

Public Accounts Committee

Oral evidence: Research and Development Funding Across Government, HC 668

Wednesday 31 January 2018

Ordered by the House of Commons to be published on 31 January 2018.

Watch the meeting

Members present: Sir Geoffrey Clifton-Brown (Chair); Heidi Allen; Martyn Day; Chris Evans; Caroline Flint; Luke Graham; Gillian Keegan; Nigel Mills; Layla Moran; Bridget Phillipson.

Sir Amyas Morse, Comptroller and Auditor General, Adrian Jenner, Director of Parliamentary Relations, National Audit Office, Siân Jones, Director, NAO, and Richard Brown, Treasury Officer of Accounts, HM Treasury, were in attendance.

Questions 1-72

Witnesses

I: Alex Chisholm, Permanent Secretary, Department for Business, Energy & Industrial Strategy, Sir Mark Walport, Chief Executive, UK Research and Innovation, Sir Chris Wormald, Permanent Secretary, Department of Health, and Professor Chris Whitty, Government Chief Scientific Adviser.

Report by the Comptroller and Auditor General

Cross-government funding of research and development (HC 564)

Examination of witnesses

Witnesses: Alex Chisholm, Sir Mark Walport, Sir Chris Wormald and Professor Chris Whitty.

Q1 Chair: Good afternoon, everybody. This is a very popular session. Today we are considering the NAO Report on cross-government funding of research and development. The Government spent £8.75 billion on research and development in 2015. That figure is set to rise. In 2017, in its White Paper on industrial strategy, the Government announced that it would spend an extra £7 billion on research over the five years to 2021-22. It aims to increase the total UK investment in research and development to 2.4% of GDP by 2027. BEIS—the Department for Business, Energy and Industrial Strategy—is responsible for the majority of Government spending on research, but other Government Departments spend around £3 billion, or about a third.

The Government needs a coherent view of the UK's research strengths to make sure that it invests in the right areas. However, areas of national importance, including emerging technologies such as robotics and climate science, lack effective leadership and robust information on funding and infrastructure skills.

This afternoon, we want to get answers from the Government on a number of subjects. For example, how do Government Departments, the new UKRI and the Government's chief scientific adviser work together to improve the co-ordination of research funding? Why has leadership been lacking in important areas such as robotics and climate science? How does UKRI plan to work with other Government Departments to improve information sharing and the quality of evidence to support evaluation and decision making? We will then have a follow-up session on the Treasury note on our recommendations on carbon capture and storage.

We are privileged to have an illustrious cast with us this afternoon—two permanent secretaries, no less, which is an exception to our normal arrangements. From my left, we have Sir Chris Wormald, permanent secretary at the Department of Health, and then Sir Mark Walport, chief executive of UK Research and Innovation—I think this is your first appearance before this Committee.

Sir Mark Walport: It is, yes.

Q2 Chair: You are very welcome. We then have Professor Chris Whitty, the interim Government chief scientific adviser—I think you have probably been before the Committee before.

Professor Chris Whitty: I have.



Q3 Chair: Finally, but by no means least, a regular appearer before the Committee: Alex Chisholm, permanent secretary at BEIS. Welcome to you all.

May I start by asking about funding of UK research? Let's look at the international comparative figures, Mr Chisholm. The EU currently spends 2.3% of its GDP on research, whereas we spend around 1.7% of ours on it. Our aim is to increase that figure to 2.4% by 2027, but the EU aims to increase its research spending to 3% by 2020. Given those international comparators, and given that others spend even more than the UK's aim, is it your view that our spending on R&D in this country is sufficient for our long-term needs?

Alex Chisholm: In short, the answer is no—we don't think we are spending enough at the moment. That is why there is this very settled approach to try to increase that substantially. As you rightly say, it is currently about 1.7% of GDP. In the last two Budgets, the Government announced very substantial increases, notwithstanding plenty of other demands on the public purse. The total increase from those is worth some £7 billion over the five years between now and the '21-22 financial year. As far as we can see, that is the biggest ever increase in public R&D spend in the UK.

We are very set and determined on increasing our R&D spend, because we see it as very important not only for our economic prosperity, industrial strategy and so on, but for dealing with wider social problems, including an ageing population, sustainability and other important things in our society. As you say, the intention is to move towards 2.4%. We will not be there at the end of that period, but we have announced that we will describe our overall route to get to 2.4% over the next year.

The other point I would emphasise is that that is public R&D. Obviously, overall R&D and the amount that business and private sector institutions invest matters even more. So, to try to stimulate that further, we also announced at the time of the Budget last November that we would increase R&D tax credits by a further one percentage point, from 11% to 12%, for the larger types of R&D expenditure. That is making our tax regime even more conducive to private sector investment in R&D.

Q4 Chair: Just as a factual question, the solicitors Bishop Fleming have given us evidence, and they say that current Government spending on R&D tax credits is £2.9 billion. What does your increased percentage take that up to? Do you know that figure?

Alex Chisholm: It depends what the effect is on private sector companies. We do not know exactly what the incentive property will be, and it is also quite hard to estimate because in some cases a private company would have made that investment anyway. We are confident that it will have a stimulating effect; we are also confident that it will make us one of the best countries in the world to make this type of R&D investment, but we cannot compute that precisely for you at this point in time.



Q5 Chair: While the headline figure of an extra £7 billion sounds very large, it takes us to only 2.4%. Whereas the EU's aim is to get to 3% by 2020, ours is to get to 2.4% by 2027. Other countries, such as Israel and China, spend a great deal more than we do on what I call transformational research—in other words, they get things to market as a result of their research better than us. You have answered the headline question of whether we are spending enough—you say we are not—but is our research directed in the most effective way, particularly in terms of transformational research?

Alex Chisholm: Could I invite one of my colleagues to comment on that? We are trying to adjust the balance a little bit more towards the D side of R&D in the context of the overall increases and indeed, as part of that, to increase the amount of translational research.

Chair: This is a critical question.

Professor Chris Whitty: This is a critical question. If this question had been asked two decades ago—or even one decade ago—I think there was a general acceptance that, although the UK was outstanding at basic research and actually very good at some applied research, as you say the translational area was relatively weaker. But, actually, things have moved on a lot in many of the areas we are talking about.

For example, if you take something like the life sciences industry, which is a very important translational industry to the UK, in terms of pounds per spin-out company and pounds per patent, which are good, objective measures of this, the UK is as good as any other country in the world. The only metric where we fall down apparently—this is for artificial reasons—is spin-outs or patents per publication. But the reason that is a false figure, in a sense, as a comparator, is because we have an extraordinarily high conversion rate of money in to good publications out.

If you take the UK's output—for all of us, what we care about essentially is whether we are getting something for this money, rather than just the input figures, though they are important—with 0.9% of the world's population and 2.7% of the world's R&D expenditure, we have over 7% of the world's citations and over 15% of the world's most highly cited papers. Because our conversion of pounds to publications is so high compared to the US, Israel and any of the other countries you have talked about, our spin-outs per paper are lower. But in terms of actual translation, it is now very good. If you talk to industry in the translational space across many industries, they would say, "This is a very different field to what it was 10 years ago."

Q6 Chair: I take what you say, but can I take you to figure 7 in the Report? It shows starkly that, while we are in the middle in terms of experimental development, we are way behind countries like China and Israel. Is there a reason for that?

Professor Chris Whitty: First, there are quite considerable difficulties in comparing what is translational, what is basic and what is applied. That is



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an important caveat. In a sense, the right ratio of those different elements is an art rather than a science.

You can see in this that the UK actually has a very balanced portfolio. Essentially, we have a strong basic science component, a strong translational science component and a strong applied science component. A number of countries are very strong in one but not in the others. We have strength across the field on this.

Clearly, we are a relatively small country, and not every area of science is covered across the whole sweep. In fact, it would be unrealistic, and not very good strategically, for us to try to achieve that. However, in terms of the balance itself, I think most people, including the countries you talked about, look quite enviously at the UK, rather than saying they are doing better than us.

Sir Mark Walport: I think it is also important to make the precise diagnosis. We are actually pretty good at forming spin-out companies, but we are not so good at growing them. That was the reason that the Treasury sponsored the patient capital review, which was led by Damon Buffini. One of the big challenges for the UK is actually growing companies, not having them swallowed too soon.

