HOUSE OF COMMONS

Science and Technology Committee

Oral evidence: Reproducibility and research integrity , HC 606

Wednesday 2 February 2022

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Watch the meeting

Members present: Greg Clark (Chair); Aaron Bell; Katherine Fletcher; Rebecca Long Bailey; Carol Monaghan; Graham Stringer; Zarah Sultana.

Questions 207 - 291

Witnesses

I: Professor Dame Ottoline Leyser, Chief Executive, UK Research and Innovation; and James Parry, Chief Executive, UK Research Integrity Office.

II: George Freeman MP, Minister for Science, Research and Innovation.

Examination of witnesses

Witnesses: Professor Dame Ottoline Leyser and James Parry.

Q207 **Chair:** The Science and Technology Committee is continuing its inquiry into reproducibility and research integrity. This morning, on our first panel of witnesses are Professor Dame Ottoline Leyser, chief executive of UK Research and Innovation, and James Parry, chief executive of the UK Research Integrity Office. Thank you very much for joining the Committee today.

I will start with a question to Mr Parry. Your written evidence, for which we are very grateful, stressed that it is very important to have a clearer picture of the overall state of research integrity across all sectors of research. This chimed with an observation that our predecessor Committee made in its 2018 report. What progress, if any, has been made over the last few years on standards and transparency of research integrity?

James Parry: In terms of the national picture, some progress has been made, but we still lack a clear cross-sector picture of the state of research integrity. You have heard evidence from bodies such as Retraction Watch about the number of retractions. That is very accurate data—its database is very good—but it is not data that comes out of UK funders, regulators and research institutions. They have not collected the data themselves.

I think that there is still space for an organisation—perhaps the newly convened Committee on Research Integrity—to gather that clear picture. It is important that the picture reflects not just the realities of research misconduct cases, which are important to track, but the more common and more insidious problems of avoidable human errors, mistakes and perverse incentives within the system.

Your second question was about whether things have improved or stayed the same. I think that there has been improvement on a variety of levels, but there is still a long way to go. There has continued to be growing awareness of the issue. Actions have been taken in response to the Select Committee report that you mentioned. There is a lot of grassroots activity, which is particularly pleasing. That in itself generates a greater desire for cultural change within institutions and within the research community as a whole.

Q208 **Chair:** You referred to the new committee that has been established. Does that mean that the committee is better placed than the Research Integrity Office to make that assessment in future?

James Parry: I think so. UKRIO is a small charity. We have five staff and no regulatory powers. We are advisory only. Some organisations will share with us, either in confidence or openly, the issues and challenges that they have faced, but we cannot compel people. If there was a desire

for us to become a repository for national data, we could do that, but we cannot make it happen ourselves due to our status and size.

In the absence of regulation—I am not saying that regulation is the way forward—I think that funding agencies are best placed to make sure that people are meeting the basic requirements of good research practice and that institutions are making reports on how they are doing, the issues that they are facing and the progress that they have made.

At the moment, that is a fairly fragmentary picture. We have data from the higher education sector because of the public sector funding and the requirements for reporting attached to it. The private sector is a world of its own. There is data in the NHS and the like, but there is no clear national picture. If someone asked, "How many cases of research misconduct does the UK have a year?", there is data I can call upon, but it is patchy and hard to gather. Some joint action by funders, perhaps with easing of bureaucracy and data harmonisation at the same time, could gather that data quite effectively. A free-standing committee, backed by UKRI, as I understand UK CORI will be, could be well placed to do that.

Q209 **Chair:** Dame Ottoline, how well placed is UKRI, as the principal UK research funder, finally to put in place the kind of oversight that Mr Perry mentions?

Professor Leyser: I would like to preface my remarks by echoing some of the things that James said. It is quite a broad issue. With reproducibility, for example, the question is: if you did the same experiment again, would you get the same result? There have always been, and will always be, instances where the answer to that question is no, for extraordinarily good reasons. As James pointed out, there is also human error, which we will never be able to get rid of and needs to be very openly discussed as an element. Then you get into the part of the spectrum that is more about corner-cutting, and then outright fraud.

It is quite a tricky space in which to get the culture right, particularly because we want a really open environment where human error can be talked about, discussed and corrected in a way that does not immediately tip people into anxiety that there is going to be some massive backlash against them because there is an assumption of fraud.

That is a key element that we as a research funder need to support and encourage. We must build a culture where lack of reproducibility is openly discussed and considered, and where robust processes are in place for managing misconduct and fraud, but that part of the system does not overwhelm the important components of creating a really open research culture.

UK CORI is the new committee that we are supporting in its early phases. We will support it for the first three years of its operation. One of the things that it needs to do is to work out what measures of the scale of

the problem across the spectrum we can bring together and what measures are needed to address the issues across the spectrum.

In terms of international good practice, the investigative and regulatory element is generally the business of a separate, specific, completely independent body. For example, UKRI not only funds a huge amount of research but runs research institutes that conduct an extraordinary amount of research. It would be better, in the context of supporting research integrity in those institutes, if the investigatory and regulatory powers were outside our walls.

None the less—to go back your original question—we have a key role, of course, in ensuring that the organisations that we fund have in place really robust systems for supporting high-quality research, with high integrity, and for investigating situations where that breaks down, and that that is embedded both in our terms and conditions for grant awards and in the assurance processes that we put in place to check that those terms and conditions are being met by the organisations that we fund. Since the 2018 Committee reported, we have spent some time ensuring that we have that robust assurance system.

Q210 **Chair:** Before I come to my colleagues, starting with Aaron Bell and Graham Stringer, may I ask you to draw on your own experience? As a career researcher of some brilliance, you have obviously been part of the system and the debate that has taken place about research integrity. Are you able to form a view on whether things have got better or worse over the last couple of decades, or is it impossible to discern?

Professor Leyser: It is a really interesting question. The data about the extent to which it is better, worse or the same are not as robust as they need to be, so we cannot say very clearly whether there are more or fewer issues. The thing that brought me into this area in the first place quite a number of years ago was the data that we do have, which come from things like surveys, where researchers are asked whether they have ever been tempted to compromise the quality of their results or whether they know of cases involving other people with whom they are working. We get quite concerning figures from those surveys about the number of people who feel under pressure to produce a particular sort of result, for example.

That is part of a broader question of excessive pressure and stress in the research base. It is absolutely fundamental that we address that to maintain the incredibly high-quality research that we have in the UK and its excitement and dynamism, which keep the really creative people in that system. People want to work in a system where they feel that they are able to do really high-quality work and to make the breakthrough discoveries of the future. At the moment, our system is rewarding and incentivising too narrow a range of activities to support a high-integrity environment where people want to work. I am absolutely committed to changing that through UKRI.

Q211 **Chair:** Do you have time series on the concerning findings you have talked about? Do they seem to be getting worse, or are they a snapshot only?

Professor Leyser: I would say that we do not have a good time series. There are a number of different surveys, conducted by a number of different organisations, over a period of time. Because they are different, it is quite difficult to compare. There is also quite a lot of variation between disciplines and the research culture in different disciplines is different, so it is difficult to draw an overall, broad picture. It is very clear that the degree of pressure researchers feel under has increased. There is quite a lot of work and discussion about the so-called hypercompetitive environment in research.

Q212 **Chair:** Which are the disciplines where that is most prevalent?

Professor Leyser: There are areas of biomedical research, in particular, that are hugely competitive. They are big communities as well. Inside the discovery research base in academia, for example, the career pyramid is particularly broad at the bottom and small at the top, so it is very competitive to move through the system. The criteria that have been developed to try to make that a level playing field process are, frankly, too narrow. They are the sorts of things that you can see very easily—for example, "Have you published in a particular high-profile journal? Have you attracted a particularly large amount of grant funding?" If those are the things that you are assessing, because they are the things that you can measure easily, those are the things people will go after. If you are going after only that type of output, it produces a culture where reproducibility becomes more difficult to achieve.

Q213 **Aaron Bell:** Thank you both for coming. It has been a really important inquiry, and it is great to have you as a couple of our final witnesses.

May I ask Mr Parry a few more questions to get a better picture of UKRIO? You are described as an independent charity. There are an awful lot of charities that end up very dependent on public money. Is UKRIO still financially independent of Government?

James Parry: We have only one source of direct funding from Government, in that one of our subscribers is the Ministry of Defence Research Ethics Committee. The vast majority of our subscribers, from which we get most of our funds, are higher education institutions in the UK. We also have some non-higher education institutions that are UK based, such as the National Physical Laboratory, and associate members—subscribers by another name—from outside the UK. There are currently fewer than 10 of those, and they are all Irish institutions.

We have a flat model of funding. While we are dependent on subscribers to keep us going financially, they do not determine whom we help or how we help them, nor do they get confidential information on our work. Because of the flat rate subscription, we are not dependent on any one institution as a particular source of funding. If anybody ever put pressure

on us, which has not happened to date, we could simply say, "We do not need your £2,600. Thank you and goodbye."

Q214 **Aaron Bell:** Is that the rate per year?

James Parry: Yes. A few institutions are on slightly lower rates for historical reasons. We have kept the rate flat for a number of years now. We are doing a review of the charity's strategy for the next five years. That may lead to some change to the subscription model, but we have not yet formulated what that might be.

Q215 **Aaron Bell:** That is the rate that you need to break even and cover your costs.

James Parry: Yes

Q216 **Aaron Bell:** Obviously, you are not profit making, as a charity, but presumably you do not have huge reserves.

James Parry: We have five people, with two vacant positions. We want to take on more people so that we can do more, so increasing funding for the charity is an aim. I do not think that we will go down the route of soliciting donations from the public or anything like that. We will continue to look to the research community and those associated with it for funding.

Q217 **Aaron Bell:** How many private sector subscribers do you have?

