. As you know, horizon scanning is something that is led jointly from the Government Office for Science and the Cabinet Office. I work with them all the time. I am not aware that they are conducting a review that is asking the questions that the Government have asked Paul Nurse to do.

Q16 David Tredinnick: Thank you very much. I have just one other question, Chair. Sir Mark, going through some of the briefing, there is some horrible jargon, and there is one phrase that has been used and bandied about, which I ask you to comment on, which is: "A good customer function accompanied by strong interdepartmental governance is crucial." Could you tell me what is meant by that? Who is the customer, and who will provide the strong interdepartmental governance? If you are not aware of this phrase, perhaps you would write to us.

Sir Mark Walport: I am well aware of the phrase, but it would be helpful to put it into context. Which paragraph are you referring to?

Q17 David Tredinnick: I am not looking at paragraphs—my colleagues might help me on this—in a particular section. I am just asking the question about the general concept of a good customer function accompanied by strong interdepartmental governance as being crucial.

Sir Mark Walport: Can I answer that, because customer function is something I have referred to a great deal? The Government fund organisations like the Met Office and the National Physical Laboratory. They fund directly and sometimes indirectly a number of very important scientific functions, and it is extremely important that Government itself is a good customer for their science.

Chair: It is page 48, paragraph 4.3.4.

Q18 David Tredinnick: I am very happy to leave it at that. One of my colleagues might want to pick up on that.

Sir Mark Walport: I think that answers your question.

Q19 Pamela Nash: The overall amount of money that has been announced to accompany and support the strategy is £5.9 billion. Minister, can I just clarify, how much of that money that was announced on 14th December is new money?

Greg Clark: Some £1 billion had been announced before. That is explicit in the document and that was for investments that had been announced, including the square kilometre array and the polar research ship. So it is all but £1 billion.

Q20 Pamela Nash: So £4.9 billion is new money that was announced for the strategy.

Greg Clark: When I say "new money", it was not a surprise that the money was announced. It was a response to a consultation as to how we should allocate the £5.9 billion of capital that had been put in place to 2021.

Q21 Pamela Nash: So the money that was announced was to be part of the strategy that had not been allocated any more specifically than that.

Greg Clark: Precisely. This was the first. The strategy made some allocations within that, but it also made some quite important decisions, for example, not to allocate it all. The reason for that, when we consulted and Sir Mark consulted colleagues in the sector, was that part of this requirement for agility in the future that I mentioned was not to commit all of the budget now but to hold some back for competition in later years, because in four, five or six years' time it could be that there will be some challenges and opportunities then that we want to be agile enough to take. So one of the decisions that we took was not to allocate it all.

One of the other very important decisions that was taken in allocating the money was to allocate £3 billion, so over half of the capital, not to new projects but to well-found labs, to help invest in maintaining what has been successful to date. The £5.9 billion was always in the public domain, and the billion that had been allocated to particular projects was there from the outset. Some important decisions were made in the strategy on how we should use that £5.9 million.

Q22 Pamela Nash: Would you be able to give us more information about that—how that money has been allocated and what areas will be prioritised in terms of spending?

Greg Clark: Sure. If we break it down, about £3 billion has been put aside for what the response to the consultation wanted, and we refer to it in the document. Lord Krebs made the point that sometimes new projects don't have the batteries included. You need to be able to maintain assets into the future. That was a very important reflection to be made. It has implications for capital and revenue. This was a capital consultation, but, of the £5.9 billion, around £3 billion was put aside for well-found labs.

The rest was for what we have called the grand challenges fund. That is to address future opportunities. As I said, £1 billion of that has been pre-committed through things like the square kilometre array and the polar research ship. Just less than £1 billion is in the agility fund for response to future opportunities, and then the first wave of allocations of capital in this phase include, for example, an investment in research into ageing at Newcastle university, the Royce Institute for Advanced Materials in Manchester and an investment in a big data facility at Hartree, and they are elaborated in the response to the strategy.

Q23 Pamela Nash: Thank you. Part of this, and much of the press coverage of the announcement, was around the grand challenges. Would you care to define for us, in terms of the strategy, what is a grand challenge?

Greg Clark: The grand challenges are the opportunities that science has to address now and in the future. We have identified some of them already. One, for example, is ageing: the importance of understanding the effects of ageing, not just the medical effects but the societal effects.

Q24 Pamela Nash: I am sorry to interrupt you, Minister, but before you go any further, can I ask who identified this? Who is making these decisions, what is the process and how transparent is it?

Greg Clark: The process is through the capital consultation, to identify where the investment should take place. One of the reasons why you have to make choices is, in relation to the health of UK science, that there are many areas that one could research. It is a combination of the stated Government priorities. Understanding ageing, for example, has been widely expressed by Ministers as something that is important to do. That and others, through the capital consultation, are discussed with the sector formally, and a set of recommendations is made as to what is the best use of the funds that we have available.

Q25 Chair: Sir Mark, when you were appearing before us about climate change issues, you said you thought that climate change is a grand challenge.