Q7 **Chair:** While you are responding, Sir Mark, can I ask you about intellectual property and whether your putative body—it will be up and running in April this year—will look at this in particular? It has always been a suspicion of mine that the UK spends a lot of money on R&D, and then other people pinch it, pinch the intellectual property rights and make a profit out of that. Will you have a specific sector in your organisation that looks at intellectual property rights to see whether we are capturing the value, as a Government, as best we should be?

Sir Mark Walport: Yes. We have an important strategy department as part of the formation of UK Research and Innovation. It has quite a lot of analytic power and it will look at that question. Again, the difficulty is of inputs versus outputs. In a way, the question is not of how many patents one has but of whether one exploits them, but we will certainly look at intellectual property as part of our work.

Q8 **Chair:** I know the Chinese, for example, have very good partnership arrangements between the Government and their educational institutions, and they make absolutely certain that they capture the intellectual property rights from that research. It seems to me that some of the research done by our educational institutions is actually just being given away for nothing.

Sir Mark Walport: Yes. I think universities are increasingly conscious of the importance of their intellectual property and do protect it. As I say, the challenge is not so much the protection as the exploitation; starting a company is one thing, but growing it is another.

On the balance between the more fundamental curiosity-driven research and the applied, it is fair to say that a significant fraction of the autumn

statement uplift from 2016 and the announcements this year will be in that translational space. About £1.7 billion has been committed to the industrial strategy challenge fund, and there is also the Catapult network. There is a lot of activity.

We were set up, in many ways, to tackle this problem; it is not an accident that Innovate UK is part of UK Research and Innovation. The research councils and Research England already have an important knowledge exchange function.

- Q9 **Caroline Flint:** I have two questions. In 2015, something like 27% of the contribution to R&D came from Government spend, not from other sectors. In the same year, half of UK investment in R&D was from UK businesses. Is that healthy or not, and how does it compare to other countries that spend more of their GDP on R&D? What is the right balance between Government and private investment?

Professor Chris Whitty: There isn't a right answer is the answer to that.

- Q10 **Caroline Flint:** How does it compare to, say, Germany, Professor Whitty?

Sir Mark Walport: In Germany—

Caroline Flint: Or Sir Mark.

Sir Mark Walport: I am sorry; I just happened to have the table open in front of me. In Germany—these are 2015 figures—the total gross spend on R&D was 2.93%, of which business was 2%, higher education 0.5% and Government 0.4%.

Caroline Flint: So significantly higher from business, then. My question to Mr Chisolm, the Business Department permanent secretary, is why are British businesses not investing more in R&D?

Alex Chisolm: They do invest a great deal—

- Q11 **Caroline Flint:** But not as much as other places.

Alex Chisholm: We certainly want to increase the level, and that was one of the reasons why we are trying to improve the tax credit. I think probably there are some differences between the UK and Germany in terms of the shape of our economy and, obviously, as you know, the proportion taken by manufacturing particularly, in Germany compared to the UK; so service industries probably do systematically invest a bit less in R&D than manufacturing businesses. That accounts for some of the difference, I would expect.

I think, also, it is a long debate we have often had with parliamentarians about the balance of short-termism and long-termism in capital markets, and the extent to which there are strong incentives for UK companies to invest long-term. As Sir Mark mentioned, the patient capital review is designed to try to strengthen the mechanisms to encourage that long-term investment focus.

- Q12 **Caroline Flint:** On page 21 of the Report, paragraph 1.9 says that £4.7



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billion will be committed to R&D and, added on top to that, from the Government industrial strategy that was published, an extra £2.3 billion, bringing us up to around £7 billion. However, on page 8, paragraph 14, there is a net loss of around half a billion euros net investment from the EU, potentially, as we leave. Will the Government add a further half a billion euros a year on top of the £7 billion to our R&D funding?

Alex Chisholm: That very much depends on what the outcome of the EU negotiations is. I think you will have seen that last September the Government published a paper expressing its ambition for a very broad science and innovation collaboration, both to continue within Horizon 2020, but also the possibility of continuing into the successor programme, which is FP9. You will also have seen that, at the time of the December joint statement, both the EU and the UK reaffirmed that commitment, both to Horizon 2020 now and to the possibility of continuing thereafter. So clearly it depends on what the outcome is. If we found that we were not going to be participating in those schemes there would be, obviously, a need for the UK Government to address some of the funding shortfall.

Q13 **Chair:** That brings me very neatly on to the whole area of leaving the EU and research. Which areas of research could be most affected by the UK leaving the EU?

Alex Chisholm: We published some information in November, on the gov.uk website, which listed all the main institutions, and how much money they currently receive under Horizon 2020. That shows, at the level of universities, how much money they receive. For example, in order: Oxford, Cambridge, UCL, Imperial College, Edinburgh, Manchester and so on was published on 28 November. We also, at that time, showed the regional distribution, which is important. It shows that as you would expect to be most likely London and the south-east receive about 40%.

In terms of the particular subjects that are affected, in absolute terms it is the sciences—largely physics, chemistry and medicine. As a proportion of their overall funding the research that I have seen, including a very good report published by the national academies in May last year, showed that actually it was archaeology, classics and IT.

Q14 **Chair:** There is clearly synergy with collaborative research with the EU, particularly through Horizon 2020, so how are you going to make sure that the benefits of that collaborative research continue when we leave the EU? In particular, how are you going to stop the brain drain of our best scientists going to the EU, where there is a bigger critical mass?

Alex Chisholm: I will start, and my colleagues may want to chip in. First of all, you are absolutely right that the international nature of the collaboration is tremendously important. It has become more important over time and there are lots of studies that show that internationally collaborative research is more impactful than things done on a narrow national basis. We absolutely agree to that. Obviously, that has increased the amount to which UK institutions work with other ones in Europe, but also beyond Europe as well. It is a two-way benefit. I was very struck, going around Germany in October, talking to some people both in



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Government and industry there, and in research establishments. They were saying that they were very considerably perturbed by the thought that the UK would be leaving Horizon 2020 because the UK is the No. 1 partner for Germany in Horizon 2020, as Germany is for the UK. The only other country that compares with both Germany and the UK is the US, so there is a great deal of mutual benefit. That is why, as you have heard from almost everybody on this topic, not just academics and people behind the scenes—Barnier most recently spoke publicly about this—there is great mutual advantage in being able to continue with this co-operation of science and innovation.

- Q15 Chair:** Without wishing to prejudice anywhere where the UK Government might be entering negotiations, is it conceivable that we would continue to pay into Horizon 2020 for the benefit of being able to continue with this collaborative research?

Alex Chisholm: Yes, indeed. That is what is foreseen for Horizon 2020. What remains to be determined is what happens for the programme that follows, which is currently called framework programme 9, but that will have a catchy title sometime soon.

- Q16 Heidi Allen:** I represent South Cambridgeshire, which is home to a lot of this, which is why I picked it. It's fantastic. I was at an event at the Cavendish lab last week or the week before, and what struck me was how, from the initial panic after the referendum result to where we are now, the language has changed and people are not really talking about the funding. They kind of know funding will follow the brains. What they are really worried about is the people aspect and that people are taking other assignments. There is the issue about feeling welcome here. It slightly concerned me, Alex, that you did not mention that in your opening statement. I am interested in your views on the people and how we are going to stop that.

Secondly, this leads on to the fact that you did not mention in your opening statement. I am looking at you three gentlemen, Sir Mark, Chris and Alex. Who has the control and leadership over science? We have a lot of boards and a lot of funding pots. Some areas of R&D are very mature, not least helped by the lobbying of companies such as AstraZeneca and Glaxo. I'm thinking of pharmaceuticals and health R&D. Other areas that are seen as key pillars in the industrial strategy like AI seemingly are not to get a look-in in terms of organisation. So where does the leadership lie and what are you going to do about the people?

Professor Chris Whitty: Shall I have the first go? I am sure Sir Mark will want to add to this. On the first point about why we want to collaborate with our colleagues in Europe, at the moment we clearly do so through the mechanisms of the EU, but if you look forward 10 years we—the whole scientific community—will still be collaborating very strongly with Europe just as we collaborate strongly with many other continents. I have spent most of my research career in Africa and Asia and in collaborating with colleagues from the USA, who clearly are not part of the EU system. If you project forward, after a period of uncertainty, which I will come back to,



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we will be collaborating just as closely probably in 10 years' time because it is mutually in the interests of the UK and of European scientists to do this. This is very good for science across whole areas.