James Parry: Currently, we do not have any. In the past, we have had a couple who have subscribed for a year or so to get access to some particular services and then moved away. On occasion, we have been commissioned, on what I guess you would describe as a consultancy basis, which seems odd for a charity to say, to help with a specific project—for example, establishing a research ethics committee at a company involved in research involving AI.

Q218 **Aaron Bell:** If they wanted to, they could join at the same flat rate. Is that the offer to any organisation?

James Parry: Yes. Most of our services are free at the point of delivery. Individual researchers and members of the public never pay to access them. Initial inquiries from organisations are free, although we politely encourage them to subscribe. We are not averse to private sector funding. We are not averse to funding from Government, funders or whomever. It is more a case of asking, "Will it help us to fulfil our charitable aims, and do so in a way that does not compromise our independence?"

Q219 **Aaron Bell:** Obviously, there is a lot of research that takes place outside the higher education sector, within businesses. Do you think that you could be doing more to try to engage those people and to persuade them to subscribe, or are you comfortable with where you are?

James Parry: We could always do more. We would certainly be very happy to have greater private sector involvement. At present, private sector organisations are welcome to access our freely available resources—virtual events, publications and the like. There are individual researchers who work there, and participants in their research projects can come to us for advice at any time. As with any small organisation, there is an issue of awareness. People can come to us only if they know that we exist. As a small organisation, we can do more to shout about who we are, what we do and the support and help that we bring.

Q220 **Aaron Bell:** That is really helpful. On a slight tangent, ARIA is coming. We have just seen the appointment of a chief executive. Do you anticipate your organisation working with ARIA and advising it on research integrity?

James Parry: We would be open to having that conversation. For example, yesterday the Government published guidance on implementing the concordat to support research integrity in Government research. We have been having conversations with GO-Science to give input into draft versions of that guidance. If other bodies affiliated with Government—or anybody, really—want to come to us to have a conversation, we are very happy to do so.

Q221 **Aaron Bell:** Dame Ottoline, on that last point, do you think that any potential research integrity ethical questions are involved around ARIA? Because of its nature and the fact that it is doing blue-sky thinking, do we need to look at research integrity specifically with regard to ARIA?

Professor Leyser: Obviously, there is a huge amount of very high-quality, high-risk blue-skies research going on right across the system. I do not think that there are any unique issues with ARIA in comparison with the system already. Right across that, integrity and ethics are crucial. I hope that ARIA will experiment with alternative ways of finding those really high-quality blue-skies research projects, but the integrity and ethical issues are fundamentally the same across the system. I fully expect every funder, public sector or otherwise, to have those issues front and centre in what they do and how they work.

Q222 **Graham Stringer:** Professor Leyser, I first got interested in the issue of reproducibility and fraud because of two cases. One was the Wakefield case, where, basically, the researcher cheated to draw a relationship between MMR and autism. That was exposed by a journalist, not by scientists. Do you think that scientists are now better at exposing that kind of fraud?

Professor Leyser: There are many points at which that is possible. If you are really working with someone, you may be able to see what they are doing. For the system more generally, the point at which there are initial checks is the peer review of the published results. Peer review is a really valuable check point, but I do not think that it will ever pick up all the cases of fraud because it does not have the information available to

it. If what you get is a paper and somebody has fabricated their data, it is extraordinarily difficult to tell if it is numbers in a table and somebody made them up.

Obviously, cases of fraud and dubious practice are picked up in peer review all the time. It is more about things like image manipulation, which you can detect from the data provided, but to expect full detection through the peer review system is not reasonable. One needs to have all the tools and scrutiny post publication, as people seek to reproduce results, to understand the causes and underlying correlations, for example, which is what was identified in the case that you cite.

That is an area where some of the research culture issues and the incentives in the system are so important. At the moment, the reward is all for the high-profile, announceable results. It is not for the careful reproduction and deeper investigation of why input A correlates with output B. We actively need to shift that.

Q223 **Graham Stringer:** I understand what you are saying. To repeat the question, do you think that we would be better at detecting that fraudulent paper now? It took an awfully long time for the paper to be withdrawn. Do you think that it would be better, worse or just the same now?

Professor Leyser: As James said, the interest in this area has driven it up the agenda. People are more alert to the possibility of fraud and are therefore less likely to accept an initial finding straightforwardly.

The original Wakefield paper was an incredibly small study of a very small number of people, and it was reported as it was reported. That is an important mechanism in biomedical research because initial concerns about anything will potentially be picked up in a rather small number of cases. You need the option of being able to say, "Hang on a minute. I am concerned that something is happening here. There is this thing that might be a side effect that has not been detected in the trials. I am just flagging this." That is a really important part of the system.

One would not want to do anything that inhibited, constrained or reduced the ability of researchers to publish that kind of result. It is a question of how you interpret and respond to it. In the Wakefield case, a significant part of the problem, in some ways, was less the paper itself than the over-promotion of that result as a cause for change in policy when it should not have been. It is almost as much about how one responds to some of these small, initial findings as it is about how one then digs into the situation around them. That is the major thing that we need to learn from that experience. These kinds of papers get published all the time. It is unusual that you get quite such a lot of publicity and drive around them. That is not a typical case.

Q224 **Graham Stringer:** My other pathway to interest in this was the Climategate issue at the University of East Anglia. I do not want to get

into that particular debate, but, when this Committee looked at it, the supporting datasets were not available, so it was not reproducible or checkable in any way. Do you think that it should be a condition of funding, if funding is coming from a public body, that datasets are made available in every case?

Professor Leyser: That is a really important issue. We are progressing towards a clear open data policy that supports that principle. We have revised our open-access policy. The next step is to look really carefully at our open data policy. One of the difficult things about research and innovation is that there is such an incredible breadth of activity and such an incredible, fast-moving pace to things at the cutting edge. It is very difficult to make rules that apply sensibly across the entire spectrum and capture unknown things that are about to come. None the less, the notion that at the point of publication, in particular, all the data underpinning a publication are freely available is achievable and would be a useful goal to head towards. Indeed, that is very much the direction of travel.

Q225 **Graham Stringer:** My next question is about the size of the problem. One of our previous witnesses said that a standard statement from academic scientists is, "Yes, there is fraud, but it is a small amount." That particular professor said that she thought that it was a much bigger problem and that there was really a slippery slope—somebody fiddles a few figures and then, gradually, they are reproducing completely fraudulent papers. How big a problem do you think it is?

Professor Leyser: As I described at the beginning, there is a wide spectrum of activity. Some of the challenge in addressing this is that one does not want the interventions to deal with the really egregious cases to drive more cases of that sort by pushing underground open discussion of the much wider set of concerns that are in the middle, to do with the anxiety-inducing pressure people feel under to emphasise positive results, not publish negative results, select what part of their dataset goes into the paper and ignore bits that do not match the story that they are trying to tell—all those kinds of things.

To answer the question, there is not good evidence that major fraud is common. As I said, there is evidence from surveys that people who come into the system with incredibly high integrity and to whom integrity is really important feel under pressure to compromise that. To me, that is a deep concern that needs addressing quite urgently.

Q226 **Graham Stringer:** I have asked whether there should be conditions on grants to incentivise reproducibility. Are there any other ways that, as a funder of scientific research, you can incentivise good practice on reproducibility?

Professor Leyser: Absolutely. There are many conditions on grants, including data sharing. Having a clear data policy, for example, is required on relevant grant applications.

I emphasise that it is about incentives in the system and what we are rewarding. I really think that that is the core of this. For example, if you are assessing an applicant, at present the standard academic CV consists of a list of your publications, a list of the funding that you have previously been awarded and, maybe, some indicators of the esteem in which you are held in the community, such as invitations to speak at conferences. Those lists have become standard because they are easy to write down, transparent and checkable, and that is viewed as good practice, but what they do is exclude any possibility of talking about elements such as how you mentor and train your students in high-quality, good research practice and support them in their career development more broadly, and how you contribute more widely to the research community in ways that build a community of high-quality, good practice, including integrity. They also emphasise where you published your paper more than what was in it. Again, the rewards are for the flashy, big, announceable result, rather than the combination of really high-quality, foundational underpinning of the breakthrough discovery that you have made.

At UKRI, we are working hard right across the system to shift the standard academic CV away from those lists to a more narrative-style CV that includes your contributions to knowledge and innovation. You could then provide evidence through the publications that you have produced, but a wider range of evidence would be relevant: how you have supported those around you—your mentees and peers—how you have supported the wider research and innovation system, and how you have engaged with stakeholders outside that system, such as the public.

It sounds like a small thing, but I hope that that narrative CV will be quite influential in shifting incentives and highlighting that we require of our researchers and innovators a much wider range of activities to build a healthy, thriving research and innovation system that attracts the best people and produces the best results.

Q227 **Chair:** We have heard evidence throughout this inquiry about how pressure to publish in the most prestigious journals is the overwhelming incentive for early-career researchers. Although contested, we have heard very strong evidence that the selection of papers goes to those who are making discoveries—they are saying new things rather than making confirmatory findings. From your perspective in UKRI but also from your career, what is your view? We heard from the publishers that they are as likely to publish confirmatory studies as they are groundbreaking ones, but that was greeted with some scepticism by other witnesses. Give us your perspective.

Professor Leyser: I think this comes down to what a high-quality research record looks like. At the moment, we are instantly attracted to those high-profile papers with the big discovery published in the journals you mention. There is no problem with that; it is exciting. If you make a major breakthrough, it is wonderful, but that breakthrough has to be adequately supported by the key underpinning work, most of which will

be much more incremental. After that, a whole series of activities is needed to understand, cement in and test for generality and the reproducibility of those kinds of results.

I have said before and will say again that the analogy of groundbreaking research comes from building and construction. You go into a field and dig a hole. That is great, but if that is all you do you have a lot of fields with a lot of holes in them and no buildings.