Sir Mark Walport: Yes. The history of grand challenges goes back to the turn of the last century and David Hilbert, the mathematician, who set out a series of mathematical grand challenges. The concept was then re-vitalised by the Gates Foundation. Globally, now, they are recognised as a series of major challenges. Some of them are pure scientific challenges, such as to understand fundamental matter, and others are the challenges that society faces, where science has the opportunity to provide an answer. The identification of challenges, like everything in science, is a mixture of a top-down and a bottom-up process. There is a slightly false dichotomy between them. Ageing, for example, would be recognised worldwide as one of the global grand challenges, where science has a lot to offer. Climate is, indeed, another one. The material sciences is another area where there are very important challenges. I will accept Mr Tredinnick's point about jargon. It has become a slightly jargonised term, but it is quite a good way of defining very important scientific problems where one needs collaboration, not only national but global, to get the best answers.

Q26 Chair: Can we expect to see a list of the Government grand challenges?

Sir Mark Walport: You could find lots of lists of grand challenges, actually.

Q27 Chair: Certainly, before the Government start spending money on them.

Greg Clark: I mentioned to Pamela Nash the agility fund for the future, and this is there to be able to identify, as time passes, what might insert themselves on to the agenda. Antimicrobial resistance, for example, is something that is of increasing interest. Years ago, that may not have been seen as important. It would be wrong for these to be set in stone and unchangeable. It came very strongly from the consultation that they should not be. So they should be part of the debate within and with the scientific community so that we are prioritising our resources on the things that can make the biggest difference.

Q28 Chair: I am just curious as to why there is not a chapter on grand challenges.

Greg Clark: I would regard that as the chapter on setting priorities, which is chapter one of the publication.

Q29 Chair: Okay. So you see that as all-encompassing in there.

Greg Clark: Yes.

Q30 Pamela Nash: Are there any grand challenges in the arts and humanities sector?

Greg Clark: Yes. They are very much a part of this. I mentioned Ebola, for example. Ageing is a good case in point. The research into ageing involves cultural aspects as well as medical aspects. These are not restricted. My view is that we ought not to be very restrictive on the boundaries that we set. Everything that is funded—all particular projects—are peer reviewed and subject to an assessment of their excellence and contribution. That is there. In many areas, there will be contributions from the social sciences, from the arts and humanities as well as the physical sciences.

Q31 Pamela Nash: I am still struggling—I know the Chair explored this earlier—with arts and humanities being included in science. Minister, with respect, all the examples that you have given to me are part of the social sciences and not part of the arts.

Sir Mark Walport: History is going to be extremely important, for example, in understanding issues around antimicrobial resistance and alcohol use. There are lots of examples where history is extremely important.

Q32 Pamela Nash: Again, that is an example for history but not all arts and humanities—

Sir Mark Walport: Design is extremely important. We really do need all of the academic disciplines, including the social disciplines, if we are going to tackle issues such as antimicrobial resistance.

Greg Clark: This is part of a very important and vital British tradition, which is to be cherished. If you go back to Prince Albert's vision and go to South Kensington, what do you see there? You see Imperial College and the Royal College of Art. You will see the connections that have been made between design, the arts and the sciences. It has been one of the things that we have done best at. This is the reason why we are absolutely determined and positive to reflect this in the strategy. It is one of the most important assets that we have, that we are good not just in very narrow areas but that we offer a breadth and a set of connections that are absolutely the way the world is going. The connections across disciplines, including broad sets of disciplines, like the arts, humanities, social sciences and physical sciences, are coming together increasingly. Take the law, for example. I have been very interested, with my innovation responsibilities, in autonomous vehicles. One of the big challenges to autonomous vehicles is not just the technology of getting them to drive without a driver but the legal situation in terms of risk and liability. That engages some of our top brains in legal research.

Sir Mark Walport: One of the topics that we have talked about on a number of occasions here is public engagement with science. The arts are extremely important in that. My old organisation, the Wellcome Trust, invested heavily in the arts alongside the sciences. Look behind you in this room here, where you have got the arts in support of democracy. The arts are an extremely important part of the scientific base.

Q33 Chair: We are not denying that. We are going to move on from that. There are no philistines around this table. Far from it. I have studied the work of Leonardo very carefully. That is not the issue and you know it is not the issue. It is a question of definitions.

Greg Clark: Chair, within the remaining weeks that this Committee has to deliberate, if it can come up with a word or a phrase that captures this, it might be a legacy for future Committees.

Q34 Pamela Nash: In terms of investment, a big part of the work of this Committee—it was shown in our report on "Bridging the valley of death"—is the work and investment in new innovation in this country. How will they be helped by this strategy? Minister, what conversations have you had with the devolved Administrations regarding this matter? As recently as Monday, I was very concerned about the issue, after meeting with life sciences companies in my constituency, of how they were being supported.

Greg Clark: In terms of the strategy, there is a chapter on catalysing innovation, for example. It is a very important chapter which contains a number of new commitments. An example is two new Catapult centres, which have been very successful, and the Committee has acknowledged their success in getting this connection between the ideas that are generated and the commercial applications. So energy systems and precision medicine will open this year. There is further investment in the high-value manufacturing Catapults amounting to £61 million. There is an investment in a national formulation centre in County Durham. There is an investment in extending the application of research in driverless cars. So there is a lot of innovation here.