In the short to medium term, there clearly are uncertainties. As you imply, the two big ones are around funding, which is relatively discrete and we can identify reasonably clearly, and around the exchange of people between the UK and our European neighbours.

Q17 Heidi Allen: With brains like that they can work anywhere they like.

Professor Chris Whitty: That's right. In the long run they will go to where the science is, and the UK is in most fields—not every field—the strongest scientific country in Europe. Good scientists will still want to come to the UK and good UK scientists will want to go to German, Italian, French and Spanish institutions to collaborate after Brexit. The mechanisms will change. In a sense, the degree to which there is turbulence will depend on how close we end up to the current mechanism, because it will take us a while to recover to an exact equilibrium, but I am very confident—this Committee should be very confident—that, in the medium to long term, the UK will be really strongly embedded in Europe, because it is in our interests to do so.

Q18 Heidi Allen: It is the human response to the referendum that is the short-term problem.

Professor Chris Whitty: I fully understand that.

Q19 Heidi Allen: If the brains go, the other brains will go where they have gone.

Professor Chris Whitty: Your second point was about co-ordination. Mark, do you want to come in on this?

Sir Mark Walport: The first thing to say is that you are absolutely right that if you go to the best laboratories everywhere in the world one of the characteristics is that they have people in them—talent—from all over the world. That international nature of science is crucial to research in general. The second thing, to pick up on a point made by the permanent secretary Alex Chisholm, is that—I was recently in Germany as well—our number one international collaborator in both cases is the United States. Researchers collaborate with the best scientists everywhere in the world and they will find ways of doing it. One of the jobs of UK Research and Innovation is to promote talent. As part of the uplift in funding that was announced from the statement of 2016, we have a fund of £600 million for talent. That is very important. We also have £100 million identified for international partnerships. While there is no question that the Horizon 2020 programme is extremely important—everyone will know from the response of the research community that it is important to them—it is only one of the multilateral mechanisms for collaboration. We need to make absolutely sure that the UK is a place where the best researchers will come, and we will only do that if we maintain the quality of research

infrastructure and laboratories. That is a significant role for UK Research and Innovation.

Alex Chisholm: I will add one point on the human dimension. This is outside my Department's responsibility, but the statements made by the Government and the Home Office at the end of last year that people who have been living here for, I think, five years would be able to move to a registration system and then have a right of residency made permanent over that time were reassuring for a number of the European academics living and working here. Obviously, what matters even more is the long-term plan. The Migration Advisory Committee has been gathering a lot of evidence on that from lots of people, including from the academic community, so when it gives its advice to the Home Secretary over the course of the summer that will be another important moment to give people long-term clarity about how they stand.

- Q20 **Heidi Allen:** It is just the short-term brain drain, isn't it? While this is all marvellous work that is going on, it is how people feel in the meantime. Can I go back to the leadership question? I am still not clear who is going to be in charge of spending and where—

Professor Chris Whitty: Can I just clarify, is this leadership around Brexit or leadership more widely around science?

- Q21 **Heidi Allen:** Widely, across the R&D piece generally.

Professor Chris Whitty: Mark, you go first.

Sir Mark Walport: The short answer is that leadership for the whole of research and innovation should not be vested in any single individual. It is about how a group of organisations work together most effectively. That, in a sense, is what the NAO Report was about. It is clear that UK Research and Innovation, the custodian on behalf of the taxpayer of a very large amount of public funding, has an important leadership and co-ordination role. Going back to the report of Sir Paul Nurse and indeed the report on the machinery of Government by Viscount Haldane in 1918, a key customer for that is Government and policy. An important part of our role is to talk to Government Departments both directly and through the chief scientific adviser, Chris Whitty.

- Q22 **Heidi Allen:** That is our question. Is it you, Mr Chisholm, you, Professor Whitty, or you, Sir Mark?

Sir Mark Walport: It's us working together, at the end of the day. We cannot either of us do it individually. One of the key things, and one of the great advantages over the last few years, is that Departments are now starting to set out the research questions that matter for them. At the end of the day, research and innovation is all about addressing questions. We now have statements of research interest from nine Government Departments and the Food Standards Agency. Our job is to work with Government Departments, through the Government chief scientific adviser and directly, to address the questions that are important for them and the taxpayer.



Q23 Heidi Allen: I suppose part of the reason I ask is that in the analysis done by the NAO, which as you will know looked at six particular areas of R&D, without doubt Health outshone any other Department in the relationship with R&D and the feedback loop of whether investment is working and producing results. Is that a leadership thing? How will you two gentlemen address that? Is there anything you would like to add, Chris, in terms of—

Chair: I was going to say, shall we bring in Chris Wormald?

Sir Chris Wormald: The first thing to say is that that situation has nothing to do with me. It was something I was delighted to inherit when I became Permanent Secretary. My one contribution is probably to have not messed it up over the past two years. Professor Whitty, who is also the chief scientific adviser for the Department of Health and Social Care, and Dame Sally Davies, the chief medical officer, have given considerable leadership in that area, as has Mark in previous roles.

The key thing, which I thought came very clearly out of the NAO Report, is having clear leadership within Government for the Government bits. The three people I have named are very important, but that is different from leadership of research as a whole. Health, as I look at it, has benefited hugely from the fact that it has a strong research council and strong departmental influence, led by Chris and others, a very strong private sector, which you mentioned before, and a strong NGO sector, with Wellcome and Cancer Research UK and so on. In this area, there is a massive boost from a multiplicity of leadership. You then need—this came out of the National Audit Office very clearly and is a role for Government—a clear framework for those people to work together, which is not about one dominating the other or telling them what to do. Look at what the NAO said about the OSCHR committee and the other things that we do. Those are partnerships of equals, where people come together, look at the evidence and take collective decisions. That seems to be where research works best.

Your leadership question has to be addressed those sorts of levels. Clear Government leadership for their bids is very important. We at the Department think that we lead that in health research, but that is not the same as a giant top-down strategy about who does what. We actually benefit from the thousand—

Q24 Heidi Allen: It is just about how we replicate the success in health in other areas.

Sir Chris Wormald: The other thing I would say before Chris comes in is that we have been at it for a very long time. It is a very hard-won position in health, starting with the great transformation of research in health in the 1970s.

In co-ordination, things have also taken a long time to build up, so there is not a quick fix. We think that some things can be replicated out of the health experience, but it is not a case of saying, "This is what health does. Let's drop that on every other sector". They do not have that history, nor

do they have the non-Government bits: not just what I have described but the Royal Colleges, *The BMJ* and *The Lancet*. The huge research community that we work with cannot be replicated overnight—that takes decades and in some cases hundreds of years.

Professor Chris Whitty: I completely agree with the points that Sir Chris makes. I chair the UKCRC, which is one of the co-ordination mechanisms in here. The OSCHR board is answerable to me and the DG in BEIS and I am in charge of the NIHR, so I fully understand the health system. It has many built-in advantages. In addition to the ones that Sir Chris talked about, which have been there for a long time, there is a reasonable degree of strength from multiple different bits of the system. There is no real disparity between the NIHR, MRC and Wellcome, for example, and generally there is a single community: you have the NHS, the patients and the UK public; it is clear in a sense who the customers are.

Moving into some of the other fields, I chair the Energy Innovation Board, and Sir Mark chaired it when he was Chief Scientific Adviser. We would both agree that that is heading very much more towards the place where health is at the moment, but unsurprisingly, because it has only been in place for just over two years, it has not got to the same stage of maturity as the health field.

The direction of travel clearly is a very good one, but you cannot expect things to arise from a standing start in these kinds of areas. For example, the last Energy Innovation Board, which I thought was very successful, had all the relevant Departments and all the relevant research councils, and the Minister of State came to give some political direction. We had leadership in that area, which I think you would not have had two years ago.

I want to be clear that the Government recognise all the points made in the NAO Report—the ones that say that things are going well and the ones that say either “in development” such as in energy, or that we need to get a bit further in some other areas. We are not disputing any of the points; we are trying to address them as they come along.

Q25 **Heidi Allen:** I suppose the question is how will we recognise different maturities, for example, and how will we change that as swiftly as we can.

Sir Mark Walport: If I may give a perspective on this, health is in a rather different position, simply because of the scale of health support—the NIHR, the charitable sector—

Heidi Allen: Global collaboration is welcome.

