HOUSE OF LORDS

Select Committee on Science and Technology

Corrected oral evidence: Life Sciences and the Industrial Strategy

Tuesday 31 October 2017

10.30 am

Watch the meeting

Members present: Lord Patel (The Chairman); Lord Borwick; Lord Fox; Lord Hunt of Chesterton; Lord Mair; Lord Maxton; Lord Oxburgh; Lord Renfrew of Kaimsthorn; Lord Vallance of Tummel; Baroness Young of Old Scone.

Evidence Session No. 10 Heard in Public Questions 60 - 68

Witness

Sir Paul Nurse, Director and Chief Executive, Francis Crick Institute.

USE OF THE TRANSCRIPT

Examination of witness

Sir Paul Nurse.

Q60 **The Chairman:** Thank you for coming. We would like to explore with you, Sir Paul, the life sciences industrial strategy, your views about it and other related issues, to see how we can help as the House of Lords Science and Technology Committee. Can I kick off? I would like to hear your overall impression of Sir John Bell's life sciences industrial strategy. What do you think will sustain it in the long run? What needs to be done about it? One of the five pillars it identifies is the science offer. What do you understand "science offer" to mean? Please feel free to talk about any issues because we would really like to hear your views rather than be guarded about it.

Sir Paul Nurse: Thank you. Can I welcome the Committee to the Crick? It is great to have you here.

Can I comment on what I see as the really good points about the life sciences strategy? First, it is making a bid to convince Government of the importance of the life sciences, which is absolutely correct. That goes throughout the report. In particular, there is an emphasis on the science base. We know that we have been languishing in the lower part of the table of OECD funding and, on the statement that we should be moving to the upper quartile, that is the very least that we should be doing.

I also happen to like—we can explore this a little more later, if you wish—the emphasis being put on the role for the NHS in the strategy. I would perhaps emphasise it even more strongly; I would use words such as: "We have to develop an NHS that is a research engine for biomedical activities and healthcare delivery, a research engine that puts the UK in a unique position".

It identifies problems, which are also important, particularly scale-up, although I do not see too many solutions there. I will come to that when I talk about the comments that need to be dealt with. Scale-up is crucial. The other important point that it recognises is the exceedingly important issue of skills, having appropriate skills, and the ability to recruit the very best from around the world. All these are in the report and are good features.

What do I think perhaps requires some more attention? In a very general sense, the report lacks detail to know quite how you go to the next step. It is, of course, a strategic document, so it is bound to be high level, but it identifies problems without always identifying, even in general terms, what the solutions might be. That is a bit of a weakness. Implementation is crucial in some of these areas and, without a better sense of how it will be implemented in a strategic way, it will lack the momentum to be able to proceed. More detail is required.

Secondly, it is not actually a life sciences strategy; it is a health sciences strategy. That needs to be made absolutely clear. I have no problem with it being a health sciences strategy—indeed, in the foreword it is essentially identified as such—but there are two points to be made about

it. First, it loses the opportunity for synergy and connection with the life sciences elsewhere outside biomedicine, which is significant in this country and which is important in its own right economically. We lack that synergy. The second thing that worries me is that it is possible, because it is called a life sciences strategy, that this other important sector will be ignored. This is a fundamental weakness, which absolutely needs to be addressed. I would be content if it were simply called a health sciences strategy and then we did something about life sciences to try to fix this but, if we do not have a connection to the life sciences, we will lose an opportunity. I am worried that the Government may feel that they have a strategy across the life sciences when, in fact, they do not; they only have a strategy across part of the life sciences.

Those are the two most general points that would concern me: it is a bit light on detail, even at the strategic level, and in some parts quite light; and it is only dealing with a restricted part.

The Chairman: What, in your view, needs to happen next? We take the point about life sciences not including other sciences but only human sciences. To stick to the strategy as it is, what should happen next and who should drive that?