In terms of the devolved Administrations, one of the benefits of being a United Kingdom is that there is, on the science side, not just the possibility but the reality of very significant access to UK-wide funds from Scotland, Wales and Northern Ireland. In fact, the Scottish research establishments do better, head for head, than the average across the country. That is a very important part of it. A lot of the work that I have done on innovation includes partners right across the country. Again, it is an area in which boundaries are not a barrier to collaboration. In fact, quite the reverse.

Q35 Pamela Nash: What about small businesses, because the examples you have given are very much large businesses?

Greg Clark: Indeed. In terms of small businesses, one of the things that we are establishing is growth hubs across the country that are there to provide advice and help to small businesses. They are being rolled out right across the country. The Catapults themselves have an initiative to work, in particular, with smaller companies, with SMEs, in the supply chains to make sure that they can benefit from the application of ideas. In fact, it is particularly important for smaller and mid-sized companies because they are often the ones that cannot afford the standing R and D facilities that some of the bigger players have. Among the benefits of the Catapults is the availability of state-of-the-art infrastructure, which is available to SMEs that otherwise would not be available.

Q36 Dan Byles: Minister, who wrote the report?

Greg Clark: It was a cross-government initiative. I took a great personal interest and involvement. My view is always, when I have written reports for the Government, to ensure that they are—notwithstanding Mr Tredinnick's criticism of particular phrases—readable yet personal. Sir Mark was obviously closely involved with that, as were my officials in BIS, such as Sir John O'Reilly, colleagues in the Treasury and the Department for Education and across government. It was very much an enjoyable joint exercise.

Q37 Dan Byles: For want of a better word, who owns it now going forward?

Greg Clark: The Government.

Q38 Dan Byles: Within government, who is responsible now for taking recommendations forward and trying to drive the vision forward? Does it rest with BIS?

Greg Clark: Again, in response to Mr Tredinnick's point, it is important for the whole of government that this should not be, and isn't, simply a BIS responsibility. Of course, there are many recommendations which are, so the funding of the Catapults, for example, and the sponsorship of Innovate UK is a BIS responsibility. The involvement of the Department for Education, for example, is absolutely crucial, and so is that of the Treasury. One of the things that we have not talked about, but of which I am particularly proud in this document, is the introduction of a postgraduate loan scheme for masters students. Again, it is across all the disciplines. In advance, there was some debate as to whether this should be restricted by discipline but it is for all disciplines. This is a huge breakthrough in terms of the funding of students who want to be educated to a higher level than undergraduate level. It is a big breakthrough and it could not have happened without the enthusiastic engagement of the Treasury. It really is a whole-hearted, cross-government strategy.

Q39 Dan Byles: I take your point. On the one hand, it is good to have a cross-governmental exercise like this, but might there not be a danger that things could then fall through the cracks going forward if there isn't a clear ministerial oversight of driving it forward?

Greg Clark: It is challenging but, as Science Minister and the Minister responsible for innovation, I have a particular personal responsibility to this Committee and its successors, if we are both fortunate to be in our posts, and we will want to do that. Equally, as you have done over the years, you will summon Ministers from other Departments to make sure that they are living up to their commitments. It is fair to say that Sir Mark, through his network of colleagues, and the scientific advisers in Departments have an important part to play. During my tenure in this role, I have been very impressed with what an effective network this is for me to access advice from other Government Departments, quite apart from my ministerial contacts. It is a very good network.

Q40 Dan Byles: Since you mention that—I am relatively new to the Science and Technology Committee—what would you say is the principal function of the scientific advisers? Are they there to provide a governance and a challenge function, a slightly outside-looking-in function, or are they part of a team that should be writing things like this?

Sir Mark Walport: The job description is a broad one. My job is to advise the Government on all aspects of science, engineering, technology and the social sciences for all Government policy.

Chair: And the arts from now on.

Sir Mark Walport: If you will excuse me, I won't rise to that, Chair. An important part of our job, as a network, is to join the dots. So the agreement is, for example, that the domain skills in individual areas of the sciences that we cover are very broad. So the job of a departmental chief scientific adviser is to advise the Department but also to use his or her domain skills across government as well. So an important part of our role is to join the dots up and to collaborate in delivering this. To be honest, this strategy is for more than in government. Clearly, it is a strategy of the Government. It will only deliver if it is supported by the scientific community and by industry.

Q41 Dan Byles: Absolutely—which is why I think that it must sometimes be tricky for you to get the balance right as to whether you are, on the inside, part of the Department or you are a non-executive type function providing a challenge to the Department.

Sir Mark Walport: In a formal sense, I am a permanent secretary, so I am a Whitehall civil servant. I am bound by the civil service code. Equally, it was made very clear to me when I started my job and to my colleagues that our job is to be independent minded and to be challenging. So our job, particularly inside Government, is to challenge. We are not there to toe any particular line. We are there to provide our expertise.

Q42 Dan Byles: That is very helpful. I want to follow up some of the points that Pamela was asking about small businesses, SMEs and the innovation side of it. We can all see the strong value in using science and technology to drive you to real-world innovations and real-world commercial developments. Is there a danger that identifying opportunities and excellence starts to step on the toes of "the Government picking winners"?