Sir Mark Walport: Indeed. Coming to the National Audit Office Report, leadership co-ordination clearly is critical. I do not think that the model is one size fits all. We have not mentioned so far the animal and plant health partnership. That was created very much along the lines of the OSCHR model, with an independent chair. In other areas, such as robotics, which was criticised, there is a special interest group that has been very



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effective, which published a strategy in 2014, and the EPSRC responded to that. We have an industrial strategy challenge in that area. There are a number of different models for that, some of which are more bottom-up, and some of which are fairly top-down. If you look at the scale of the research and innovation cake, you can cut that pie into many pieces. It is important that UK Research and Innovation is catalytic, and one of the ways in which we can be catalytic with taxpayers' funds is to ensure that there is leadership and co-ordination.

You mentioned AI and machine learning, which of course is one of the four grand challenges in the industrial strategy. It is of enormous importance. The creation of the Alan Turing Institute is an opportunity to focus, and will provide leadership and co-ordination. One of the big challenges for material science, which again was mentioned and criticised in the National Audit Office Report, is that materials are literally life, the universe and everything, so their scope is absolutely gigantic.

- Q26 **Chair:** Can I challenge some of that? The two professionals in the middle—Professor Chris Whitty and Sir Mark—are putting a very good gloss on this, but in advanced materials, if I can take you to paragraph 2.12 on page 29, you had a leadership council, which was shared by the Minister of State for Universities and a representative from industry. It was dissolved in 2016 and reconvened on a trial period in 2017, and the Report says: "but it did not produce a detailed strategy for growing capability." That is in advanced materials. Surely some of the leadership in some areas is not as rosy and as glowing as you both make out.

I suppose the essence of this question is this. Sir Chris Wormald's Department has ownership of health research. It is all directed towards his Department. In things such as advanced materials and robotics, which cross Government Departments, where there is no good reason to learn best practice from what is happening in health, your new putative organisations, Mark, should look at best practice in health and try to replicate it across some other areas.

Sir Mark Walport: Chairman, I agree with that. The Advanced Materials Leadership Council is active in its new form—I have the minutes of its September meeting—and it is working on a landscape review at the moment. It has not actually disappeared; it has been reformatted. I was involved in the precursor to it, and one of the challenges is that the breadth of the area is so large that it probably had a bit too much push and not enough industrial pull.

- Q27 **Chair:** The proof of the pudding is in the eating, Sir Mark. It was re-established for a provisional period of one year from June 2017. We are almost half way through that period. Do you envisage that it will continue after June 2018?

Sir Mark Walport: I do not know the answer to that. It will depend, to some extent, on what the landscape review recommends. I would go back to the fact that it is not that there has not been any activity there. During the work that constituted the Henry Royce Institute, which is a materials institute built in Manchester, there was a seminar in No. 11, and industry



came along to that and said that one of the things it wanted was a focal point for industry interaction with the materials community. One of the functions of the Henry Royce Institute is to do that.

- Q28 **Chair:** Can I press you a bit more, Sir Mark? On the issue of cutting across Government, which is really why your organisation has been set up, it seems from the health model—I might ask Sir Chris Wormald this question—that everything stems from good leadership, including the right priorities, outcomes and skills. All of those things are critical for success in research. We have an exemplar in health. Your organisation has the opportunity to take that across Government and learn best practice. Is that what you intend to do?

Sir Mark Walport: We absolutely intend to focus on the point you just made, which is the importance of leadership. It does not matter whether it is a small research programme, a large research programme, a catapult or an institute. Things go up and down on my mental risk register, as it were, on the basis of leadership, so leadership is important. There is not a single, one-size-fits-all model for how we co-ordinate the format of that, but your leadership point is absolutely correct.

- Q29 **Heidi Allen:** We have touched on this a bit already, but I would like to understand a bit more about how you, BEIS or wherever it will come from will prioritise the type of R&D. It is clear that there are different departmental priorities. What struck me in the industrial White Paper is that there was a lot of talk about the return, and the value of R&D and its industrial application. The Genome Campus is in my constituency and a long time ago we might have asked, “Why on earth do you want to decode a genome?”, but now we realise that it will unlock pretty much every health conundrum we have. How do we draw the balance and who makes the decision on blue sky R&D, as it were, and something that we know will have an immediate industrial application and is therefore revenue generating? Where does the balance lie?

Sir Mark Walport: If you take the history of the genome, which I think is a good example, the initial push to sequence the human genome came from the most basic science research community. Leading scientists in the Laboratory of Molecular Biology talked to Government and the Wellcome Trust and said, “The time is now ripe to do this”, because although it was there, it was an intractable problem. So the push came from the research community. But allied to that is the pull question as to what you can do when you have genomes. I think that there has been a very long debate as to whether research and innovation is all about push from the bottom up, or pull from industry. The answer is that it is a mixture of both.

One of the important jobs—I will hand over to Chris in a second—is the role of horizon scanning. That is an important function that Government offer for science, so looking and seeing what is important and is out there. For example, Lord Willetts did work when he was Minister for Science on the eight great technologies, identifying what was important—data science and artificial intelligence.



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The other, frankly, is just making sure that, when the smartest scientist researchers come up with the most interesting ideas, there is money available to support them—

Q30 **Heidi Allen:** But practically how do we do that?

Sir Mark Walport: That is through a mixture of the programmes that we have, so UK Research and Innovation and the Research Council have programmes that are designed, first, to support the brightest minds—to provide PhD support, fellowship support—and talented people who are asking interesting research questions, where the question is interesting but the implications of what is discovered may not be known.

Professor Chris Whitty: May I just build on that? I obviously completely agree with what Sir Mark has just said. There is an area of science where the right thing is just to spot the best and to fund it. That is generally speaking in the basic sciences. Fields take on a momentum of their own at particular moments in time—you have mentioned genomics, and another example picked up in the industrial strategy is artificial intelligence. This science's time has come.

But if you just do that, you end up with some areas that get better and better, while other areas alongside them—let's say in health and take some examples of where health has not got it right. I come from that field and I do not want it to be seen as an exemplar of somewhere everything goes right. We have not got it right, for example, in mental health research. A very powerful speech in the House of Lords from Lady Tessa Jowell about brain cancer research demonstrates another area where things have not gone as well.

This is where Government do have responsibility, as UKRI does, to say, "Let us look at what could be done with science. Where is it going well? In which case, let's just stand back and fund. And where is it not going well? In which case, we have to ask why not." Sometimes the answer is, "It just needs more money." To be honest, that is rarely true. Usually what it needs is to get people in with new ideas who are then fundable. So you build up the field at a rate at which the field can be built, but if you just leave it to the market of where things are going well, you will be left with these lacunae.

Q31 **Chair:** Let me bring Alex Chisholm in, because I can see he is itching to get in, but I would like him to couple whatever he is going to say with how Sir Mark Walport's new organisation UKRI is going to take a holistic look at the search across Government to do precisely the sort of things that you, Professor Whitty, are saying. If we are not putting enough into mental health research, how would your organisation in the future, having taken that holistic view, say, "Actually, we have to devote more of our money towards mental health", and direct that to happen? How will that happen in future?

Alex Chisholm: If I could start, I will then hand over to Mark.



First of all, it is such an important question. One of the ways in which we try to shape the future orientation of research is what we call these grand challenges within the industrial strategy. They have not just been dreamt up by people working in Government. There was a big consultation exercise—2,000 people fed into that. So the four challenges there are AI data, clean growth, ageing and mobility. Each of those reflect things that we think are going to be enormously important to this country for the next 10 or 20 years. That in itself is a way of trying to light up the path and direct research and development activity on both the public and the private side into those very promising avenues.

I want to give an example of what that means in practice. Let us take the future of mobility, which is a very important area. As a consequence, we made a big allocation of funding to the Faraday Institute, at each of the levels we described at the beginning. The Faraday research, led by EPSRC, has had £78 million for fundamental research into battery technology, which is going to be very important. We have also given £88 million to Innovate UK for innovation to help with the translation of that research into business advantage, to help companies here in the UK. Finally, we have given £80 million to the Advanced Propulsion Centre to help with scaling up—for prototypes and pilot production. That gives you one illustration of where we have chosen an area—in this case, mobility—and given funds at each of those different levels of research to help with that activity and try to move it out of the laboratory into people's hands as new products and services. That is how we try to do it.