Sir Paul Nurse: We need to get the other life sciences in. That could be done by another study but we should not ignore it. What is required before we can take this forward is a greater attention to how a number of the important issues that have been identified can be solved. I already mentioned the scale-up. It is identified but I read what is said about the scale-up and I could not see anything that really solved it. I do not mean to imply that that is simple—I read it because I wanted to know what one could do—but there needs to be more attention. It sometimes felt like a McKinsey report—one of these boilerplate things—where it identified the issues but did not necessarily get to grips with the dirty work of finding solutions. It needs more work on implementation and the strategies that can drive the practical consequences of it. I know that I am not answering what should be done; I am saying it is a problem.

Q61 **Baroness Young of Old Scone:** One of the previous Members of this Committee, Peter Hennessy, said that the problem with the last 93 industrial strategies was that there were no implementation plans, and you have just identified that. Who should be given the job of masterminding and maintaining the drive forward? The other problem with implementing these strategies is that people wander off after quite a short time; then another one comes along and it does not get implemented either. Should we have a Gauleiter for implementation? Where should that sit?

Sir Paul Nurse: It is a problem here and it has been seen in the past. This is why I am particularly concerned with it. I would have liked to see, in a report at this level, more attention but it is probably too late at this point for this particular report. The details have to be put in place by some other mechanism, rather than a conventional report.

Where could that sit? It might be a role for UKRI. It might be; I am not sure it is, but UKRI has a broad grasp of the science research issues. I do not think it was set up to quite deal with this but it might provide an opportunity there. Another possibility is to go back into an appropriate—I am not quite sure where the appropriate one is—government department to find out how to develop this. I am struggling a bit because we have lost the opportunity in some respects.

How should it work? John Bell has done a really good job in OSCHR, for example, and OSCHR would cover some of this territory, so that could be another route for building this. But I have already commented that it is just a bit too narrow. I am struggling to know quite what to do here. I suppose you could involve think tanks and so on. I am not really a fan of that. I would go into something around UKRI. The CST could at least discuss it. It would give it something to do. Sorry, I did not mean that in a pejorative sense, having sat on it for 15 years, but I meant that it would be a meaty project for it to do. It has to be somewhere in the Government's support system. I am sorry; I know I have not given a good answer.

The Chairman: You commented earlier that the NHS should become the research engine. Would you like to expand on that? How are we going to do that?

Sir Paul Nurse: There needs to be a culture change in the NHS that it is not simply a healthcare delivery system but a real opportunity. As is well stated in this report, if we can persuade the public—and I want to say something about that—to engage in providing personal data, we will have a fantastic opportunity. You asked me in the private session about the US. There is nothing like the NHS in the United States, and the United States is rather inefficient in its healthcare delivery. We have a number of structures here. Sometimes we beat ourselves up too much. Having worked there, I saw how inefficient it actually was. You only have to look at the cost of healthcare delivery to see that we have something that is working pretty effectively, but it will work even more effectively if we can turn it into a research engine. That is a culture change that means we should not just be constantly driving, knowing how complicated it is, hospitals, GPs and so on, but we have to somehow get into a way of operating that provides research data that will be for the good of society.

Can I just amplify that? One of the big problems with the importance of data, which comes through a bit in the report, is that it is clear that we need the data, but it is equally clear that there will be a big fight over getting that data because of public records. There are two issues here. One is confidentiality, and everybody has a focus on getting the codes right so that it cannot be released. That is only part of the problem. The second problem, which the NHS can perhaps solve, is to persuade our public that they are contributing to the public good by contributing their data and their information. This should be a case of the public good. That means we need to think very carefully about how we set this up. This is not solely a matter of a public-private partnership, which obviously can provide one way forward. The big stumbling block is to get the public

engaged so that the NHS is not only a research engine but might provide a way of getting access, if we emphasise the public good, to patient data.

Lord Fox: Accepting all the positive things you said about the NHS, it is clearly stretched as a healthcare delivery system, which is how most people who work within the NHS identify themselves and which sits front and centre in that culture. How do you set out to change the culture? How do you incentivise different behaviours? How do you, frankly, make them possible within the capacity of an organisation that is already running over 100% in many cases? How do you effect that change?

Sir Paul Nurse: It is money, money, money, I suppose. It needs more money, in part. Do not forget that the Department of Health is one of the few government departments that still have a research budget. It is approximately £1 billion a year. Looking at and maybe expanding that budget, which is separate from the healthcare delivery, to drive research, in the way that I think we would all agree is a good idea, is the way that I would start. Just dumping money into the healthcare delivery system may not be the answer, but to drive it through the research fund may be.