There is that similarity in the research system, and we need to reward that whole range of activities. A high-quality CV should not consist only of digging some holes; it needs to consist of a much wider range of activities and include the building of high-quality structures supported by the foundations you put in. That is achievable.

As for publishers, there has been a shift, partly because of these issues. There are now journals that specialise in publishing negative results and replication-type studies. That is good. What we need to shift is the value attributed to those papers on people's CVs and for their careers, because at present that value is too low and needs to change.

Q228 **Chair:** Is it a satisfactory solution to have a kind of publishers' salon des refusés where, if it is producing not any interesting results but confirmatory results, you are confined to a journal that specialises in those things? Is that not rather defeatist?

Professor Leyser: That comment is predicated on the notion that there are good and bad journals, and interesting and boring journals. That is something that at some level we need to shift. Where you publish something should not be nearly as important as it currently is; it is what you have published. This is part of a much broader discussion about the future of publication, because obviously we are now in an electronic age, whereas our publication system is still quite deeply rooted in the notion of a published bit of paper. Therefore, the whole structures behind how it works are particular publishers with particular views on how things should work acting as gatekeepers to decide what does and does not go into their journals. There are lots of quite exciting models coming out that are much more open about putting data on to open platforms in ways that break the kind of cycle you talk about.

The difficulty then is helping people to find the science in which they are interested and is relevant to them, because at the moment one of the key things those journals do is curate papers that will be of interest to the particular target audience for that journal. That is very helpful in allowing you to find the papers that are of interest to you, but with search engines and so on increasing and improving in their operation all the time finding the interesting stuff for you as a researcher will also be revolutionised by the way we can bring data into the public domain.

Q229 **Chair:** Perhaps not now but in the past during your academic career, I am sure that you were a peer reviewer and a referee for papers for

important journals. Did you consciously recommend the publication of papers that were not terribly interesting—they were surprising in their results but were confirmatory, to adopt a phrase that has been used?

Professor Leyser: I absolutely have done that. I have also worked on the editorial boards of journals where that is the case.

The question that is useful for editors on different sorts of journals is: will this be of interest to the community that is reading this collection of papers, which is essentially what the journal is doing? Where a negative result is of interest to that community, one would recommend publishing it.

None the less, most of those journals do have the criterion that you have found something new and have pushed forward knowledge. Again, that is shifting because of the debate triggered by all the conversations we are having today.

Q230 **Rebecca Long Bailey:** Dame Ottoline, you mentioned the narrative CV. Is this a prerequisite for all researchers who apply for grant funding? How would you deal with a grant applicant very early in their career who cannot demonstrate such a CV? How would you incentivise them to have a commitment to research integrity and reproducibility?

Professor Leyser: We are piloting the scheme now and intend that it becomes the standard CV required for applications. One of the things I really like about the CV is precisely that it is easier for early-career researchers to provide information in each of those categories than it is for them to provide long lists of papers, grants they have won and conferences at which they have spoken. Everybody, from the day they first set foot in a laboratory, can be delivering things in each of those categories, and what you highlight is exactly the point of that CV format.

Q231 **Rebecca Long Bailey:** Roughly what proportion of UKRI funding grants go to replication studies, metaresearch and longer-term research grants to encourage slow science? I do not expect you to have the exact figures.

Professor Leyser: I can try to come back to you with some real data on that. It is remarkably difficult to answer because quite often a project will start with, "Can we reproduce and generalise this previous finding? If we can, we will do this, that or the other." Whether that is a grant focused on replication or on new stuff, who knows?

The issue of slow science is very interesting. A typical project that we run is a three-year one. Whether one considers that to be slow or fast depends on all kinds of things. I think that the notion of slow science is less about the length of time for which you have the funding and more about the underpinning research culture that supports the way in which you do research. It is useful precisely because it shines light on people's concerns about the very high pressure in this system to work in ways that undermine research integrity. The core of what we have to address is multiple interventions, including the way and what we fund.

Q232 **Rebecca Long Bailey:** In terms of the level of funding allocated to those three areas, how would you say we compare with other countries and their funding bodies?

Professor Leyser: I suppose that one of the very positive things about the way this debate and conversation has moved forward is the excellent collaboration and co-operation across countries in trying to address this. We are working very closely with all kinds of bodies in other countries, other funders but also organisations focused specifically on research integrity. I would say the UK is in a relatively leading position across a lot of this debate. There is good practice across the world and we are certainly trying to learn from that, but I do not think that we are in any sense behind or trailing—quite the opposite.

Q233 **Rebecca Long Bailey:** Do you think that the UK and specifically UKRI should be funding more of these types of research?

Professor Leyser: I think we should be embedding the principles of ethics, integrity and high-quality, robust and reproducible science right across everything we do. I do not think it is useful to identify it as a separate activity going on over there; it needs to be deeply embedded in the way we all work together. That comes into what we fund and how we fund it, but typically the notion and requirements need to roll together with the discovery and pushing-back-frontiers part of the system, not to be an entity separate from it.

Q234 **Carol Monaghan:** Dame Ottoline, over this financial year UKRI has seen its budget cut by just under £300 million. Has that had an impact on the work you are able to do in promoting reproducibility and integrity?

Professor Leyser: That is a very interesting question. We absorbed that cut mostly in two parts of our budget. One was infrastructure funding, which is always quite vulnerable to budget constraints because it does not instantly cut into active research programmes—it has a much longer-term, more insidious effect in undermining some of the research we can do—and there is the very sudden and unexpected cut in the official development assistance budget. I do not think that those cuts, which have been very difficult, have had a major impact across the piece on things like research integrity.

If we get this right and the culture is right, it should save money. One of the things that is frustrating about the current pressures is that, for example, if you do not publish negative results, somebody else repeats the experiment looking for the positive result without knowing that five people have done it already and the result was negative. I hope that, if we can shift the culture into an environment of much more open data and negative results, we should be more efficient and effective with our budget. I do not think we should see it as an extra draw; rather, we should see it as a mechanism to embed efficiency and value for money.

Q235 **Carol Monaghan:** Do you see the new open access policy as supporting this?

Professor Leyser: Absolutely. I think that open access is an important element. It is a stepping stone on the way to open data, which is not quite the same thing. Open access is to do with the ability of anyone to access the published results of work rather than just people who are paying subscriptions to journals. It is part of a broader open science movement that encourages the deposition of underpinning datasets much more directly and rapidly at the time of publication, but to get to the situation you are talking about we need to move forward with much wider open data systems, which are now the focus of an awful lot of work.

Q236 **Carol Monaghan:** There has been a lot of talk about this and articles have appeared in scientific journals. How are you going to evaluate and monitor the impact this is having, and how will you evaluate whether this new open access policy is having the desired impact?

Professor Leyser: There are multiple layers to this. On open access policy, what we are interested in doing is to make sure that for as high a proportion of research as possible at the point of publication there is open access to anybody who wants to get to it. That is part of the broader shift in publication culture that absolutely contributes to the move away from the idea that publishing in a particular journal with a focus on just the flashy results is the only thing that is valued in the system. It is part of that cultural shift.

As for monitoring the policy, the obvious thing to do is to make sure that people are complying with it. To do that will be relatively straightforward because of improvements in the collection electronically of information about what is published linked to the research that we and others fund.

I view that as quite a small part of the work that needs to happen to drive the culture shift we are talking about and we need. It is a broader and important question in all of this. Culture change is difficult; it requires multiple interventions at multiple levels. It is never the case that one intervention can be linked straightforwardly to the culture change we need to see. How you measure that a culture has changed is also quite difficult. The way we tend to respond to these kinds of problems is to say, "Oh, dear, we have a problem. What can we measure going in and what can we measure coming out, and how do those things link together to demonstrate we have done something?" That approach altogether is fundamentally part of the problem.

That is one of the reasons we have the problem. We have done that in a whack-a-mole way for multiple things over multiple years, and now people are measuring things going in and measuring things coming out, none of which is an actual measure of what we are interested in, which is whether these are cultural and integrity issues. That is the zoom-out. Focus back in on what we are trying to achieve in the system and embed across the board incentives to support that change—that is what we need to be able to do, and it is one of the reasons I find UKRI such an exciting opportunity: it brings together the whole research and innovation system

in a way that creates multiple co-ordinated levers to do that which we would not have had previously.

Q237 **Carol Monaghan:** You mentioned previously in response to the Chair that journals are now publishing less exciting negative results. What journals are doing this?

Professor Leyser: There are two sorts of journals. There are journals that are specifically focusing on that, and there are journals like *PLOS ONE* that have as their criteria that the research they publish should be rigorous. They have no criteria that are to do with how exciting it is, if you want to put it that way.

Q238 **Carol Monaghan:** Is it sustainable for these journals to publish such materials?

Professor Leyser: Yes.

Q239 **Carol Monaghan:** How do they fund it?

Professor Leyser: Interestingly, a key element of the open access policy has been to put the entire open access system on to a more financially sustainable footing by driving a new model as standard for the UK. Previously, there were subscriptions to the journals. There was a move as part of open access instead to have an "author pays" policy. When you want to publish a paper you pay for that particular publication. Now, the system is shifting towards broad agreements between publishers and universities, for example, where what you pay for is so-called read and access. Everybody gets free access, but authors who work at those institutions can publish without a per manuscript fee. That is quite an exciting shift that will break us out of the unsustainability of that open axis funding constraint we were in before, which was a kind of dual model of subscription and pay per paper.

Q240 **Carol Monaghan:** An article was published recently—I cannot remember whether it was in *Nature* because I do not have the notes here—about potentially extremely high fees of up to £8,290 for individual researchers to have an article published. How does that fit into what you are saying?