To come back to the Chair's question—how can UKRI help? Going back—this was before my time—to the thinking that went into the Higher Education and Research Act, the seven research councils had been going for a long time, were performing generally very well and were areas of strength, but nevertheless, once funding was given at the top, it tended to go straight down within each of the silos. One of the two big ideas was that, by putting them together in a single organisation, there would be a much stronger ability to take a strategic overview and say, "Well, actually, what are the gaps and what are the opportunities between them? Where is the case for moving money from one area to the next? What's the future?" Otherwise, they tend to reflect the needs of the past and what has been funded in the past. There is inherently a much more dynamic, forward-looking orientation to this.

Q32 Chair: Sir Mark, do you want to address that?

Sir Mark Walport: Let me pick up that point. The first thing is to reiterate what Alex has just said. The main role of UK Research and Innovation will be strategic. We have our board, which is chaired by Sir John Kingman, but each of the nine councils within UK Research and Innovation will have a council, which will be chosen from the main experts—in engineering and physics in the case of EPSRC, for example—and users, so there will be people from the world of public policy and government, too. We will talk to Government Departments, as we have said, and to industry. We will be producing a strategy during our first year—first a rather high-level

strategy and then a rather deeper strategy, informed by work in each of the councils.

As Chris has already indicated, there are a number of very strategic funds. We have talked about the industrial strategy challenge fund—the two key words of that are “industrial” and “challenge”—and we have the global challenges research fund, which is ODA funding. It is a large amount of money—about £1.5 billion—and precedes the formation of UK Research and Innovation, and it is very much targeted at asking questions around the sustainable development goals. We have the opportunity to create specific programmes where those are appropriate, and we are discussing and developing a business case at the moment—it was announced during Budget week—for a strategic priorities fund within UK Research and Innovation. We will have the tools.

This is about getting a balance. We need to ensure that we can support the most talented innovators and researchers who come up with ideas out of the blue, as opposed to putting everything in such strongly hypothecated funds that we may not get the balance right.

- Q33 **Chair:** I want to bottom this out. How is this going to work in practice? We have two permanent secretaries here, who are going to fight very hard for research resources for their Departments—quite rightly; that is their job—but you have identified a significant area of research in another Department that is underfunded. How, in practice, will the Government make that decision? Who will make that decision? Where will your recommendations go?

Sir Mark Walport: The first answer is that the job of the board is to recommend to BEIS Ministers each year what the distribution of resources should be between the research councils.

- Q34 **Chair:** So it will go to BEIS.

Sir Mark Walport: The Secretary of State for BEIS has the ultimate decision-making power on the division of resources between the nine councils.

Professor Chris Whitty: In UKRI.

Sir Mark Walport: In UKRI. There is then a second question about the scale of the R&D budgets in different Government Departments. We now have statements of research interest, but at the end of the day decisions will have to be made on the balance of funding, and that will need to be done by discussion.

Sir Chris Wormald: To be clear, the first bit—the ministerial decision—has not changed. That is the current situation. It is BEIS Ministers who take an overview. They will of course consult with other interested Ministers, including my Ministers, and so on. That is the decision point for Government. That is where the strategic decision that you were alluding to gets taken.



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The big thing that UKRI adds to that is a proper strategic overview before it goes to Ministers, if you see what I mean. It actually diminishes the amount of—

Sir Mark Walport: It has been done, historically, on allocation.

Sir Chris Wormald: If it all works, it will be less Departments fighting it out in their own interests and more UKRI giving a recommendation of where our money is best spent across the piece. I am sure individual Departments will continue to argue for what they want, but it will be Mark's job to balance those things up.

Professor Chris Whitty: I want to clarify one thing that comes across in the Report but needs to be clear to the Committee. There are Government Departments that have chosen to have a significant research budget of their own: Health, DFID and the MOD, in particular, but there are others. There are other Government Departments that essentially rely almost completely—not completely—on UKRI and its predecessor organisations.

To deal with the second of those, Sir Paul Nurse's report recommended that every Government Department, including those with their own budgets, write an area of research interest statement that says what things they think, in broad terms, need to be done. Clearly, the conversation with a Department that has money to put on the table alongside UKRI may be a different discussion from that with Departments that have not chosen to do that, but those two models exist and they both work in different ways. I do not think anyone would say that one model is necessarily superior to the other, but they are different.

There are also mechanisms to try to keep an eye over the whole. There is obviously the Government Office for Science and the Government chief scientific adviser, which is a role I am doing on an interim basis; Mark did it previously, and Dr Patrick Vallance will take over from April. There is also the Prime Minister's Council for Science and Technology, which has the ability to challenge the Government and say, "As independent, senior people, we actually think you have this balance wrong." They could say that to Sir Mark, to a number of other people, to BEIS, to other Departments or, indeed, directly to the Prime Minister. There are a number of mechanisms within the system to challenge if we end up getting the ratios badly wrong.

Sir Chris Wormald: If I could just add to that, it is not just the money. This goes back to the point Ms Allen raised earlier. In Health, what happens is that we are making explicit decisions about what the Medical Research Council does, which is largely pure research, and what the National Institute for Health Research does, which is largely the deep bit of how you turn that into something. That is an explicit decision about where we put the money. I think it is less about the quantum of the money in each place and more about having more clarity about where the focus is and who is doing what.

Chair: Can I bring Ms Moran in, please?



- Q35 Layla Moran:** Carrying on the theme of leadership and focus, I want to ask particularly about the set-up of the board of UKRI. First, to Mr Chisholm, how did that happen? What decisions were made about the make-up of that board?

Alex Chisholm: There was a need, first, to appoint an acting chief executive and acting chairs. We have subsequently had an open competition for those roles. Over the course of the second half of last year, we also concluded quite a long, drawn-out process of, again, open competitions, with lots of different people applying and lots of evaluation of that. I think you have now had your first two board meetings, Mark. Is that right?

Sir Mark Walport: We have had three now.

Alex Chisholm: Or three.

- Q36 Layla Moran:** And what criteria were they chosen against? Was it directly linked to the industrial strategy or was there a broader set of criteria?

Alex Chisholm: I don't actually have them to hand, but when the posts were advertised those criteria would have been made available.

- Q37 Layla Moran:** But it's not specifically linked to the industrial strategy?

Alex Chisholm: It's not just linked to the industrial strategy. It includes people with some business skills, but also people with strong subject matter expertise—leading academics. It is a very distinguished board, and one that I think brings balance from different communities.

- Q38 Layla Moran:** Well, that is what I want to get to. Six of the 15 have a medical background, yet we don't have any representation of automotive, aerospace, electronics, defence or the manufacturing industry. None of those is currently represented on the board. In your view, Mr Chisholm, is that the right balance, given what we have just said about how important the board is going to be in making recommendations to your Department?

Alex Chisholm: I have spoken to the chair about this. I think his idea about how the board should work is that it is a kind of organic body and they develop a set of relationships and views together. It is not simply one where each member is trying to represent a constituency or community of people. They are people who are outstanding in their own right and not just as representatives of a particular industry, sector or academic discipline. Let's say that you tried to have that. As we know, there are 60 different industry sectors and lots of different and significant academic research backgrounds. There are also different parts of the country. So it would end up like a Parliament if it were truly representative like that. The intention is that it is a board that operates effectively. If there are any areas where, in their first year of running, they say, "Gosh, we feel under-representative in terms of hearing that particular voice"—I have heard not only views similar to your own, but some others questioning whether we have all the expertise necessary—I am sure we shall make additions to the board.



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Sir Mark Walport: May I comment on that? It is important that the board was not selected, as it were, with a view to getting representation from each domain. The domain expertise comes in the nine councils themselves. They are just in the process of being appointed, and there is no shortage of domain expertise, from both academia and industry.

- Q39 **Layla Moran:** Yes, but you will be recommending the way the pot is carved up, so the make-up of the board matters.

Sir Mark Walport: Yes, but it's going to be on the basis of fairly rigorous evidence that we present to a highly challenging board. It is important that it is a proper board that can manage an audit committee, as well as look at the finance. It's like any board: the board members are there not to represent a discipline, but to be board members of the organisation.

- Q40 **Layla Moran:** Indeed, but Mr Chisholm, you feel you have a good enough mechanism to ensure that they are not making—it's a classic case of going with what you know, even if you are looking at other things. Six out of 15 seems to me quite a large chunk coming from just one industry when others are not represented at all. It strikes me as perhaps the wrong balance. I agree with the industry, I have to say.