Q62 **Lord Oxburgh:** You partly answered this already, but you worked in the US a lot. Is there anything that you have not said but you feel we should be doing to make it easier to move good ideas out of the laboratory to the bed, to contribute to healthcare and make money?

Sir Paul Nurse: I have said this a little in the evidence and I have said it more in the report I wrote that led to UKRI. There is one problem that needs to be dealt with, and it is roughly as follows: to translate too quickly may result in you becoming lost in translation. It is the way that science is done. If you are exploring and doing research into a subject, the way it works—you might be aware of Karl Popper and the way he has spoken about these things—is that you carry out experiments and you make observations to test a hypothesis. If the hypothesis fails, you change the hypothesis. Your objectives are changing all the time to follow the research evidence. That is how we operate.

If you are doing translation and, even more so, application research that is trying to get to a particular objective, that results in a problem. Let us say that glass of water is our objective and we are starting here with this paperclip. When you are doing conventional discovery research, you may start in that direction but your first experiment could bring you here, your next one over here and you are lost. If your objective is that glass of water, you get lost in all this.

How do we deal with that? First, we have to recognise it as an issue. This wastes money. We have an immediate start-up for some crazy idea and, of course, it fails because it is not sensible. The answer is twofold. First, let us get a bit closer with our knowledge of the paperclip and the glass of water so it is a more reasonable ask. Secondly, sometimes the term "valley of death" is used here and people talk about the finance. It helps here to build bridgeheads out from both sides. If we have no capability on the applied side—industry or healthcare—they cannot recognise stuff coming in from the other side.

I would say two things in general terms. First, let us not have a moonshot that is too long. I want to say something about moonshots. I do not like "moonshots" as a term. Let us try to avoid it and make the "shot" much closer. Secondly, let us have capability on both sides so that they can reach each other.

Lord Oxburgh: One of the problems we have in looking at that, both in the biomedical area and in other areas, is that you get university or other research groups, which have a great idea on which they work and effectively become one-trick horses. In other words, what they have done is very good and it may have a particular application, but it will not expand into much bigger things. Going back to what you said previously, is the best solution for that sort of company for it to be bought up by a big one?

Sir Paul Nurse: It reflects a lack of close contact on both sides, which is exactly the way that we are trying to deal with it in the Crick, as I was explaining earlier, by having closer contacts very early to learn those sorts of things. People like me are by no means expert in knowing these sorts of issues. The mistake is to pretend that we are. By closer contact, we will learn and respond to that information from elsewhere.

Lord Oxburgh: Did you find, in the US, that the companies that were interested in helping people across the valley of death were much better informed than their opposite numbers in this country? We are really talking about the level of education, in a rather specialised sense, of venture capitalists.

Sir Paul Nurse: We have good venture capitalists who are specialists in this area in the country. I do not think we have enough of them and I do not think they control enough funding. In the US—in the area of New York and Boston, and it will be the same on the west coast—I found there were real experts who understood the territory, who were in the investment industry and who had very close contact with academics. At Rockefeller every month or two, I would have a breakfast meeting, because that is what they do in the US, for a couple of hours at 7.30 with the Wall Street investment guys and girls—I was using "guys", just for the record, in the American usage of the word, which covers both sexes—and the people we have in the Rockefeller. They would just mix, have coffee together and have a few talks. We need more of that. That is something that the Crick could contribute to, to go back to an earlier question.

Lord Oxburgh: This is part of your mission to educate and, indeed, change the venture capitalist industry in this area.

Sir Paul Nurse: It will be when we have the air conditioning working.

Baroness Young of Old Scone: Can I pick up that issue and take it one step further? You talked about more venture capitalists who have more money in the States, as well as the different climate. Does that mean that we are stuffed for ever? We are a small-ish country and we will have a limited scale. Is scale an endemic problem that will last for ever? Is there anything that we can do about it?

Sir Paul Nurse: It is, of course. I have not mentioned the size of the market, but this is one issue that we will face with Brexit. We had a large market in the EU. It was not perfect or as permeable as in the US, but it was there. Turning our back on Europe will dramatically reduce our market, and that is another factor here. I am no economist but that is another factor in how this would go. We will have to work very, very hard to find our market.