Professor Leyser: That is exactly the problem that the new open access policy will get around, as a much higher proportion of journals and publishers negotiate the so-called transformative agreements with research funding organisations.

Q241 **Carol Monaghan:** Universities will negotiate with a journal what their fee is in order to have their journals published.

Professor Leyser: Essentially, it is the replacement of the subscription fee the university used to pay with a kind of block publication fee.

Q242 **Carol Monaghan:** How does it work if you have a university that is extremely well funded, has a lot of private investment in it and is able to pay big fees to get its papers published compared with a smaller one?

Professor Leyser: It is not run on a university-by-university basis. These are broad agreements with entire consortia of universities and publishers that fund suites of journals. The difficult issue is to find good ways for smaller journals, particularly the ones run by learned societies, for example, which are relatively small and are themselves in some ways charities, to create those arrangements cheaply and sustainably. That is being supported by JISC, the Joint Information Systems Committee, which is overseeing this and finding a way in where those smaller journals can form these so-called transformative agreements.

Q243 **Carol Monaghan:** Who funds JISC?

Professor Leyser: I ought to know but I do not.

Chair: There are some questions on the UK Committee on Research Integrity.

Q244 **Aaron Bell:** The Committee on Research Integrity is something of a success for the predecessor Committee. The Chair and I were not on that Committee, but some of the members here were. UKRI has been very helpful as we have been going through that process. You wrote to us last July with an update. Are you able to give us the absolute latest progress in the establishment of that committee?

Professor Leyser: Very recently, we held interviews for the chair of the committee and we are hoping to be able to make an appointment very shortly. It was a very high-quality field and I was encouraged by the deep thought that senior leaders in the community had put into their applications who wanted to contribute in this way. Following that appointment, the wider committee will be recruited, and then off it will go.

Q245 **Aaron Bell:** When you last wrote to us you said that you expected recruitment and consultation to take place during the autumn of last year and the first committee meeting to be in early 2022. "Early" is a loose term, but is that still attainable in the first half of this year?

Professor Leyser: I would hope so.

Q246 **Aaron Bell:** Therefore, at some point in the next few months it will have its first meeting.

Professor Leyser: Absolutely.

Q247 **Aaron Bell:** You have described the process and have had good-quality applicants. How are you making sure we are getting good representation from all elements of the research ecosystem—these are the same sorts of points I raised with Mr Parry earlier—and from all around the UK?

Professor Leyser: That will be embedded in the appointment of the committee members, and is also obviously a consideration in appointing the chair. It is important that this body is an independent, stand-alone committee. The committee needs to be able to get on and do that job.

Obviously, I will be very interested in whom it appoints, but it is not up to me.

Q248 **Aaron Bell:** If there are vacancies on the committee, it will be up to the committee to appoint replacements; you will not have ongoing oversight of appointments after that.

Professor Leyser: Absolutely not. It is an independent committee. We are providing the administrative and secretarial support to ensure that the committee can do its work for the next three years, and part of its job will be to plot a course for the future landscape that is successful in delivering the multiple functions across this space that need to be delivered.

Q249 **Aaron Bell:** How will you measure the success of this committee? I know it is independent, but what structures is UKRI putting in place to assess whether it has worked and has contributed in the way we hope it will to the research landscape?

Professor Leyser: We are back to the dual problem. How do you measure research integrity, which is a real challenge? One of the things the committee will be looking to do is to try to identify whether there are good ways to measure it that are straightforward and can be collected without horrendous bureaucracy and all those kinds of things. There is that element. Retractions might be an example.

To go back to my previous point, the key point for me is the research culture issues. Culture is incredibly difficult to measure. It is a very high topic for debate in the context of research integrity and the issues we have with things like bullying and harassment. Not doing things because you cannot measure them easily is a real concern to me. We simply will not act because we cannot come up with some metric that captures it. That would be a disaster. We know there are issues that need to shift and we need to work collectively with the community, which is very much what UK CORI is about, and the forum for tackling bullying and harassment to support people to move forward the whole system into this much higher-quality and more supportive research culture that we have.

Aaron Bell: I could not agree more about culture. I am sure this Committee will continue to take an interest as well.

Q250 **Rebecca Long Bailey:** There are lots of brilliant research organisations in the UK. What will be the unique contribution to the research landscape of the UK Committee on Research Integrity?

James Parry: The terms of UK CORI are very broad. It will be a free-standing committee and its chair and members can take it in many different directions. Of course, there is the potential for overlap, which UKRI itself identified very early on. We had early sight of the terms of reference, and, as the last iteration of this Committee did in 2018, we advised on the formation.

I think that UK CORI will avoid duplication of effort and will fill the gaps that are there. It will have great convening power. It will be independent, but it has the backing of the biggest public funder of research in the country. That gathering of data can be very useful.

It will also get a high level of conversation going, followed by concrete action by funders and the like. A lot of good work is being done by separate organisations, but in linking up the bigger guns, the funders, the large publishers and that sort of thing at UK level and beyond it can make a very valuable contribution.

Professor Leyser: Absolutely. As we have discussed well on this Committee, it is quite a complex landscape, with many issues that need to be addressed. I see the key role for UK CORI as being to pull together all the different actors and concerns that people have, and where possible to create a common language and a common understanding of the different issues and how best to provide stable long-term systems that address all those different elements in the most effective way. I think that is a unique role that this committee that reaches across can play.

Q251 **Rebecca Long Bailey:** Mr Parry, how do you think the UK Committee on Research Integrity differs from the UK Reproducibility Network and UKRIO, and how can all those bodies work together?

James Parry: To answer the second question first, I think we are already working together. I have regular discussions with the head of the research integrity team at UKRI and Marcus Munafò at UKRN. UKRI's research integrity team will be providing the secretariat for UK CORI. We have been looking at the issue of avoiding overlap and having effective collaboration to support the research community from the word go.

UKRN describes itself as a peer network of research; it is very much within the research community. UKRIO is an independent advisory voice which sits outside. UK CORI will be a free-standing body that I think can connect the dots a bit, but, with the backing of a major funder behind it, it will have a bit more clout than two relatively small not-for-profit organisations, UKRN and UKRIO. I am not underselling what the existing organisations can do. I think that UK CORI will be able to get action at a higher level than we currently can, but we can all work collectively and we are already in discussion about joint working on various issues.

Q252 **Rebecca Long Bailey:** How do you think UKRI should ensure there is no duplication of effort?

James Parry: I think it is having an ongoing conversation. Obviously, from UKRI's perspective—I am speaking in a personal capacity and I am not trying to pre-empt what others might say—if it wants to establish a free- standing committee it has to be left to do its thing, but presumably there will be some oversight or performance measures to make sure it goes in directions that are currently not being covered.

UKRIO has evolved a lot since we were founded in 2006. Our aim has always been to give support where it otherwise is not available. Therefore, if UK CORI starts to do things which we do some of but they can do better, we will say, "Great. We'll focus our efforts elsewhere." Equally, if we are already doing things, it may make sense for UK CORI to look at other issues and areas which perhaps are not being dealt with as effectively.

Q253 **Graham Stringer:** One of the pressures on researchers is time and the length of research projects. One of our distinguished witnesses who sits on a number of funding panels said she had sat with Nobel prize winners who, when giving out grants and applying conditions, chuntered into their beards and said, "If these conditions were opposed when I was doing my original research I would never have got the grant." It is sometimes said that if Crick of Crick and Watson was applying for grants now he would never be funded. Do you recognise that as a problem, and how do you deal with it?

Professor Leyser: I do not recognise that as a problem. There is a very wide range of criteria that are important in allocating funding, and the notion that high-risk blue-sky stuff is not funded through the current system is much vaunted but is not the case. We fund a very wide range of things precisely because we need to fund the work around a breakthrough discovery that embeds it. Is it generalisable? Can we take it through to application? It is all those kinds of things.

To me, the important element in what you say is to ensure that the criteria that contribute to whether or not to fund a particular grant are not applied in an inappropriate, blanket way so that every grant has to meet every criterion, but rather that they are applied in an appropriately nuanced way so that the panel of experts, in their engaged discussions, can decide that this grant, which is fabulous, amazing, high risk and is at the frontier of science, should be funded, but so should this grant, which is confirmatory analysis of whether something that has worked in a cell culture can be translated into a patient, for example.

We need a system that values all those kinds of things. It is quite common for people who have had their grants rejected to come up with a reason as to why it has been rejected—for example, that it is not applied enough—which is not necessarily the case. That is a perfectly human thing. I am not saying that our system is perfect. It definitely needs careful consideration about how we fund the right diversity of project types, and we need to be more transparent and clearer about how we do that, but I do not think it is inevitably the case that the current system does not fund breakthroughs. After all, we are still winning Nobel prizes. Let me put it that way.

Q254 **Chair:** I see that the Minister has arrived for his session, but I wonder whether he will indulge me if I ask Dame Ottoline a couple of quick questions. You have been very generous with your time before the Committee, but we do not see you every week and there are a couple of

topical things.

We understand that the negotiations and discussions on Horizon Europe continue. What is UKRI's view? What do you see as the most desirable outcome? How bad would it be, if I can put it that way, if an agreement was not possible?

Professor Leyser: This is a very live issue. There is very widespread agreement right across the research and innovation community that association would be tremendously beneficial for a whole variety of reasons, and that is the very clear position of government. We are ready to associate. Our pen is hovering over the paper, if only the paper would be put there for us to sign by our European Commission colleagues. That is still the priority.

Having said that, it is clear that that decision has become linked to other elements of interactions with the European Union in ways that are not necessarily ideal from a science point of view. We are simultaneously having to work very hard to ensure that projects currently under consideration that are winning competitions for funding are supported—the so-called underwrite guarantee, which is up and running and operational—and that we have a high-quality plan for what we would do if association did not happen. It is excellent that the Treasury has confirmed that the funding set aside for association would remain in research and innovation were that to happen. That gives us a good basis on which to plan an exciting programme should we not be able to associate.