Alex Chisholm: Just to reiterate what I said, we are very open to seeing whether, in practice, we have all the expertise we need on the board, but it seems to have got off to a promising start. Also, I emphasise again that the people were chosen not because they came from a particular background, but for their personal qualities.

- Q41 **Layla Moran:** I have a follow-up question for you, Mr Chisholm, about the roles of the chief scientific advisers and how they interplay with the chief scientific officer. Do you feel that all chief scientific advisers are equally effective at the moment?

Alex Chisholm: Could I ask the Government's chief scientific—

Layla Moran: Yes, Professor Whitty was also on my list of people to comment on this.

Professor Chris Whitty: First, I think that almost anybody who is a chief scientific adviser in Government has a distinguished track record, either in Government or outside it—usually outside it, although not absolutely all of them. They start off by at least coming in with considerable skills and back-up from the outside community. The chief scientific adviser jobs in different Government Departments are actually set up to do relatively different things and, in some cases, very different things. For example, in Health, where I am substantively the chief scientific adviser, a large portion of what you are doing is running the National Institute for Health Research—NIHR. It is a large amount of money; there is a serious management load. There are other Government Departments where what people want primarily is people who can provide challenge in the system. Both of those are valuable; they are slightly different roles. Some people combine a bit of both—some management and some challenge within the system.



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The key thing is that people are able to listen to evidence and, in the privacy of Government, are prepared to say, "That is simply not based on evidence; what you have said is incorrect," but also are prepared to accept that there is a role for politics and that any decision is a mixture of a technical side, which it is the job of the chief scientific adviser rigorously to defend, even if what is said by her or him is unpopular—but the final decision has to be a political decision, which will then be defended to Parliament. People who can do that clearly and independently tend to do a good job, however it is set up.

- Q42 **Chair:** May I interject here and ask Sir Mark a question about the chief scientific officer? What role will the chief scientific officer and the scientific officers have within your new organisation? If we take the NAO Report, the chief scientific officer went into the MOD and completely refocused their research in a more focused way. What role will they have within your new organisation?

Sir Mark Walport: I was the Government chief scientist responsible for doing the review of the MOD.

Chair: Well, there you are—I knew I was praising you.

Sir Mark Walport: But an important point is that each of the councils will have a chief scientist as an ex-officio member, so there is an absolutely explicit link between the chief scientists network, the seven research councils and Innovate UK. Historically, it has been normal for a member of a research council to be a chief scientist, but this has been made absolutely explicit in our new structure, so that is baked in. There will also be regular meetings between UK Research and Innovation and the Government chief scientific adviser and the network of chief scientists that meets regularly with the chief scientist.

Professor Chris Whitty: As a departmental chief scientific adviser, I have a very, very close dialogue with the relevant research council heads, and I expect that to continue in the new system.

Chair: That is very helpful.

- Q43 **Layla Moran:** Professor Whitty, do you feel there is enough support within the Departments for the work that the chief scientific advisers have to do? It strikes me that it is a huge job.

Professor Chris Whitty: In my experience in the Departments I have been closely involved with, the answer is: there has been a lot of support. Now, there is not much point in having a chief scientific adviser in a Department unless the Department is prepared to support that role and the independence of that role. I have always been very cautious about forcing a Department that is cautious about having a chief scientific adviser to have one until they are ready for it, because all they will do is put them in a room with someone and say, "Think deep thoughts." It is very important that the Department has bought in and people have a serious role, with serious back-up and proper access, where necessary, to



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Ministers and senior officials, as well as independence. Provided that all of those are available, they can work very well.

I meet with all the Government chief scientific advisers at an unearthly hour of the morning every other week, and collectively we can do things for Government which individual chief scientific advisers cannot. You can do things as a group. It is a good network.

- Q44 **Layla Moran:** That is very helpful. Sir Mark, a concern has been raised with me by universities that now the pot, in essence, will be apportioned by UKRI and will then go into the research councils. They used to have several people they could go begging to, if you like, when they had a bright idea that might be a bit crazy. You mentioned earlier supporting the brightest minds and—these are my words—the maddest ideas, because sometimes they lead to amazing things. But universities are worried that if there is this one behemoth organisation, that raises the risk to their research projects, because it will be either a yes or a no, and then there is no one else to go to. Are you aware of those concerns? What would you say to address them?

Sir Mark Walport: I am spending a lot of time in universities—in fact, I am going straight from here to St Andrews University and Dundee, which I am visiting tonight and tomorrow. The first thing to say is that we are preserving that structure of the seven research councils and Innovate UK, so universities will still be going to the research councils. But actually, one of the big challenges they face is that there are increasingly commonly circumstances where they want to do interdisciplinary research, and that has been much harder, because they have been separate legal organisations. At a time when research is not siloed into the traditional disciplines nearly so much, one of the things we need to do is to lower the energy for them to be able to get interdisciplinary research.

I think our job is to simplify access and to provide the catalysis to enable the most talented people to do the research and innovation, whatever it is. To be honest, that is not the perception I get from most universities, and I spend a lot of time in them.

- Q45 **Layla Moran:** That is interesting. I have been lobbied very hard on it. Have you heard that concern? That was my question.

Sir Mark Walport: I have heard that concern. I think it was a concern that was expressed more before UK Research and Innovation was starting to get going, actually.

- Q46 **Chair:** It may be useful for the two of you to have a dialogue or correspondence about this, because there is clearly a concern, and it might be useful for you, Sir Mark, to know of that concern. If the institution would be prepared to let you have that concern, you could probably answer it.

Sir Mark Walport: Of course.

Chair: So would you like to continue that offline?



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Layla Moran: Absolutely.

- Q47 **Caroline Flint:** At the top of the session, we talked about the amount we spend on R&D; I think we are in about 10th or 11th place among the 28 members of the EU. Clearly, we also have a productivity gap. Could I ask each of you: quickly, off the top of your head, which is the worst sector in applying research and innovation? Sir Chris?

Sir Chris Wormald: I am not sure I can comment.

- Q48 **Caroline Flint:** Why not? You were in other Government Departments before. Which is the worst sector?

Sir Chris Wormald: They are very, very different. As I said, health is in a completely different place to many other Departments—

- Q49 **Caroline Flint:** Well, you have got the care sector. “C” has been added to your Department.

Sir Chris Wormald: Yes, clearly, and I think Chris Whitty has said it already—

- Q50 **Caroline Flint:** So you don’t know the answer, or you haven’t got a view on which is the worst sector?

Sir Chris Wormald: Sorry—across Government, no, I couldn’t say. Within health, and Chris Whitty has already said a bit about this, the traditional hard bits of medicine have clearly got a lot more research than the—

- Q51 **Caroline Flint:** Okay. Shall we move along to Sir Mark, because I don’t think we got answers? Sir Mark, which is the worst sector in research and innovation?

Sir Mark Walport: I am going to answer your question in two parts. One of the big challenges for the UK is that if you look at every single industrial sector, the gap between the most productive companies and the least productive companies is greater than in every other OECD country. So, simply saying, “Well, it’s this sector”, or “that sector”—one of the big problems we have is diffusion. The point about R&D is that if you look at the most R&D-intensive sectors in the UK, which would be pharma, aerospace, defence, automotive, the companies there invest with the same intensity of R&D as any company in the world.

- Q52 **Caroline Flint:** Okay. So you can’t tell me which you think is the worst sector?

Sir Mark Walport: I think the sector with the least R&D explicitly set out is broadly the service sector, but that covers a variety of sins and within that the finance sector is probably quite advanced on R&D.

Professor Chris Whitty: I think there are two elements to this, obviously. There is the production of research, so there is actually good research to transmit, and there is receptivity to that research, which in a sense is separate. Now, in general they tend to go together, but they don’t completely.



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I do have a kind of batting order of which sectors are historically strongest, and then there are some that are in very rapid transition. So, for example, education, which used to be really quite weak on research, is now massively better than it was.

In general, I would say that the areas—

Q53 Caroline Flint: My question was about which is the worst. So, if you could—

Sir Chris Wormald: That is what I am coming on to. In general, the areas where I think there is the biggest gap between where we could be and where we are at the moment tend to be in areas where the social sciences and political sciences could have a huge contribution.