Q63 **Lord Fox:** Winding back from scale-up to the early translation period, the formation of UKRI, which to some extent was presaged by your own report, brings together research councils and Innovate UK. What is your assessment of the risks and the opportunities of pulling together seven research councils and Innovate UK into that organisation? What has to be done to deliver the benefits?

The Chairman: The author of the report has to defend it now.

Sir Paul Nurse: My main argument for putting them together in this way was to have a strong voice for science in government. I found, when I took evidence, that the relationship of all the different research councils and, for that matter, Innovate UK with BIS, as it was then, was weak, because they could always be picked off one at a time. My notion was a strong body, inhabited by a strong board and strong individuals who could make the case for science.

I will come to the research councils first and then to Innovate UK. The research councils in their original form had been, on the whole, very good in their relationships with their constituencies, and that worked effectively. They were inefficient in the many back offices, which were all duplicated and different, and that just got in the way. They did not have the individual strength to argue the case, which I am hoping they will. Some people have worried about Innovate UK, because it would lose its identity. In the report I wrote, I was neutral about whether it should be in or out. I was slightly in favour of it going in because I feel that these different funding agencies need to be talking with each other. I did not think in any sense at all that Innovate UK should be the tech transfer company of the research councils. That would be crazy. But, because they occupy adjacent territories, I thought it would make it more efficient and effective.

There is a theoretical danger but, if it is run properly, I do not think it should be an issue. That is my personal view.

Q64 **Lord Vallance of Tummel:** You have partly answered my question already, Sir Paul. I am coming back to capital and capital availability. Earlier on, you mentioned that, when you were at the Rockefeller, there was plenty of what you call gung-ho capital, whereas here we have the Treasury looking at breathing life into patient capital. In a way, that says it all. Gung-ho capital is to do with enthusiasm. I am sure that you have lots of enthusiastic scientists here. Is it partly an issue of how you translate the enthusiasm of science into a new breed of enthusiastic finance people? Is there a difference between enthusiasm at the translation point and at the scale-up point, and in how you deal with the

two?

Sir Paul Nurse: My experience, frankly, is more at the former than the scale-up, so I can address that. It is simple: we need to get our communities to mix and talk to each other, both in an informal way—the parties for the 30 year-olds—and in the formal sense for those with white hair who might be setting strategies. We just need to talk more. Surely we have an opportunity in the city of London, with great research—London is a city of science—and great finance.

Lord Vallance of Tummel: Exactly, there is a language of science, a language of industry, a language of finance and a language of politics. They do not all work together. You are absolutely right; we have to breed a new generation of polyglots.

The Chairman: We will get a chance to explore this when we see some of the investors to take evidence, but it has been said that one difference—I am familiar with the west coast, not the east coast like yourself—is that it is easier for companies to be developed and then get on to the stock market, where they raise their money, than it is here. I do not know.

Sir Paul Nurse: This is a bit beyond my pay scale because I am not a financier, but I make two observations, one of which is not quite as you are asking it. We have to recognise that, at least at the early stages, there is a lot of risk with these sorts of initiatives. The people who drive translation, through setting up companies and so on, recognise that risk and realise that, though they are engaged with a company, it may well collapse and there have to be opportunities to go somewhere else. This has been extremely important, in my understanding, in Boston, where you can move from one to another. We have possibilities in Cambridge where the critical mass is building up. We should try to develop something similar in London. That would help significantly. If we had a collection of entrepreneur translators who could move from company to company, we would have a more secure way of doing it. That is one way I would think about that.

Q65 **Lord Hunt of Chesterton:** Can I go back to your very important point about the public being interested in being involved in medicine? My own story is that I had a very severe operation at Queen Square when I was 12 years old. After that I was a prize product. I was sat there, and tiers and tiers of doctors wanted to see me, so I was rather pleased about that. It is an important question of people being interested in their treatment. That must be the big theme, as opposed to the theme of people being worried about privacy.