It is difficult to be working simultaneously against multiple alternative options, but it is a very important area and we are focused on getting it right.

Q255 **Chair:** I have a feeling that we will ask some questions of the Minister about that.

Later today, the levelling up White Paper is to be published. The Committee has a separate inquiry into the role of science and technology in prosperity and recovering from covid. We hope that it will feature prominently in this. As chief executive of UKRI, have you been involved in the drafting of the White Paper, or at least the thoughts behind it?

Professor Leyser: Absolutely. We have been deeply involved for many years in conversations about the role of research and innovation in levelling up and building highly productive and vibrant economies right across the UK. We have a significant amount of work in this area to understand the evidence base. Our current investment portfolio is heavily concentrated in the greater south-east. That is not because success rates vary across the country. Success rates for all our programmes are essentially flat across the entire country.

How one can sensibly drive up capacity across the UK through smart, targeted investment is a key question we have been asking. We have run

some pilot schemes in that context. It links back in some ways to the question of research integrity, because one of the consequences of the disproportionate interest in particular sorts of publication in the research and innovation system has been to drive competition across the country on these very narrow criteria.

In my view, that has reduced diversity in the system so that institutions have felt less free to specialise in particular areas and capture the excellence that exists in particular parts of the country and harness local economies in a way that is locally appropriate.

If all universities are being judged on how many papers they have in fancy journals, there is insufficient focus on how they can contribute to high productivity innovation clusters with local businesses, the skills agenda and all those kinds of things.

That is excitingly shifting. One of the major leadership initiatives of Mr Freeman is to think much harder about these innovation clusters and how we can drive them right across the country. There are very exciting examples where that is beginning to work well. I think there are huge opportunities.

Q256 **Chair:** When the Committee met in Manchester, Professor Richard Jones at the University of Manchester said this was an opportunity, given a rising total science budget, for a disproportionate component of it to go to regional centres of research without cannibalising existing centres, so it is literally levelling up—it is bringing up areas without reducing the others. If that is the intention of the White Paper, will UKRI be a willing participant in that?

Professor Leyser: I am excited by that opportunity in the context of the smart investment specialisation I have talked about. We are very keen to avoid a situation where you put significant amounts of money into places that do not straightforwardly have the absorbative capacity to deal with that funding—so, thinking hard and working with local leaders and businesses about the blockers in particular areas and getting the funding right, aligning it with opportunities for those areas, is absolutely crucial.

The cross-Government levelling-up agenda is so important because it is not just about lobbying for research and innovation funding; it is about aligning infrastructure, transport and those kinds of things. Skills are absolutely crucial. It is about getting all of that right in a way that is context-specific across the UK.

Chair: Thank you very much indeed. I am sure that our ongoing regional inquiry will pick up these themes and we will go into that in more detail. I thank Dame Ottoline and Mr Parry for their evidence this morning.

Examination of witness

Witness: George Freeman.

Q257 **Chair:** We welcome, with apologies for keeping him waiting, George Freeman, Minister for Science, Research and Innovation at the Department for Business, Energy and Industrial Strategy. Thank you very much indeed for being our final witness in this inquiry.

We want to come to the questions we have been asking throughout this inquiry on research integrity, for which you are the responsible Minister, but can we kick off with some topical questions, in particular on the levelling up White Paper? Would I be right in assuming that, if not a co-author, you have been heavily involved in this?

George Freeman: That is correct. I thank you, Chair, and the Committee for the opportunity to appear before you and support you on reproducibility, but also more generally. I hope we get some stability in the science ministerial portfolio as well as the funding and we have the chance to work together. I genuinely relish your open and critical feedback. Ministers need that, and I hugely welcome it. I have already looked at a number of your previous reports. That is sincerely meant, and thank you for it.

I am very closely involved in the levelling up White Paper. To frame that answer, perhaps I may set the scene of the mission I have taken on in this role, which is quite significant. It is a change in how traditionally in government we have thought of science in terms of both its funding and where it sits in Whitehall.

First, to my joy and, I suspect, yours, the Government have made a very strategic commitment to shift science, technology and innovation from where I think it has tended to be for decades, which is in a slight silo in Whitehall—a rather specialist area—to the mainstream of our economic thinking. This is a big shift. We are attempting to move from being a service economy that does phenomenal science, too often in silos, and has not really been an innovation economy. We are trying to grip that seriously.

Therefore, there is big infrastructure behind this within and behind No. 10: the Cabinet Office, the Office for Science and Technology, the equivalent of the National Security Council for science and technology—the NSTC—on which I sit. It is chaired by the PM and deputy chaired by Secretary of State Kwarteng. We have set out a strategic commitment through the integrated review to put strategic thinking about science and technology for the UK, both economic and geopolitical influence, at the heart of the machinery of government.

Secondly, the Chancellor has made a very major commitment. We are moving UK R&D from £14.9 billion a year to £20 billion a year, which is a 30% increase over three years. It is a substantial rise, but crucially it is part of a commitment to 2.4%. As you will know, that is the average GDP percentage for research in the OECD. Switzerland is at 3.4%. If we are to be a science superpower and an innovation nation, that is a first step, but it is an important one that we have committed to in that journey.

Thirdly, the real challenge for me but also for all of us involved is to show that this substantial increase investment can drive not just, crucially, world-class science but can have a global and local impact.

I frame the mission in two parts: first, science superpower. It is a big word. I define that to mean world-class science. We continue to punch well above our weight, as we have done historically, but it is all built on world-class science.

Secondly, it is about making sure that UK science is impactful in helping to solve global challenges from preventing melting of the ice caps to feeding 9 billion mouths.

Thirdly, there is talent. In a world where China is spending $240 billion and America $170 to $180 billion a year on science, it seems to me that talent is absolutely key. We need to be attracting the very best young scientists to come and start their careers here because that is a very good way to build a leadership.

Fourthly, it is about industrial R&D. As new economies and markets emerge, we need to be attracting much more of that to the UK.

Lastly, it is about harnessing all of that for geopolitical influence.

The other half of the mission is the innovation nation piece, tackling what I would describe as a historic systemic structural failure in the UK for decades properly to commercialise and develop our D; we have really been a discovery rather than a development economy.

To your point about the extra £30 billion of public funding, to get to 2.4% we need to match that with about an extra £70 billion of industry funding over the next six or seven years. It sounds a lot, but I am very confident, as a former investor, given the wealth of our science, that we can pull that money in from life sciences, quantum, fusion and the space sector. The bulk of that D—industrial investment in advanced manufacturing and scale-up—can go well beyond the south-east.

I have been closely involved with the Secretary of State for DLUHC and the team on levelling up to make the case that we cannot move the golden triangle north. It is there for deep historical reasons around a world-class cluster of academic university excellence, but what we must be doing is investing the new funding and attracting as much as we can of that extra funding around the country. UKRI is in the process of mapping for us the clusters around the country. We have identified about 30 and they go from the north of Scotland to the south tip of Cornwall, Northern Ireland and Wales; they are all round the UK. I want us to focus on those clusters and grow them, because in the end I think that is the most powerful way of making sure that levelling up is sustainable, resilient, lasting and genuinely transformational.

Q258 **Chair:** I am grateful for that. It is good to have a strategy and to have a

vision, but as Minister you are responsible for the operational aspects and the nuts and bolts. When do you expect to be able to confirm the individual R&D budgets for the next financial year, which begins in eight weeks' time, for the organisations under your command?

George Freeman: Imminently. You will be aware that the CSR process is a series of steps. The Chancellor allocates to Departments and Departments allocate. As you say, I am responsible for the allocation of the thick end of £40 billion within BEIS to UKRI, Innovate and the agencies. We are now in the process of going through a very detailed plan of how that money will be allocated with UKRI as our lead agency. You will appreciate that quite a lot of discussion is going on, but that needs to be done within the next month or six weeks.

Q259 **Chair:** You agree that to have a budget settled after the beginning of the financial year would be unsatisfactory.

George Freeman: Yes. Some things over the course of the CSR—the second and third years—do not necessarily have to be locked down by the end of March.

Q260 **Carol Monaghan:** Welcome, Minister. It is good to have a Minister who understands the importance of science and the role it will play and continues to play in inspiring innovation. I will send you a letter later today, so perhaps you could keep an eye out for it. I very much appreciate that.

We have been asking a lot of questions about Horizon. This Committee has been asking questions about Horizon for over a year now. We know that Horizon grant settlements are due in about March. Therefore, is the case for the UK's association weakening now?

George Freeman: I look forward to your letter. You will be delighted to know that one of the innovation accelerators that we are announcing today is in Scotland. That is about developing the Greater Glasgow cluster, a real centre of excellence, for wider impact in that area.

I do not think that the case for the UK being active participants in Horizon has weakened at all. It is recognised that we have many friends in the Commission, in DG for research and the DG for finance, who recognise that the UK is an incredibly important partner. To restate the Government's position as confirmed by Cabinet in November, it is to seek association. Part of the withdrawal agreement we negotiated was about association with Horizon, Copernicus and Euratom. It is something I am committed to trying to secure.

You will not need me to tell you that the high geopolitics of Anglo-European relations at the moment, particularly Anglo-French relations around fishing and the Northern Ireland protocol, is complicated. I think that it is pretty clear that we are in a holding pattern with our association not being granted. Similarly, Switzerland has not been allowed to

associate. I shall be in Switzerland on Monday at CERN to meet the Swiss Science Minister. We both want to make the case for association.