Greg Clark: This is a perennial and classic debate. Governments do not have a good track record, to say the least, of picking individual winners. That is why we should not get in the business of doing that, but it is right for the Government to take an active view through its strategy as to whether it wants to fill in gaps in the structure of the sector. In innovation, for example, as the Chair says, there has been long identified a problem of translating ideas into practice. So the Catapults and the existence of Innovate UK are a deliberate response to say that some public support to provide facilities and to enable that to happen more easily is appropriate. They are run on an arm's length basis. Innovate UK and the individual Catapult boards have individual business men and women and experienced technologists who decide what should be funded, as, of course, do the research councils

when it comes to individual scientific projects. That is the right way to address the situation.

Q43 Dan Byles: In terms of the Catapults, I instinctively like the idea of Catapults, and I have had dealings with a number of them now through my various other hats. I do note that the report says that the Catapult system is starting to pay off. How do we measure that? What metrics are you using to decide whether the Catapults are achieving what they set out to achieve?

Greg Clark: For example, if you take the high-value manufacturing Catapults, one of the reasons why the funding was increased to the high-value manufacturing Catapults is that they have more applications to work with businesses than they can accommodate. The model that was proposed by Hermann Hauser in establishing them was that they should be what he called one-third, one-third, one-third models. So it should be a third core public sector funding, a third contracts won from public sources, but competitively, and a third from the private sector. If you want to stay true to that model, given the level of interest from the private sector, it required a further investment to keep that in balance. If over-subscription of fundable, reviewed and worthwhile projects is an indication of success, that is demonstrated.

Q44 Dan Byles: Is not the intention, within five years, that they are going to be weaning themselves off the public purse? I don't know that this is true for all of them or just the ones that I have spoken to, but shouldn't they be standing on their own two feet with their own income streams within a certain period of time?

Greg Clark: Certainly to have their own income streams. Of course, when they set up they grow this income stream from the outside, but the high-value manufacturing Catapult shows how quickly that has been established. The model that Hauser proposed was based on the Fraunhofer in Germany, where there is a permanent one-third, one-third, one-third contribution from each. So, they are not places where companies that can afford to do this themselves simply contract out and dominate, but there is the opportunity there to do things that may not be a demonstrated commercial sure-fire hit but have enough of a prospect of that to justify the application.

Q45 Chair: In one of the previous reports that we wrote, we looked very closely at the comparisons with the Fraunhofer model. One of the very strong themes coming out of the German model in terms of defining success is that there appears to be a strong connection between the triangulation between the Fraunhofer, the entrepreneur and the provider of finance in making money longer in Germany. Is there any evidence yet to support that in terms of the Catapult, and don't you think it would be a good idea if the Treasury started monitoring that and making some local and regional comparisons, perhaps in supply chains? The point is that if that theory is correct—and it was very bluntly put to us by the equivalent of the senior civil servant in the Department of Business in Germany, who followed up his

response by saying, "I ought to know as I used to be a banker"—it does justify the Treasury investing much more heavily in the future in the Catapult model.

Greg Clark: That is a very fair observation, Chair. It is early days in the cycle to be able to have the data on that, but to set ourselves up to make sure that we do have the data is a very fair recommendation.

Q46 Dan Byles: Do you think there is any danger that, because of this mix of public money and commercial activity, Catapults could end up competing directly, with some public backing, with some purely private sector companies? I have had a few companies, not many, I admit, which expressed some concern that they are a bit cautious about getting too close to the Catapult in their sector and sharing what they are doing because the Catapult is going to be a competitor for some of their activities.

Greg Clark: I haven't picked that up, and I would be interested to hear about any particular cases. When I have made visits to the Catapults, I have been quite impressed at the range of businesses that have found it fruitful to collaborate with them, from very large businesses which, in turn, if the ideas prove successful, will build facilities to be able to exploit the innovations, to very small—sometimes micro—businesses that simply would not be able to get into the space. Catapults are certainly not dominated by either the very largest businesses or very small. They are not captured by the largest ones. So I am not aware that that is a concern.

Q47 Dan Byles: It is not something I have heard a lot about, but it has been mentioned by a couple of people.

Sir Mark Walport: May I comment on that, because I am aware of that as a potential issue? It comes back to the point, if they are asked to become entirely self-sufficient and not to need government funding, that that would provide pressure on them to start competing. Therefore, it is about having a very clear mission and governance that their job is to catalyse and support the sector and not to compete with it.

Q48 Dan Byles: And to add value where, perhaps, value isn't currently being added.

Sir Mark Walport: Precisely so. The justification for them is that they are operating in a sector where the market will not invest fully. They are in that so-called valley of death. You are right that it is a potential danger, but I do not think there is any evidence that it has happened. It is something that does need to be dealt with through the governance of the Catapults.

Q49 Dan Byles: Thank you. In terms of the discussion within the strategy about collaboration between academia, the private sector and so on, this Committee recommended that the Government should identify a way for SME businesses to feed their research requirements, as they see them, into academia in, perhaps, a clearer way. It has been

suggested to us by some people that some SMEs, in particular, do not really know how to access the university network and academic research, and that larger companies find it easier because they have networks. Do you think more can be done to try to open up a dialogue route between SMEs, in particular, and academia, not so much on the Catapult side now but with university departments?