Sir Paul Nurse: The obsession with privacy will get in the way of this data revolution, as was described in the life sciences strategy, unless we solve it. This notion of the public good, engagement of the public and the interest of the public in the NHS, because it is free at source, provides a way to approach this that perhaps has not been exploited enough. I am not sure whether that would work, but it gives us another possibility. We have to be careful about quite what arrangements we put in place.

I would like to say something more about data, which goes back to the life sciences strategy. The emphasis is on genome sequencing: lots of genome sequencing. I happen to be a genome sequencer so I am very sympathetic to this; it is a part of what we do. But two further things are required. That sequencing has to be coupled to phenotypic outcomes—that is, the clinical outcomes—and I do not see the same efficiency and effectiveness in the connection of outcomes for individuals to that DNA sequencing. It will be a problem if we do not have that in place. It is very easy to sequence; you just put it on the machine and out come the letters. Connecting it to good and usable records is crucial for this, and there needs to be attention to that. That is recognised, but I am not sure it is solved.

The next one is not so clearly recognised. As well as genes, we have environment in its most general sense. There is no mention of the word "environment" here—not a mention of it. We will need, in the longer term—and we are certainly not there at the moment—to also collect information about, in the most general sense, the effects of the environment on the human being. If you then combine the genomics with that, you have a much more powerful paradigm to work with, because the environment affects how the genome influences the outcomes. We again can use the NHS to monitor that. There are various things we can do. Epidemiology and population studies are crucial here but they are not being thought of in the same way. That is at least my view, and that was a lack in just focusing on genomes. I know I was not asked that.

The Chairman: The biobank of 500,000 and the genome of 100,000 have phenotypic information. I accept that they do not have the epigenetic information. Do you not think that sequencing that genome will create enough data?

Sir Paul Nurse: We need reliable outcomes. You can ask the experts, who will come after me and who think about this. The effects of the environment are simply not there at all, and we know very well that that would influence what the outcome will be. In actual fact, the epigenome may provide information that records, in part, some of the environmental exposures. That is an area of research that is prevalent in insecticide usage and the impact it has on people. There are interesting things here that could be developed, which have not been touched on.

Lord Maxton: I agree with you that we ought to be combining all our data but there is a problem of confidentiality in data. If it is an international business, as it is, that data can be shared with other people outside this country. If it is not confidential, it affects employment, insurance and all sorts of other ways of life. That is a major problem for data.

Sir Paul Nurse: I can only agree completely. We have to solve the problem of confidentiality, which should be a technical one, combined with will, of course, but we also need to have the right data, and that is what I was challenging.

The Chairman: We have data protection legislation going through just now, as you know. Yesterday we spent over an hour particularly focusing

on patient information, biological research information and the use of data. I do not think that we have found a solution yet, but you are quite right that a solution needs to be found.

Q66 **Lord Renfrew of Kaimsthorn:** We have already referred to Brexit. Do you feel that it will get research institutes like the Crick bogged down in various ways, or are there perhaps some opportunities that might accompany it?

Sir Paul Nurse: From my perspective, I have seen very few opportunities. We have, of course, many people from outside the European Union who have to go through the normal visa applications. It is expensive, tedious and it puts people off. If we leave the EU, where we have rather greater permeability and fluidity, we need to simplify the immigration system. Of course, a significant amount of the pressure to leave the EU was in fact to make it more difficult. We have a real dilemma there. Getting people into the country will require, in my view, simplification of the visas and so on.

There is a second point, which perhaps is not said enough. People worry about funding, EU networks and so on. All that is true, but, for me, going round to quite a few countries in the world, the real problem we have is our image. Our image is suffering terribly at this moment. Other countries feel that we are turning our back on the world, not just on Europe. That image is made even worse by the fact that, if the vote had been left to younger and more highly educated people, it would have gone the other way. We are alienating the very people we need. This is not helped by the posturing of some politicians. That hits the headlines out there. That is what they read. There is lots of sympathy on the science side, but we are losing all that sympathy by the image that we are presenting politically. We need to be much more robust, in a political sense, in embracing what the world will bring to us.

The Chairman: Is it having an effect on your recruitment at a junior level?