I think that is for a variety of reasons, including that the volume of research is historically much less than it should be and that some of the research is inevitably more contestable. It is much easier to do a randomised trial with quantitative outcomes than something that actually has got these more qualitative outcomes, but many of the key policy questions around, for example, policing behaviours and a variety of different areas—you mentioned social care—require behavioural changes.

In my view, if there was one very broad area of science I would like to strengthen for the public good, it would be in the social and political sciences, because so much of the gap between what we could do and what we are doing now is in those areas.

Q54 Chair: Can I interject here and try a specific one, in addition to Ms Flint's question? Paragraph 2.16 of the Report says, "In 2017, the Committee on Climate Change identified areas of climate change risk where coordinated action is needed". It goes on to say that there is "the absence of routine data collection to assess if policies are meeting their goals." It further goes on to say that "along with government departments and the new UKRI, to inform policy on adaptation to climate change."

Is this an area where we are lacking in co-ordination and where Sir Mark's new organisation—overall co-ordination across Government Departments—could actually be of considerable assistance?

Professor Chris Whitty: I will give a view from Government and then Sir Mark will want to come in on that. On adaptation, I go back to my previous answer. If you look at the bits of adaptation that are around technical answers—for example, drought-resistant crops or flood-resistant rice: fantastic advances. The climate science of climate change: substantial improvements. Weather forecasting, medium to long term, is still weak but getting a lot stronger, and the climate models are really a lot stronger. That side of the science is developing very rapidly.

The bit that is much less rapidly developing is around the behavioural science of this and how people are going to adapt their behaviours, both to mitigate and to respond. That is because the field as a whole is less strong than in the more sort of fundamental sciences, where we have been able to do it on the back of very strong existing agricultural or climate science.



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- Q55 **Caroline Flint:** Can I just put my question to Alex Chisholm as well, because I think that has been lost and he is the Business Department?

Alex Chisholm: I will approach it more from a business and economic perspective, because you asked about productivity. First of all, if you look for those sectors of the economy that you asked about—you asked which are the top and which are the bottom. The top ones for labour productivity are things like financial services, oil and gas and aerospace, and the bottom ones are things like construction, public administration and social care.

Quite often, when people look at productivity, what they are really interested in is not just the level at a particular point in time, but the change over time. It is interesting that one of the problems that the UK has experienced, and a reason for our low productivity growth for the past few years, is that two of our biggest sectors are financial services and oil and gas. Because financial services have been de-leveraging, and oil and gas prices have been falling, our productivity in those huge sectors, which are very important to the UK, has not been growing at the rate it did for the previous decade.

- Q56 **Caroline Flint:** If I may suggest so, Mr Chisholm, there might also be an over-reliance on those sectors, so that when their productivity has fallen, other sectors have not been driven up to compensate for it. In other sectors such as agriculture, perhaps technology and robotics have not been used so much, because there is a reliance on migrant labour.

Alex Chisholm: We absolutely agree that for future productivity, we want those sectors to be moving in lockstep with the much higher level of research and development and innovation that we think will be necessary. Taking a sector like agriculture, the big future there is probably not in large numbers of people working, but more in things like agri-tech, which will be very important for overall economic value.

Sir Mark Walport: And that is an area that is being considered in the context of the industrial strategy challenge at the moment. As you say, there are potentially big benefits from precision agriculture.

- Q57 **Caroline Flint:** By my calculations, by the end of this Parliament, with all the money going into this area, unless there is a massive upturn in private sector investment around a third of all R&D investment is going to come from Government.

Maybe you can help me with this, Sir Mark: when you are deciding what research, development or innovation to support, how much are you looking at which the weakest sectors are, where the productivity gaps are and, importantly, at the end of a project that has been funded, where the application of that knowledge is? If it is not applied, we are not getting value for money.

Sir Mark Walport: That is absolutely critical. We are absolutely clear that there are three arms to what we do. It is about the generation of knowledge, about making it useful through economic gain, and about



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making it useful through social gain—of course, economic and social gain are related. We are about turning knowledge into utility for all of us.

If I may, I will just come back to the climate question that was raised. On 2 February, the Committee on Climate Change's adaptation sub-committee wrote to Andrew Thompson of the Arts and Humanities Research Council, who has cross-cutting responsibility for this area, and set out a series of questions. That is an example of a committee providing some leadership and identifying the key questions. The Natural Environment Research Council is the research council responsible for this, and there is a lot of activity in response to that.

There is co-ordination. There is a forum called RIDE—Research and Innovation for our Dynamic Environment. I think its name was driven by the acronym rather than anything else, but importantly, it brings together the partners, including DEFRA—the Government Department responsible for the impacts of climate change—and the Environment Agency. There is a co-ordination mechanism through that. Are any of these co-ordination mechanisms perfect? No, and it is very important that we work on that continuously.

I think it is also important to say something else, which may not yet have been said clearly enough: a lot of these issues are global. We need to be globally competitive and take advantage of global expertise. When you come to the primary climate change research, we are part of a global enterprise.

Q58 Heidi Allen: A final question from me, Sir Mark. Your role at UKRI has been in shadow, if you like, and it goes live in a couple of months' time. What are you most nervous about? What is keeping you awake at night? What is the biggest challenge that you think you will have when that job becomes real? It seems to me that this is brilliant, but it is herding cats.

Sir Mark Walport: Getting the plumbing right does keep me awake at night sometimes. The work that is needed to merge eight organisations and create a ninth is keeping me very busy. But the most important thing is making sure that we taxpayers get the most out of the money the taxpayer gives to research and innovation, and that we translate the knowledge for benefit.

Ultimately, that is the important thing that we are there for: we are ultimately there to make sure that we get the outputs and impacts from the input. It comes back to the other two bits of the NAO Report, which are leadership co-ordination, priority-setting and informed decision-making and then evaluating to make sure that the money is spent well.

That does not mean that everything will yield a result, because research, by its nature, is a risky business, and so are innovation and translation. We will fail; if we don't fail from time to time, there is something going wrong. What we have to do is fail well, if I can put it that way.

Heidi Allen: There is no such thing as failure; you just learn.



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Q59 Chair: I have a few quick-fire questions to conclude this session. The first is for you, Sir Chris Wormald. One of the successes in research and development in your Department is the Office for Strategic Coordination of Health Research, which costs a mere £46,000 to run, out of a research budget of some £2 billion. Isn't this a really good example of a cross-cutting organisation that can provide good leadership in a particular sector of research and development at very little cost compared with the overall budget of R&D?

Sir Chris Wormald: Yes. It cost more than that to set it up and get it going; that is what I mean about maturity.

Q60 Chair: Yes, but it got its costs down after that.

Sir Chris Wormald: The important thing to say about OSCHR is that it is a coalition of the willing. In itself, it does not have executive power to do anything; its importance is in getting the right people together, and in what those people do when they leave the room, as opposed to the discussion within the room. That is why it is so low-cost: it is not doing executive things. It is a forum where the right people come together, agree on something and then go do things in their own organisations.

Q61 Chair: Sir Mark, given that example, and given your comments about the plumbing keeping you up at night and Sir Chris's comments about the coalition of the willing, is this the sort of coalition that you think you can build more of?

Sir Mark Walport: Yes. I think that the co-ordination leadership can be done. It is done at marginal cost; that is the point. There are a lot of contributions lying underneath that. An activity that we kicked off last week is a strategic roadmap of the infrastructure needs of research and innovation, very broadly, between now and 2030. We have people volunteering to take part in that, and we are not paying, so we will do this as efficiently and effectively as we possibly can.

Q62 Chair: Can I ask all of you a question about skills? Are our academic institutions in this country producing enough skilled people to undertake the research needed in future? Perhaps I could start with you, Sir Chris, and then move across all of you.

Sir Chris Wormald: I will leave Professor Whitty to comment on medical researchers themselves, but there is a very definite skills question which is wider than that, which is about being good consumers of research. Even within health, which has huge advantages, it is an area where we want to make progress. If I were to pick out an area of challenge in health, it is second adopters of research. We are great at getting first adopters who do something amazing; the question is how it then spreads across the NHS and how people consume it. To be honest, that is the issue I worry about more than—

Q63 Chair: Back to my transformational research question, basically.

Sir Chris Wormald: Well, yes, but it is less about the research and more about the people receiving the research. Again, you mentioned Tessa



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Jowell earlier; this was an issue she raised—people positively seeking out what the world best practice is and implementing it, which is different from the process of creating the research in the first place or implementing it in one place. That is the bit we need to make further progress on.