Greg Clark: I am sure there is. There is a recognition on the part of universities for them to be open, as they increasingly are, to collaboration with business. Obviously, it is easier with very big businesses, but some of the most exciting opportunities involve smaller businesses. As I visit universities around the country, it is quite common for them to have incubator units themselves. Science parks, for example, are a very important part of the way that universities organise themselves. In almost every university I go to, you've got small businesses on site. That is something that can be expanded because it is a foot in the door. Once you have got used to the presence of small businesses on site, they will bring in their counterparts elsewhere in the sector. They will see the opportunities that come from it. Again, it is a positive direction and I am sure we can go further.

Q50 Dan Byles: On the issue about upscaling quickly and small businesses being able to scale up—there is a recent report by Tech UK on the importance of upscaling and its potential to the economy if we can, perhaps, make it easier and better—is there anything in the strategy that helps to provide for small companies that are growing quickly but are struggling with how to upscale, especially if they are operating in a technical sector or a technical manufacturing sector?

Greg Clark: Yes. The Catapults have an important role to play, because if you crack the technology then you want to grow it and you have got advice. Often, people who work in the Catapults have been responsible for growing small businesses into medium and large ones. The other thing is the growth hubs. There has been a problem over the years in that there has been a plethora of different alternatives and sometimes overlapping sources of advice for small businesses seeking to grow, but bringing them together into growth hubs that involve the local enterprise partnerships, and often involve the universities—I am visiting a growth hub at the university of Gloucester later this week—is designed to make it easier to obtain that advice and to make use of it.

Q51 Dan Byles: You mentioned local enterprise partnerships, which is another interesting dimension. Do you think there is enough linkage and overlap between this and, with your other hat on, where you are doing city deals and some of the regional agenda? Government Departments and local authorities have a tremendous opportunity to be a catalyst simply because of the money they spend on infrastructure and services, and they have the opportunity to be innovative in how they do that to pull through new technologies, new techniques and the like. Do you think there is enough of that happening and does this document help drive that?

Greg Clark: It does. One of the key principles we have established here is the importance of place. It is a recognition of what is already important. One of the things we know is that a cluster of adjacent and complementary institutions—they may be universities, research

institutions or technology bodies—can deliver more than the sum of the parts. That should be recognised. It should also be recognised, and I have been particularly keen to promote this, that we have the science budget, which is very important. That is handed over through the research councils and the peer-review bodies to fund science, but that should not be the only source of money. There is additional funding. When local authorities and, indeed, central Government, are investing money into the regional economy, I want science and innovation to be working with local enterprise partnerships to be able to invest some of that money and, increasingly, they are. In Birmingham, for example, the city deal that we struck with them involves the establishment of the Institute of Translational Medicine, which is something that was done to cement the opportunity that the University of Birmingham and the city of Birmingham have in that field of medicine.

Sir Mark Walport: A major point in all of this is the people. So finance and skills are the two things that are needed. We make some quite strong points about skills in this as well.

Q52 Chair: Just going back to Dan's earlier question—I have a slight vested interest here in that the Chancellor opened an institute in my constituency owned by the University of Chester last Friday, and Stephen Mosley was there as well, where we have a series of incubation units—one of the things that struck me in terms of your role, Minister, particularly in relation to universities, is that, looking back historically across several Governments, the universities have been fantastically successful at accessing moneys from what was Framework 7, and are on track for doing the same with Horizon 20:20. The converse is true with our small business sector, where the French lead on that. It seems to me that, with the expertise that we have in our universities of accessing that money, there is a role for them to play in their regions, working with small businesses. Can you take an initiative to help push that, because it seems to me that it is a missing link?

Greg Clark: That is an excellent point. You are absolutely right, Chair, that universities are now firmly established as among the leaders of their local economies. You know it in Cheshire, as does Stephen Mosley. A lot of the investment that is going into Cheshire and the north-west is spearheaded by the influence and the leadership that the universities and the leaders of the research institutes there make. To apply some of that success, as it has been led by them, to other areas is, again, a very useful suggestion, and I am very happy to take that away.

Q53 Stephen Mosley: In moving into that subject, I want to talk about the importance of place. In your answer to Dan, you talked about the importance of clusters. Wearing your science hat and talking about the strategy, is the aim of the strategy to focus research and innovation on existing centres of excellence or is the idea to try and develop new centres of excellence?

Greg Clark: One of the points I made in response to Pamela Nash is the need to recognise agility, which means that there will be capabilities that will be needed in the future, of which the institutions may now be embryonic, so we ought to have the ability to respond quickly to that. Where we have existing centres and clusters of excellence, joining them up is a good way to get greater value out of them. Since we were talking about Cheshire, you

have, in Cheshire, in Manchester and over into Merseyside, a number of institutions—universities and research institutes, like Daresbury—that have very important connections. One of the things that we recognise in the strategy is that importance of place. The deeper the connections and the more active and alive they are, the more successful they are likely to be.

Q54 Stephen Mosley: One of the criticisms we have heard, and it might be because you wear both the cities hat and the science hat, is that in science you are looking at scientific excellence but in cities you are looking at regeneration. We have heard some suggestions that the strategy might be there to try and encourage regional development rather than scientific excellence. How would you respond to those suggestions?