Our position is actively to seek association, but we cannot allow doubt and concern about whether we will associate to undermine UK science. When I arrived in this role at the end of September a number of applicants were concerned, quite naturally, about whether we would associate with Horizon. Therefore, I put in place the immediate short-term guarantee, so we will fund the so-called in-flight schemes that have been approved through the initial gating. Shortly, I will set out a second piece of supplementary confidence provision about extending that guarantee and clarity on how we will handle it if lack of association extends into the spring and summer.

In case we need it, we are also working in parallel on a very bold global Britain science and discovery plan for how we can, if we are not part of Horizon, use the budget that the Chancellor has put down, which is just over £5 billion in this year, to deliver the crucial things that Horizon delivers. The Chair and a number of colleagues across the science community have been incredibly helpful in the work we have done in the past few months. We are pretty advanced in developing internally some thinking with UKRI about a so-called plan B. It is a clunky phrase, but it is about how we make sure that, if we are outside Horizon, we can continue to be active European partners; we can continue those flagship fellowships that are so important; we can continue and do better in industrial collaborations; we can do more with SMEs and more global science with other partners around the world and include sectors like space that are not in Horizon at the moment. I confirm that our preference would be to associate.

Q261 **Carol Monaghan:** We could probably spend the rest of this day talking about the withdrawal agreement that was signed up to and the Northern Ireland protocol, but I will park that. You have mentioned plan B. Is there a date by which you will trigger this?

George Freeman: There is no firm date yet because we are in some quite fluid geopolitics. The Foreign Secretary has taken over negotiations from Lord Frost. We are in the early stages and there are some quite positive signals. You will have heard the Foreign Secretary refer to a thawing, but it is clear to me, further to the Chair's earlier question, that we cannot go into a financial year with ongoing uncertainty. Internally, our thinking is that we need to be ready in the new financial year to start to release some of the funding we have put aside for Horizon into programmes so that the science community is not left sitting on the bench, as it were, rather than on the pitch. I am keen to make sure that those could seamlessly, like a motorway slipway, segue back into Horizon association were that to materialise, perhaps after the French elections.

Q262 **Carol Monaghan:** I think all of us here would hope that Horizon association is the final outcome. You mentioned Euratom. If Horizon association did not come about and we did not remain part of Euratom,

what impact will that have? You have mentioned plan B. The money can be replaced, but collaboration is not so easily replaced. Euratom is a different ball game.

George Freeman: You are absolutely right, and that is why I am going to CERN in Switzerland on Monday. I have spoken to science Ministers across Europe. Of the three—Euratom, Copernicus and Horizon—Euratom is probably the hardest of all to reproduce.

Carol Monaghan: We cannot.

George Freeman: I still think of them very much as a bundle. We would like to remain in all three, but, if I had to pick one, Euratom is the one that is impossible to reproduce. I would like to think that if the thawing of relations continues we will be able to remain active members of all three.

Carol Monaghan: Maybe I will follow this up with some written questions about Euratom, because that is quite worrying.

Q263 **Graham Stringer:** It was often said, accurately, that we got more out of Horizon than we put in. It was rarely said that we put a lot more into science via the regional development funds, which we did. Have we brought back into science the money that we were previously spending via the regional development funds?

George Freeman: That is a good question. In terms of specific pots, I would probably have to ask colleagues at the Treasury. I think that the Chancellor would say that in the allocation of a significant increase in R&D funding we are making up for it and giving a strong signal about a significant expansion. I think this is linked to the levelling-up conversation earlier. That is why we made the commitment we have today. We are absolutely committed to making sure that both core science and the innovation economy growth disproportionately support that regional development piece all around the UK.

Q264 **Graham Stringer:** Do you think you could write to the Committee and try to answer that question quantitatively?

George Freeman: I would be absolutely delighted to.

Q265 **Graham Stringer:** My second point is a comment as much as a question. If we stay in Horizon, we will not get a net contribution back. I have always been more doubtful than many of my colleagues about Horizon because, quite frankly, if you take the Swiss universities and Paris out of the equation, the rest of the European universities are not of the standard of our universities in science, partly because they make political and not science appointments. If we are not getting money out, I think there is a real advantage in looking for partnerships in better-quality universities than you find within the European Union. Would you agree with that?

George Freeman: I would. In all of the extensive conversations I have had in the past three months with the science community, 80%, if not

100%, have said they would prefer association; it is continuity and they know how it works. Only 20% have said they cannot envisage an alternative, and 80% have said that it is good and important but not perfect.

I have tried to listen very carefully to what it is that makes it so valuable. Broadly, I have heard that, first, the fellowships are very valued and prestigious, but they are also long-term funding mechanisms. Secondly, the ease of standard off-the-shelf terms for international collaboration is valued.

On your point, I agree that, if you look at the second pillar—industrial funding—the UK does not have as much industrial engagement as other countries in Europe. Under the SME pillar, given that we are a very strong SME economy, strangely there is not as much there, either. I think that with the right balance of continuity, recognising it is a substantial revenue resource today for some of our key research universities, we could evolve a genuinely very exciting programme where flagship fellowships are even more prestigious than the current Horizon ones, perhaps longer term; we could support strategic industrial sectors, including sectors like space that are not allowed in; we could do both European and global collaborations with Five Eyes countries and allies.

There is an exciting opportunity to make it a very powerful global UK science programme that drives bilateral and multilateral research. If we were to do that, I suspect that quite a lot of people might say in a few months, "That's pretty exciting. I'm not sure which I prefer, that or Horizon." That may be the best way to get association.

Q266 **Rebecca Long Bailey:** Can you share any updates on the Grant, Tickell and Nurse reviews? How do you plan to bring those three reviews together?

George Freeman: That is a great question. I inherited the three, as the Committee will know well. The first thing I suggested was that, although each has its own terms of reference, we bring them together with UKRI as part of the allocation of funding so that there is one strategy that BEIS, with myself as Minister, and UKRI agree reflects both strategic Government priorities and the key findings of those reviews. I am delighted to say that that is happening. Paul Nurse, David Grant, Adam Tickell, Dame Ottoline, and the chair of UKRI are in active discussion and are sharing those initial findings. I did not want to agree a UKRI strategy and make a big allocation of £40 billion and then receive three very important reviews suggesting profound changes in the way the system works.

To the Chair's earlier question about agreeing as much as we can before this financial year end, it is equally important that we get only one moment and grab it properly. I would like to get to a point where in April or May it is all done: that, broadly, the key findings of the three reviews

have been reflected in UKRI strategy; the funding has been allocated, and then it is all about delivery.

On your point, the three are looking at different bits. The Nurse review is looking at the institutional ecosystem and whether we can get more out of the institutional structures; the Tickell review is looking at the research bureaucracy piece, which touches on some of the reproducibility issues; and the Grant review is looking at UKRI internally, but they are really three sides of the same coin, if I can put it like that. I am delighted to report that the three of them are very aligned in their thinking, so one problem I will not have is trying to balance very different views; they are pretty coherent. I am quite excited about what we can do by bringing them together.

Q267 **Rebecca Long Bailey:** Are you hoping to see those reports by April or May?

George Freeman: They are all on slightly different timelines. Perhaps I can drop you a line afterwards and confirm the latest thinking on when they are due to be published and available.

Chair: That would be very helpful.

Q268 **Rebecca Long Bailey:** On a separate issue, I am sure you will be aware that we have an ongoing inquiry into the UK space strategy and satellite infrastructure. When we took evidence from the Civil Aviation Authority it was unable to confirm that a launch would take place this year, which was the stated ambition of the Government. Can you confirm that that is still the ambition and that there will be a launch this year?

George Freeman: Those are two key questions. I can confirm that it is an absolute pillar of our space strategy. I was on the phone yesterday with Minister Harrison, the CAA, the Virgin team and our officials, with a very detailed pathway to launch, if I can put it like that.

The timeline of exactly when is being locked down right now. The original aim was June. I think it is fair to say that June now looks ambitious and that we are looking at July; it may be August, but if I said to you I am very confident that it will be in summer 2022 that would be a fair reflection of where we are.

As you say, our space strategy sets out an ambition to accelerate the UK sector and help it to accelerate the global sector's move from being quite a vertical military and sovereign-led capability to a global open satellite and space sector with lots of players. We see an opportunity for the UK. We are very strong in so-called downstream satellite manufacturing, servicing, optics, robotics, space debris and all those services. If we are clever, we can also lead in some of the standards around debris, sustainability and insurability and make London the best place to get a space company financed and insured, and make the UK, from Cornwall to the Shetlands, genuinely a nation that is leading in an international open competitive space economy. That is the mission.

Launch is important. I often use an analogy. We have a Formula 1 pit lane of satellite expertise, but if you do not have a car in the race it is difficult fully to realise the value of that. Therefore, by having launch in Cornwall and Scotland the idea is that that will then drive the supply chain, and that is why it is such an important piece this year.

Q269 **Rebecca Long Bailey:** That is helpful. We can expect to see a launch in the summer of 2022. In your view, are there any specific issues on which this launch is predicated that could delay it or push the date back?

George Freeman: There are three. It is a groundbreaking project and there is an awful lot of risk associated with each of these stages. Broadly, there is one key risk and perhaps two secondary risks. The first arises from a regulatory point of view. This is a big step for the CAA. The FAA has a very clear programme and regulatory package for launch. Virgin launching in the US is very familiar with the FAA system. The CAA has signalled loud and clear—Minister Harrison, who is responsible for it, and I are working closely with them—that it needs to work a bit like the MHRA did in the pandemic in looking at how it can accelerate its processes without in any way compromising safety.

That process is ongoing and it is actively working on it. It would be wrong to say it is straightforward. It is not off the shelf; it is a new programme and it requires Virgin answering questions it has not been asked by the FAA. Launching out of Cornwall is different from launching out of the desert, and it will require the CAA to embrace a whole new set of approval processes and protocols. That is challenging, and I do not want to pretend it is not.