- Q64 **Chair:** But since leadership in your Department is an exemplar, how are you disseminating this research to the relevant medical experts?

Sir Chris Wormald: That is a core function of NIHR, so I will leave that for Chris, who has much more detailed knowledge.

- Q65 **Chair:** Perhaps Professor Whitty would like to answer.

Professor Chris Whitty: The health sector works because there is a very co-ordinated approach, as we have heard, to training people across the multiple disciplines we need. This is not cheap to do, but you have to do it in a systematic way and spot where the gaps are and then fill them. It takes a while between someone going to university and becoming an independent researcher, so you need to spot the gaps relatively early on.

Overall, the UK system works extremely well, with one important caveat. We get very good academics out of universities, there are very good researchers in the private sector and we get good people into the doctoral system. We get a substantial fall-off in women at postgraduate level—particularly at the stage when they have done a PhD, and sometimes earlier than that—and they tend not to go back into the sciences.

- Q66 **Caroline Flint:** Why do you think that is?

Professor Chris Whitty: I was going to come on to that. This is something that we all think is a very serious issue. I know that UKRI is also taking this very seriously. For example, in NIHR, we only fund institutions if they have an Athena SWAN silver award, which is a way of saying they put a lot of emphasis on getting in women and disadvantaged groups and on keeping them.

What seems to happen is that people leave research when they start families. That happens in other professions. What is different here is that people do not rejoin subsequently. It is that second bit that we really need to look at very seriously, because we clearly cannot have a situation where, in the long run, we are not using the fantastic skills of women and other groups in science.

- Q67 **Chair:** So, Sir Mark: skills.

Sir Mark Walport: The short answer is we can never have enough skills. We are going through an extraordinary industrial revolution at the moment. We need more people with quantitative skills. There is the whole issue of lifelong skills and lifelong learning, and the Government Office for Science has done some foresight work on that. Of course, this is a system-wide problem. It starts in primary education and goes all the way up to retirement.



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It is clear at the moment that, with the enormous focus on technology, jobs are going to change. You cannot open a newspaper without seeing that topic. In a sense, the question is: what are the no-regrets policies that will make sure that people are equipped for a future world where work is uncertain? Of course, part of that is about emotional skills—human skills. In the caring profession, for example, the skills that are needed are the human skills of caring. I do not think robots provide all the answers. There is clearly a strong focus in engineering and information technology. We will work in that area—we have funding for talent—but UK Research and Innovation can only be a part of the answer.

Q68 Chair: Thank you. Anything to add, Mr Chisholm?

Alex Chisholm: Just very briefly. Everybody needs to have good digital skills. That applies right through schools, education and the workforce. Everybody will need to reskill at different points in their lives. Skills cannot be something that you just get as an endowment at one point in your life and live off for the remaining 40, 50 or 60 years; we need to keep topping up.

As my colleagues have said, we need many more people to study STEM subjects. My Department sponsors a network of 30,000 STEM ambassadors that goes around to almost every school in the country to encourage people to take STEM subjects. Even that is not enough: the amount needs to increase very greatly. I would also say that those people who study STEM subjects and become engineers, technologists or scientists need to understand the world of business. They need to understand, as you said, intellectual property and the needs of the economy. That is the sort of vision that we want to see around all this work—around the industrial strategy and the work of UKRI—to make sure it connects up.

Q69 Chair: Time is moving on. I want to ask you and Sir Chris a question. Do you think the civil service recruiting system reflects enough the need for science and STEM subjects? Academic institutions have recognised the need to move away a bit from humanities and towards the sciences. Do you think civil service recruiting is going far enough in that respect?

Alex Chisholm: My impression is that we could probably strengthen that. Speaking for my own Department, which obviously is the one I know best, about four months ago we established a new community for all the scientists working within BEIS. They did not have one before; they were not identified in the way the lawyers or the economists were identified. There are about 100 of them. Bringing them together in one room to see what they have in common and what they are contributing, and really having a focus on that as an area of strength for us as a Department, has been very positive so far.

Professor Chris Whitty: Can I add to that? I am actually head of the science and engineering profession in Government, so I have strong views on this.



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There are around 10,000 members of the science and engineering profession in Government. To be clear, some of the most outstanding scientists in Britain work for the Government. Sometimes they work in policy roles, but very many of them work as scientists in Government or semi-detached Government institutions.

Some of the best science in the world comes out of those institutions—both historically and now. We do have very strong scientists. That said, we could always have more, particularly in the policy area. There is a science and engineering fast stream, which is specifically about taking very bright people with science skills who are relatively recently out of university and putting them into the system. That is one of the ways we can help build this up, but we fully accept the point you are making.

Q70 Chair: I am going to bring in the Comptroller and Auditor General in a second. Sir Chris, do you want to add anything on that?

Sir Chris Wormald: Just on that point, I have another hat: I am head of the policy profession, and I do that work with Chris. We need to do three things: we need more scientists coming in as scientists; we need more people from a scientific and engineering background coming into policy, so it is not just the home of the humanities, PPE and economics; and then we need everyone in the policy profession to have a better grounding in how you work with scientists, so people who are not specialists are able to draw on scientific expertise. It is about those three things.

Chair: I think my question was probably directed towards policy. I am going to bring in Sir Amyas Morse.

Sir Amyas Morse: I just want to point out some forthcoming attractions. In April, we will be bringing a Report to the Committee on the policy for the development of STEM skills. That is quite à propos, and hopefully we will have a chance to discuss it much more fully then.

Q71 Chair: That is a very helpful piece of information.

The final question is probably for you, Sir Mark, but others may wish to comment on it. There is a comment somewhere towards the back of the Report that, due to a lack of central Government information about what research is being carried out—some of the Departments you referred to, Mr Whitty, don't necessarily have their own research budget—research is overlapping unnecessarily. Is there a need for perhaps the Government Digital Service to produce one source of information that lays down all the research that the Government is doing?

Sir Mark Walport: The first thing to say—I hesitate because capturing the totality of all the research and information would be a monumentally difficult thing to do. We increasingly have bibliographic tools, so I can get access to the research that is funded through the research councils. There is a tool called researchfish, which the Medical Research Council initially developed as a reporting tool.

Part of the need for strategic co-ordination is that, if you don't know what you are funding, you are in trouble. Having Departments working towards



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a statement of their research interests starts to provide an answer to that, and the role of CSAs in individual Government Departments is to have a pretty good idea of the portfolio. For example, in Health, Chris will have a pretty good idea of what is going on in NIHR.

Some duplication is actually a good thing, because there are concerns about the reproducibility of research. It is very rare that you make a policy decision based on a single piece of research; duplication is not in and of itself a bad thing, but if you don't know what you are funding, at the end of the day you don't know what the gaps are.

Sir Chris Wormald: We are not doing exactly what you say. The What Works centres are on this agenda. If you take the Education Endowment Foundation, which has been to this Committee before, its job is to take all education research and distil it in a way that is useful both for Government and the sector. It is not just Government research. Those sorts of translational bodies, which can make research easy to access, are very important. I don't think you could have a central register of all research, for all the reasons that Mark set out. The challenge of your question is the correct one. It is about how you make it accessible to people.

Q72 **Chair:** I think what you are effectively saying, Sir Chris, is that each Department needs to do more to disseminate what research it is doing on its own.

Sir Chris Wormald: Yes, and Sir Mark has already mentioned the statements of research interest, which are one step. As I say, the What Works centres are another. It comes back to the point I made earlier, which is that the Government has two roles in this. It is a player, because we are of course a big funder. Just as importantly—as I said, I had the luck to inherit this in Health—it must create the right framework for research to be done and then to be used. We are possibly further behind on the second bit than on the first, which I think was the point of your question. Yes, every Department should take seriously.

In the policy profession, we are doing a study at the moment of the links between policy and universities—who is working with whom and how we can build better links between the academic world and the policy world. One of the frequent challenges for the policy maker is, "Who do I ring up? Who is the world expert?" If you are lucky enough to have a great chief scientist, you can ask them, but if you are an average policy maker, knowing who to talk to is the single most important thing.

Chair: Can I thank you all very much? You are all very busy people. This afternoon's session has been very informative. It is a huge subject, and I am sure we and our sister Committees will return to it time and time again. I am very grateful to all four of you. Thank you very much indeed.