Greg Clark: I regard the two as, essentially, two sides of the same coin. If you accept my contention that I made at the beginning that the future prosperity of the country requires scientific success, it requires us to build on that excellence, so excellence is absolutely essential. There is no good having institutions that are anything less than excellent. The recent research excellence framework has established that we are becoming even better than we have been. The foundation of that is peer review to make sure that the projects that are funded are those that deserve to be funded on the basis of their excellence, but they are always in particular places. Scientific research does not exist in the ether. It is the people who are based in institutions. For too long, we haven't recognised enough the importance of those institutions to local economies. You can get more out of these collaborations. For example, I mentioned the case of Birmingham, where Birmingham businesses and local authorities were willing to invest some of their own money in science and the research projects are then peer reviewed, so then you have a good combination. That is what I am doing but also what is being led by many vice-chancellors around the country.

Sir Mark Walport: One measure of excellence is being elected to the Royal Society. If you look at the distribution of Fellows of the Royal Society, you will find that they are very widely distributed across the country. As the Minister says, excellence must underpin everything, but it is a complete mythology to think that you can only find excellence in a rather small number of places.

Q55 Chair: Some women scientists might baulk at that as there is a massive imbalance there.

Sir Mark Walport: There is always more to do, Chair.

Chair: We are back to history again.

Q56 Stephen Mosley: I am going to ask a slightly cheeky question, because I see that the Chair is wearing his University of Chester tie. He has mentioned the Thornton research labs, which were opened last week by the Chancellor. I know that you are looking for a location

for the energy systems Catapult. Don't you think that Thornton would be an excellent location?

Greg Clark: You allow me to demonstrate the point that I have no influence over that. It is decided by an arm's length body of experts, and they, I am sure, will look at the no doubt impressive credentials of the area, and then will make their view uninfluenced by Ministers.

Q57 Stephen Mosley: Let me move on to something slightly different. One of the concerns we have heard raised is the nature of the competitive tendering process, in particular for scientific infrastructure. There is concern that you might have a large amount of capital investment in infrastructure which then, because of the competitive tendering in a short period of time, might lead to that scientific research moving elsewhere. Do you think there is an opportunity to look at the funding and, maybe, to introduce core funding for certain periods of time to ensure that any investment that is made is secured for the long term?

Greg Clark: In general—I will ask Sir Mark to comment—we have talked a lot about, implicitly, research council funding. One of the important features of our dual-support system for research is that there is funding for institutions that flows from the assessment of their excellence in research that is not tied to particular research projects but is there to reflect the longevity and the continuity. That dual-funding system is very important. One of the things that it does is provide an ongoing capacity for things that do not come to an end when a research project comes to an end. One of the things that we have also done, which we were talking about earlier, is to respect the view that came very strongly from the capital consultation that funding should not just be about new things but it should be about maintaining existing institutions. We have reflected those points in the strategy.

Sir Mark Walport: It is a good question. Overall, existing institutions tend to have a competitive advantage because they have been around for a long time, but I don't think that any scientific organisation should have guaranteed infinite funding. So the principle of having quinquennial peer reviews is very important to maintaining the excellence of established institutions. That is the point. It is a balance between giving people long enough, which is extremely important, and personal support to be able to tackle difficult questions so that they are not limited by very short-term funding. Equally, very long-term funding needs to be underpinned by regular peer review.

Chair: It would be a total abuse of my position to follow up on Stephen's tempting comment as I chair the Thornton advisory board. I will hand over to Stephen Metcalfe.

Q58 Stephen Metcalfe: Thank you, Chair. I want to look a little bit at the importance of communication in science, whether that is between scientists and scientists, which we seem to be very good at, if you take the number of times our scientists are cited in other scientists' works, which is excellent, but also there is an emphasis within the report about the importance of communicating more with the public and other funders to create a more open environment. The strategy says that researchers and innovators must be prepared to engage in discussions with all those who support their work. What does that actually mean? What level

of engagement do you think is required? Does it mean answering every tweet about your work, every letter or what?

Greg Clark: Since you have given me the opportunity by saying that scientists are good at talking to each other, it is fair to put on record, as we do in the report, just how good we are. We have 1% of the world's population, 3% of research funding and 16% of the most highly cited articles in the world. That is a phenomenal record of influence, which science takes in its stride. I do think, and it is reflected in the strategy, that there is increasing interest in the country and around the world in science, whether it is particular moments of excitement, such as the Rosetta mission, or every day on the TV and the radio there will be a science story. It is right for science to respond to that appetite, not least because, right at the beginning of the strategy, we say that bringing forward new talent is important to that. That new talent might be attracted at a very early age, for example, children choosing their GCSEs and choosing to work hard at them because they have been motivated by seeing science on the TV and around the place. It is an important mission, which I know is shared by scientists, to tell people what they are doing. It is incredibly exciting and incredibly thrilling. That is one part of it, which is promoting it so it is not a closed world that people are unaware of.