The other issues are to do with preparation on the ground—the site—and some of the permissions for airspace elsewhere, but I think the big one is regulatory.

Q270 **Chair:** It is great news that you are talking about the summer of this year, but is this horizontal launch? You have been talking about Virgin and Cornwall. The sites in Scotland—Shetland and Sutherland—are vertical launch. Are they on the same timetable for this summer?

George Freeman: You are absolutely right that we are committed to promoting both horizontal and vertical launch. The Scottish projects are slightly behind Cornwall, for a whole series of technical and other reasons. I would not be as confident of making the statement I have just made about the summer of 2022 in connection with them, but we are confident that they will follow shortly afterwards. The key is not just that we have one launch from Cornwall but that this is the beginning of a series of launches.

Q271 **Chair:** Therefore, it is summer for Cornwall and tourists will have an important attraction; it will be the first space launch from Cornwall. The Scottish sites are slightly behind. What is "slightly"?

George Freeman: I am hesitating because this is being discussed as we speak. There is a window of an autumn launch from Scotland.

Q272 **Chair:** When you say "window", is that a kind of meteorological window?

George Freeman: That is a very good question. It is partly meteorological. You will appreciate that as the autumn comes on, the weather slots shorten, but it is also technical. The consortium leading on the Scottish launch—

Q273 **Chair:** There are two. Which one—Shetland or Sutherland?

George Freeman: Shetland. They are literally in the process of confirming to us what they think a realistic timeline would be. I am confident that we will get a launch this year from Cornwall. I am hopeful—less confident but optimistic—that we might get a launch from Scotland in the autumn.

Q274 **Chair:** Would I be wrong to infer that you think that Sutherland is behind Shetland?

George Freeman: Perhaps I could drop you a line on that because I need to check exactly where the two projects have got to. There is a lot in flux at the moment.

Chair: You have a wide portfolio. One of the hazards of that is that you can be asked questions relating to any aspect of it even in a discussion on research integrity, which we will turn to now.

Q275 **Aaron Bell:** Minister, it is good to see you before the Committee and in this role, especially given your own experience in the life sciences sector. What do you think the role of Government is with regard to reproducibility and research integrity?

George Freeman: In a sentence, my role as Minister and Government's role is to set the framework; it is to set some clear ambitions around what good looks like to help to make sure that the incentives, direct and indirect, through the funding system support best practice, while never forgetting that our universities are free and sovereign institutions. Research at its best is and should be led by those on the frontline of research. It is not for me to decide. I do not think anyone would want a Minister directly telling a team of researchers. It is about setting the framework, which is the approach we have taken.

Q276 **Aaron Bell:** Do you think the Government could be doing more?

George Freeman: Undoubtedly, Government can always do more. Having had a career in and around the research community and seen up close and first hand many of the frustrations that researchers feel about the pressure to publish and short-term funding, I am very conscious that this is a long- standing issue and that it touches on bigger issues about how we fund science and the balance between freedoms and accountability. I am hugely looking forward to the Committee's advice.

You have taken evidence from some very distinguished people and I genuinely await your steer.

To answer your direct question about what we are doing and have done and to share some of my own instincts on it, not least so you can disabuse me, you will have seen—this has been going on for ages—that we set out in the R&D road map some thoughts about how we help to change the culture and incentives. Broadly, if I was to define how we view this, there is a problem but not a crisis. I think that is how I would describe it. It is a long-standing issue. I think we describe it in three parts. There is a cultural issue, which is partly the pressure to publish, and the culture within science. As a society, these days we perhaps value more the discovery announcements than the careful and studious clarification of results.

There is a point about incentives, which I think does come partly from Government, and getting the right balance between long-term and short-term funding and what we incentivise.

There is also a clear issue around data, technology and the digitalisation of research. The use of AI and algorithms has changed and created some issues around reproducibility. There are also some technical issues.

There is a genuine question that I am mulling on hard through this process and am keen to hear your views on. It seems to me that to unleash the vision I described at the beginning we need to have a combination of some really deep science frameworks and institutions that can think long term and work on deep science issues. I am thinking of something like the Laboratory of Molecular Biology and such institutes that have proven their worth over and over again and should not have to keep doing so. We should have a system that rewards proven success and earned security, if I can put it that way.

Equally, at the other end we need to make sure we can be agile. Science is moving faster than before. We need to be quick and able to set up fast-moving challenge funds. Therefore, I think we need a mix in the ecosystem.

Q277 **Aaron Bell:** That is very comprehensive. You caught the end of Dame Ottoline's evidence to us. We talked about culture. It is almost impossible to measure, but it is almost the most important thing. What lead can you give from Government on culture?

George Freeman: We set out the people and culture strategy last year in which we highlighted an important issue on which we want to work with the sector. We set up various initiatives, projects and committees: the reproducibility network; the Résumé for Research and Innovation; the UK Committee on Research Integrity and the concordat.

I think your question hints at the truth, which is that we can have as many committees as we like, but culture in the end is not a committee;

culture is the lived reality of researchers at the bench or coalface. I think that in the end that is internal to the UKRI and how budgets are allocated and what is rewarded.

We need to think deeply about incentives. What behaviours do we reward? In the end, science shows that humans respond to incentives, not necessarily monetary ones. If we can make it easier for people, I think that the science community will follow that path. That is why I am excited and I am taking a bit of time with UKRI on its strategy.

If we can get this right, we build an ecosystem where the very best labs and scientists get the security of the long-term funding that they need. That is why we are setting up ARIA as a kind of Sputnik or Mars Rover for new science in new ways to see whether by liberating scientists from the traditional constraints of funding we might discover new ways of doing things, but that is also why those reviews are so important.

We have to tackle it. I do not think that not doing anything or just setting up committees is the answer. We have to move the dial, but it really has to be led from the universities.

Q278 **Aaron Bell:** I am sure we will have recommendations for both you and the universities.

We have just lived through a pandemic, which has raised the profile of science and made it more attractive for people to go into it. Science, including British science, has helped to save us from the pandemic. We had an evidence session in this inquiry about the origins of covid. You do not have to answer, but do you want to speculate about the origins of covid? Do you have any theories about whether the lab leak hypothesis is credible?

George Freeman: As Minister for Science my first duty is to defend the importance of evidence-based policy making, so I will not speculate, but it is important to get to the bottom of it and that we learn the lessons of how, with globalisation, we may well get more infectious disease pandemics and need to be better equipped to learn the lessons globally so that we can respond quicker, but I would not want to speculate specifically.

Q279 **Aaron Bell:** The vaccines, treatments and pioneering research that we did about the effectiveness of different therapeutics were amazing. To go back to the "origins" point, leaving aside whether or not it came from a lab, are you as perturbed as I and other members of the Committee are by the way the scientific community closed ranks? The World Health Organisation seemed to do the bidding of the Chinese Communist party, and *The Lancet* published and then did not retract or clarify Peter Daszak's position? Are you as concerned as we are about what happened within the scientific publishing community?

George Freeman: I am concerned. I cannot say how my concerns compare with yours, but I do share the concern. It is important,

particularly on issues to do with science, that the rigour of the scientific method is followed. There is something quite perverse about seeing scientists—this may speak to the issue of incentives—not embracing the openness, rigour and accountability of cross-examination and peer review, which is the bread and butter of daily science. I am concerned about that.

I think that it speaks to the broader second point, which was the geopolitical issue I touched on earlier, that part of the science superpower piece—it is a big word—is harnessing UK leadership in science for good and good science and making sure we establish international codes so that, as more science is global, we have common rules and a common framework.

I would argue that science has been a fundamental part of defending, supporting and promoting freedom. It was free thought, free speech and the universities that helped to break the shackles of unaccountable monarchs, superstition and religion in the middle ages. Science drove the enlightenment and I think it has a big role to play in driving enlightened global collaboration for global good.

Q280 **Aaron Bell:** That leads me nicely to my final question. How do we make sure that the United Kingdom is a leading voice on the importance of integrity and reproducible research in the international arena?

George Freeman: That is a key question and there are several bits to it. I think it comes through the G7, the UN and our international leadership. That is an area where we are highly respected as a science powerhouse. The chief scientist, Sir Patrick Vallance, and I are working through the structure I talked about earlier to make sure that we use our geo-diplomatic influence.

I have raised it in all my bilaterals with European science Ministers to signal that, while we may not be in the European political and monetary union, we want the values of western European science to be adopted, promoted and shared globally.

I think that in all of our collaborations, if we are to do our own version of Horizon, we need to start to put in place the right mechanisms. This links to research security as well as reproducibility. We have a serious threat, which is far bigger than in the days when I was in research, from both sovereign and industrial espionage. That is a big word, but the aggressive capture of IP illegitimately is one of the things I am picking up and putting some energy behind. We have to help our researchers.

Q281 **Carol Monaghan:** It is nice to hear you talking about the enlightenment, which started through comprehensive education in Scotland, but I will not go into history. I want to talk a little bit about the REF and how funding decisions are made. What plans do the Government have to reform the REF in future years?

George Freeman: That is a really big question. I will try to answer this as best I can, but, if I may, I would like to write with a more detailed answer.

Q282 **Carol Monaghan:** Maybe you could give a bit more background. We have had written evidence from the University of Oxford and Professor Timothy Bates at the University of Edinburgh about a specific ring-fenced amount of budget that is for reproducibility, which the REF does not capture at the moment. Is there any comment that you can make on that?

George Freeman: Only to say at this stage that as part of the wider conversation we are having with UKRI we have the allocation of funding for the next three years to reflect those priorities. We have identified this—in part that is why we are eager to see the Committee's report—as something we tackle in this change moment for UK science. There are a number of different ways one might do it. We are actively listening and I am keen to hear from this Committee how we might do it.