Another aspect is about the scrutiny and the engagement of people who might want a critical engagement in it. When things are done behind closed doors, then that fuels suspicion. Sometimes, there are no grounds for that but people tend to be sceptical that something untoward is going on. As a general principle, to be open in science, to say what is being done, to share results widely and to have them widely debated, is good for the confidence in science. We have in this country—I don't think there is a particular problem—a very high degree of support and public backing for science, and we should build on that. We are good at it.

Q59 Stephen Metcalfe: The report talks about greater democratic scrutiny, which is part of that openness process. How do you ensure that democratic scrutiny does not end up as politicising science? What's the safeguard?

Greg Clark: One of the safeguards is that the scrutiny should, with respect to this Committee, not just be done by politicians and Members of Parliament, important though that is, but by the institutions and the learned societies, which should engage, as they do, in the public debate and put out in front of the public what the scientific view, or scientific views if they are plural, are on particular subjects. They can do that directly. They should have the self-confidence to do it, and they do. That is a good thing.

Sir Mark Walport: May I bring in something here, which is that there is an important issue about the application of the science? Of course, although democracy is extremely important to these areas that we have discussed here over the years, it is around the application of science, so genetically modified organisms, stem cells—the list is endless—and nuclear research, where it is important to have a clear discussion but it is also very important, and it comes back to the annual report that I did on innovation, that we distinguish the scientific discussion from the values discussion. It is really important that we do talk about these things. Coming back to where you started, there is always a

proportionality issue. Do you respond to every tweet? Of course not. It is about being sensible about it.

Q60 Stephen Metcalfe: Do we need some sort of authoritative repository for scientific information so that it can be seen to be available to both sides without being politicised or coming from a particular angle?

Sir Mark Walport: That would be the repositories for, increasingly, the open-access peer-reviewed literature. It is important—again, it is something that has been discussed here over the years—that the peer-reviewed results of scientific research, normally published as papers, are available as widely as possible.

Q61 Stephen Metcalfe: How accessible do you believe those to be, for example, to the public, specifically as an item?

Sir Mark Walport: If you take one area, which would be medical science, we now have Europe PubMed Central, which, literally, holds millions of papers, which are accessible to anyone who wants to look at them, but I would be wrong if I didn't say that it required a certain amount of expertise to know how to search it and also how to interpret it. The media plays an important role. It's a role of scientists not only to publish the results of their research to other scientists but also to make sure that there are, for example, lay summaries, which increasingly we are seeing associated with papers.

Greg Clark: There is a very useful cascade. The fact that we talk about publications and citations is to illustrate that the norm in science is to publish and have things scrutinised. Of course, Mr Metcalfe, you are right that often at a technical level it may not be directly accessible to the layman, but the fact that they are in the public domain then means that other journals, the *New Scientist*, for example—if you review scientists regularly, you have a good sense of some of the contents of the journals that are coming out and translated at a more general level. Other people can monitor that type of specialist media, such as the science correspondents of the newspapers and broadcasters, who are very good—we hear this every day on the media—at taking what could be rather technical and inaccessible insights that have been made, and through their talents at explaining them and interviewing people who can illustrate them, bring them to something that can be appreciated by the generalist.

Q62 Stephen Metcalfe: Do you think that this scrutiny and openness should apply to scientists regardless of where they are working, whether it is in government or academia?

Greg Clark: Sir Mark is a scientist and he will comment as a member of the profession, but it is fair to say that the norm, it seems to me, among scientists is that you want to share your research and have it scrutinised. That is how scientific advance takes place. As someone trained in the social sciences as an economist and who gained a PhD, you defend a PhD, as it is a public process. That is part of the ethos of it.

Sir Mark Walport: I agree with that completely. The default is openness, but recognising there are circumstances in which openness is not appropriate. For example, research in areas of national security may not be, and there are certain commercial circumstances where, before patents are taken out, there may be commercial confidentiality. Where publicly funded research is concerned, the norm is openness.

Q63 Chair: Before we leave that, it seems that there is a degree of inconsistency on the part of the Government. You might just pass this back to your colleagues who are responsible. As my valedictory Bill, I served on the Committee stage of the Infrastructure Bill, and there was there some positive movement on the part of the Government towards the Opposition's position on baseline monitoring but resistance to an amendment that I put down, setting out the case that baseline monitoring data should be made available in a form which could be subject to scientific peer review. That seems to me eminently sensible, but for some reason or other it was pushed aside.

Greg Clark: Let me take that away and look at the amendment.

Chair: The last question will be from David.

Q64 David Tredinnick: I have the honour to ask the last few questions. Some of the ground we have covered already, but the long-term future of UK science really is in schools today: I think we are agreed. How do you see this strategy influencing the experience of those future scientists?

Greg Clark: It is incredibly important, and we devote a chapter of the strategy to this precisely. If we take the physical sciences where we know that, especially among girls, for example, there is not the participation that we want to see: we need to encourage that. We are seeing some very encouraging moves in terms of the number of people taking GCSEs in the sciences and then going on to do undergraduate degrees. They have both increased substantially in recent years. The curriculum, as you know, is being reformed to place a greater emphasis on that.