It is clear to me that the research excellence framework has achieved a huge amount, but it also sits in the middle of a series of direct and indirect incentives that drive certain behaviours. I link back to the earlier comments I made. We think we have a problem. Too many of our scientists are working in an environment where the balance of bureaucracy, time spent applying for grants and box ticking is overly burdensome. Some of that comes from Government. We need to create that mixed economy where excellence is rewarded with security, accountability measures are sensible, realistic and proportionate, and we have an agile funding system that allows the faster moving, more creative and immediate research to be funded quickly. We have a super tanker stuck in a bit of a slow lane and we need a motorway with slightly different streams, and the REF sits in the middle of that reform.

Q283 **Carol Monaghan:** Has any consideration been given to removing originality as a criterion from the top score bracket for funding?

George Freeman: I think there has been. Again, perhaps I may come back to you on that having spoken to officials. On this we take advice from Sir Patrick Vallance, UKRI and the academies. Perhaps I can come back to you and see where that has got to.

Q284 **Zarah Sultana:** To follow Carol's questions, do you think it is appropriate that institutions are able to submit to the REF the work of staff they have made redundant? This is following up work done by the University and College Union. It has criticised the entrenchment of the casualisation of academic staff in the culture of fire and rehire and how it can end up treating staff as disposable commodities if institutions are able to submit the work of staff they have let go.

George Freeman: I think the straight answer to your question is no. I would be very interested to follow that up and hear about that case and others that it may reflect. It is important that we get the balance right

between institutional interests and personal interests. It flows from what I was saying at the beginning about the way you could describe this portfolio. One way I think about it is: ideas, people, infrastructure, clusters, technologies and sectors. In the end, it is all about people. If we do not create the most exciting, agile, fair and fulfilling ecosystem, we will not attract the best people. It is important. That is true for both deep science funding reliability and what type of research we value, and it is about making sure that the relationship between the institution and the person is fair.

I am very conscious that intellectual property touches on this and that there are different models. For some institutions, the intellectual property is owned by the academics and the university has some rights; in some cases, it is owned by the university and the academics have rights. There are pros and cons, but I am not sure we have got this quite right. I would be very interested to follow up that specific issue.

Q285 **Zarah Sultana:** I am grateful for that response. Reform of the REF and incentivising certain behaviours that you talked about definitely deserves a further look.

In a similar vein, how do the Government plan to address job insecurity and pressures on academics, which can incentivise poor research in favour of quick publication?

George Freeman: This touches the key point that I keep circling back to. I think the answer to that question is that we need to get to a point as quickly as we can where researchers here in the UK start to say, "This is better. Yes, I am accountable, but I'm not drowning in endless duplicated accountability forms and bureaucracy."

There is a clear mixed economy, if I can use that phrase. If you do deep science you are able to get on with it. If you do industry-facing science there is a clear framework for fair incentives. If we want to do agile discovery science there is a pathway for it. I think this is all of a mix. We will not be that science superpower and innovation nation unless we change the culture in our research base. If you hear the hesitancy in my voice, it is just that I genuinely think that the independence of our scientists and institutions is the golden freedom, so it is about changing the culture.

I have a role, obviously, as we allocate £40-odd billion to UKRI to make sure that the work it is doing is reflected in the detail of all the programmes and applications. It is also about sending a very clear signal that we get it for great scientists who want to come here and stay in science. We have some fantastic scientists who then leave science. One reason is some of the issues you are touching on. We have to get this right. I do not think that at the moment many scientists in the UK would say they are here because it is such a fantastically helpful and conducive funding environment. Most of them will say that the bureaucracy, administration and accountability regime, which they all accept needs to

be done, is too clunky, bureaucratic and slow. That is something we can change.

Q286 **Zarah Sultana:** Do you believe that it is an issue that publicly funded research can generate profits for private publishing groups?

George Freeman: In principle, academics and the institutions should be free to make commercial arrangements that suit them. Having spent most of my career before coming to Parliament in 2010 in and around university research and commercialising it, I know there are different ways to do it, but it is important that rewards flow fairly. I know quite a few scientists or researchers in the humanities who spent a lot of time in the early part of their careers doing work for which they never felt they were given much recognition, and in the second half of their careers they spent most of their time filling in grant application forms for the team now doing the work underneath them. There is a rather old-fashioned hierarchical and bureaucratic model and we need to encourage diversity in the ecosystem.

Q287 **Zarah Sultana:** How do you think the benefits of public funding can be translated in the public sphere? What can we be doing to make sure that the benefits that are generated go back into the public sector?

George Freeman: That is a great question. For the public sector and public realm there is a whole series of ways. In a way, the key question that the public will rightly ask the Minister is, "The Government have increased the allocation to science substantially. To what benefit for us collectively as the UK?" We know that our universities punch well above their weight. Every pound invested in research unlocks multiple pounds in the economy. We are creating great science research institutes and career opportunities. We need to do more on STEM in schools to make sure more people are flowing in. That work then creates opportunities, whether it is on the humanities side or institutes like the Design Council, which I was with yesterday. It is an incredible design economy underpinned by great design research. In life sciences we are creating jobs and careers and developing treatments.

Crucially, I think the benefits of this science and innovation economy have to go more broadly around the country. Too many people have felt alienated and cut off from it. We have today's levelling-up announcements and have launched the three innovation accelerators in the first three areas. If we get this right, we will give a whole new generation of young Brits a chance to participate in the new economy in either science and research or jobs, clusters, companies and opportunities that it is creating. That would be a great thing for the country as well as individuals.

Q288 **Zarah Sultana:** I appreciate that you have been in this role only since September, but what plans do you have to improve science literacy and the use of science evidence both within Whitehall and in Government?

George Freeman: I think it is worth saying that we are pretty good and are regarded internationally as leaders in our institutional science advisory network, with every Department having a chief scientist and the Prime Minister having a science advisory cabinet.

We are quite good at making sure that there is that network. The pandemic has revealed that in the end scientists can provide the data and evidence, but it is elected politicians and accountable Ministers who have to take the tough decisions. I think that the infrastructure of advice is world class.

We have to move the dial to get a wider appreciation in Parliament. I suggest there is not enough recognition of the scientific method and the value of evidence-based inquiry and hypothesis testing, particularly in the House of Commons, although there are very eminent scientists in the Lords. I do not think there is much understanding of the value of the scientific method.

One of the things I worried about in the pandemic is the tension between science and the lived reality of people on the ground. That is a false dichotomy. We need to explain to people that all the drugs they are getting and the everyday devices they use have come from great science and technology. Breaking or challenging that cultural divide is important.

Q289 **Graham Stringer:** To follow up your comments about science and the epidemic, which hopefully is coming to an end, I think there is real difficulty between politicians and scientists in understanding each other. I think that was what you were alluding to. That has some policy consequences. How do you think you can improve that communication and relationship between scientists and politicians?

George Freeman: It is a great question. Before I come to that, given my own field of life sciences and health, to me the pandemic revealed the importance of health economics. That is a whole discipline that looks to balance the wider economic impacts, the cost of disease and the value of health. If the pandemic has shown us anything, it is that many people and businesses who had not thought about it now recognise just how valuable health is and how expensive and costly disease is. That is an important lesson to harness. If we can embed that in our health policy going forward, it suggests that, as we are doing, we shift the focus towards population health and the prevention of disease. Every pound spent on prevention will be repaid multiple times later in the avoidance of late stage chronic disease. Your point is broader than that and I would be interested to hear the Committee's views on it.

Q290 **Graham Stringer:** We have written a very long report with the Health Committee that touches on some of these issues. Was that one of the reports you read?

George Freeman: Yes. Your question touches on a bigger issue, which is how we grow that mutual understanding of and respect for the different

disciplines of science, research and politics. I just make the observation that occasionally issues flare up on the frontline. For example, GM food is a topic that I know the Committee has dealt with in the past. It is one of those issues where the public and media become very exercised about issues where the science community has clearly laid out the evidence. Some of the concerns do not need to be concerns and the real concerns are elsewhere. You get these two groups not really engaging.

I just observe that the last time that flared up the best thing that happened was when scientists at Rothamsted came out and spoke to the news cameras, often taking out the politician and letting the scientist speak direct. The authority and respect elicited at that moment, which I remember clearly, was invaluable.

We need more of that. Part of my role is to try to help scientists to speak more loudly about what they do and support and promote science as an endeavour, the scientific method and the importance of good research for everyone all around the country.

Q291 **Graham Stringer:** That is a fair point. Sadly but understandably, the public trust scientists more than they trust us as politicians. One of the recommendations and conclusions of that report—I not trying to trick you into answering before we have had a formal response—is that politicians are very cautious about challenging scientists, yet science progresses by challenge. That is at the core of some of the problems of the interface between politicians and scientists. Have you thought about how one can approach that problem?

George Freeman: Yes, I have, and you are right to put your finger on it. It is an age-old problem, is it not? C.P. Snow wrote a rather wonderful chronicle of books about that tension.

I observe and share with you that when I worked in the field of the commercialisation of science—I worked for 15 years in and around universities and hospitals with incredibly eminent scientists—I was humbled and very aware of how little I knew about their work when I met them. Similarly, it turned out that they were often not aware of what the commercialisation journey and what setting up a company would look like. In the shared mutual and private revelation of each other's ignorance a lot of trust was engendered. I think that for all of us in positions of authority, in acknowledging the difference between what we know and what we do not know, framing the question well, which is what this Committee does so eloquently, will often elicit the right conversation. I think the answer to your question is that it is up to us as politicians to ask the right question. The science community has shown that it is pretty good at answering questions when they are well framed.

Chair: We appreciate that answer and the thoughtful way in which you have answered our questions on a wide range of subjects. As Carol says, it is evident that you have a great enthusiasm for your portfolio, and we look forward to seeing you on multiple other occasions as we continue

our work.