One of the constraints in the past has been the availability of qualified scientific teachers in schools, as the Committee will know. So one of the things that I was particularly pleased that we secured in the science innovation strategy was £67 million, which is a lot of money, to train maths and physics teachers. That will train 17,500. If you think of 17,500 extra maths and physics teachers, the number of children that they will be in contact with, who will pass through their classrooms over the years, that is a big advance. My view is that the more expert you are in your subject, the more passionate you are likely to be about it and the more infectious that passion will be in communicating itself to your pupils and students, the more that can be taken up. That is an important part of it. I would re-emphasise, again, the postgraduate loan scheme. It is now possible for people without financial means to be able to take a masters degree in a way that it was not before—as it shortly will be.

Q65 David Tredinnick: Are you worried that they will not be able to repay them?

Greg Clark: No. One of the strongest arguments for this is that the financial returns, let alone the personal and cultural benefits, to taking a postgraduate degree are hugely in the interests of the individual and, indeed, the taxpayer. The employment levels are higher and the earnings are higher. It is easily possible to reliably repay it. In some ways, not to have that funding available has cut us off from prosperity, as it does the individuals.

Q66 David Tredinnick: Do you, as an individual, when you are sitting behind your desk, find yourself torn in two directions: that, on the one hand, you are trying to be hands off but, on the other hand, if you don't have some input into the running and assessment of schools and qualifications, you are not really doing your job? How do you manage that?

Greg Clark: You are asking about schools specifically. I work closely with the universities, but they are independent of me. I don't run the universities, but they share the ambition to get more and better qualified people available to recruit. Often, you don't need to be in a position to direct or to command. Where you have a mutual interest, and there is Nicky Morgan and her colleagues in the DFE, in schools and universities, we all have a common interest in making it possible for more people to have the qualifications to enable them to go on to deeper and further study. I find it possible, as reflected in the strategy, to be able to act on that.

Q67 David Tredinnick: We live in a world of apps and social networks. Indeed, this morning, I was handed a card adverting a dry-cleaning app, inviting me to do my dry cleaning—I am sure I do a lot of dry cleaning—online using a new app, which I thought was interesting. How on the pulse are you? We have had other people coming before this Committee who are not necessarily as aware of apps and modern technology as they might be or should be. Do you count yourself as technologically knowledgeable?

Greg Clark: I do. I confess I don't have the dry-cleaning app, but I hope some physical dry cleaning goes on, and it is not cleaned virtually. A good case in point is the London buses app, which is a very useful and important one. I am sure lots of people in this room will use it. To know when the bus is going to turn up is very useful, and it can, cumulatively, reduce congestion because more people can have confidence in getting the bus as they will know when it is going to come. It is very useful. You see it in real time.

Q68 David Tredinnick: Minister, you can stand down. I have one last question for Sir Mark. I understand, Sir Mark, that you have taken over responsibility for the Arts and Humanities Research Council.

Sir Mark Walport: No.

Q69 David Tredinnick: Have you always had it?

Sir Mark Walport: No, I have not. The research councils are part of Research Councils UK, which are part of the knowledge and innovation section of BIS, so I do not have any direct line-managerial responsibility.

Q70 David Tredinnick: Or interest.

Sir Mark Walport: Of course I have an interest. For some time, since I started the job, I have regularly met all of the chief executives, collectively and individually, of all of the research councils.

Q71 David Tredinnick: So you do have influence.

Sir Mark Walport: That is a different question.

Q72 David Tredinnick: That is a separate question.

Sir Mark Walport: My job is to provide advice on the whole spectrum of science, interpreting it in that very broad science. In that sense, interacting with the research councils is extremely important. We do work together closely. It turns on an important part, which was in the triennial review, which is the importance of the interaction of the research councils with Government.

Q73 David Tredinnick: This is my last question. Has anything changed recently in your relationship with the research councils?

Sir Mark Walport: No, I don't think so. The trajectory is getting stronger. As I spend longer working in the role, my relationship with all of the stakeholders is getting stronger, which is, I think, a good thing.

Q74 David Tredinnick: But that is not empire building.

Sir Mark Walport: No, it is not empire building in any sense at all.

Q75 Chair: Just for clarity, Minister, before we finish, in response to your question about numbers of teachers, paragraph 2.9 refers to training up to 17,500 maths and physics teachers. I take that to mean 15,000 being upskilled in post and 2,500 new ones. Is that right?

Greg Clark: I can't remember the breakdown, but I will write to you about that. It is to get 17,500 trained maths and physics teachers.[1]

[1] The witness later clarified that the Chair's quoted figures were correct: upskilling 15,000 teachers and recruiting up to 2,500 extra specialist teachers over 5 years.

Q76 Chair: Finally, while you are here, we are delighted to see that the vacancy for a chief scientist in BIS has been advertised. We welcome that. There is only a fortnight for the advert to run before the closing date. If that fortnight does not get the necessary calibre of candidates, what will you do?

Greg Clark: Perhaps Sir Mark should answer that.

Sir Mark Walport: As you know, I am involved in the appointment of all of the chief scientists. The short answer is that, if we don't have someone of adequate quality, we won't make an appointment and we will go round again. It is worth noting, as I suspect you know, that the DFT chief scientist is actively recruited for at the moment.

Chair: Yes. This advert came across my desk the other day, not that I am applying, I must say, although I fit the bill. Gentlemen, thank you very much for your attendance this morning.