Sir Paul Nurse: It has not yet. I will say something about it. We have had one junior group leader recruitment, which was a year ago, so just after Brexit. We were really looking for three junior group leader appointments. We had nearly 400 applicants, 80% of whom came from overseas, so it had no impact at that point. We are just about to close our present search so I will have a comparator, given what has happened in the last year. I cannot tell you what it is yet but, if you ask me in a few weeks, I will be able to do so. I also have figures on our graduate programme, which is at a lower level. There we had—it is extraordinary—1,300 applicants for our graduate programme of 40 individuals. Can you imagine? It is completely overwhelming. We therefore have large numbers—big data in this case—which will give us a percentage of UK, EU outside the UK and rest of the world. We will have three data points and see where it is going. Interestingly, last year there was a 40% drop in applicants from outside the EU in the rest of the world, and that addresses this point that I was making about our image.

Q67 **Lord Mair:** You referred earlier to your dislike of the term "moonshot". Can I ask you about Sir John Bell's strategy regarding HARP, which is a DARPA-like programme?

Sir Paul Nurse: HARP is a good thing but quite difficult to deliver well, which is the reason why I was saying we need to dig under it as to how to deliver it. Defining moonshots is quite difficult. The reason I do not like moonshots is the following. You are an engineer and I hope you will agree with what I am about to say. The moonshot was built on Newtonian physics, which is from 1700, and bigger V2 rockets. What was required to make it work was political will and money. The amount of computing was relatively low.

What I am trying to say is that it is not the same territory. It is not a good metaphor for this stuff. It just is not. That is a metaphor where, if you throw money at something, the problem will solve itself, which it did. Trying to understand how human life works or how life works and thinking of ways in which we can use it is something that requires a lot more work before we can do it. That is why I do not like moonshot.

While I am on a rant over this, I will say something about risk. It is understood here, but if you read the summaries, they say we should be funding "risky research". It is utterly absurd to say we should fund risky research. We should fund bold and ambitious research, which is actually in there, and minimise the risk. Yet this is translated into saying we should fund risky research. This will get out there. Sooner or later, somebody will read this sentence and say, "What are these turkeys doing saying we should fund risky research?" Of course we should not. We should fund bold and ambitious research and minimise risk. They know that but it is when it gets turned into this soundbite that it loses sense.

Lord Mair: What about the multiple-partners aspect of the HARP programme?

Sir Paul Nurse: That is okay. I like multiple partners, but you have to get them to work together. There are two problems. You have to get them to work together, and that requires understanding human nature and where people come from. The second most difficult thing is identifying the nature of the moonshot. There was only one moon so you knew what to aim at but, in fact, there are lots of "moons" in this endeavour. I do not know how to work that out. That needs attention.

Lord Mair: How do you think the funding for HARP will work? It is a bit unclear as to what is meant in John Bell's report.

Sir Paul Nurse: I was not quite sure what it meant. I am used to setting things up, not understanding where the funding is coming from and hoping that it will continue. I do not worry about that too much yet, but what you are reflecting is a lack of strategic detail that is needed to deliver some of this stuff. That does not mean that this is not a good thing; I think it is a good thing but delivering it is pretty difficult.

Baroness Young of Old Scone: Can I have a small rant and then a question? I am keen on moonshots and I will tell you why. When I was at Diabetes UK, it used to drive me insane that we were so close to

developing a "vaccine" against type 1 diabetes, which revolutionised the lives of children across the globe, but we could not corral the research community in an effective way to focus on that. We knew what the moon was. The moon was there. For me, the big challenge was what the Yanks cracked with the moon programme, and that was a sustained corralling of research effort, anticipating what the problems would be and starting the research on the problems before they hit them. It was doing it in parallel rather than in series. When we were doing the type 1 vaccine, everyone was working in series and it was going to stretch into infinity for ever. Discuss.

The Chairman: Do not discuss the science of the vaccine development.

Sir Paul Nurse: I will not. You have an immunologist over there who is coming up; you can ask him about that.

It is not that I am against the corralling. I am in favour of it; that is what I tried to say. I am just objecting to the word. I do not like "moonshot" because I do not think it describes what is actually going on. I am saying that it is quite difficult to deliver because it is difficult to corral. It would be nice to see how we can actually deliver. I suspect we are not so far apart. Was that the rant? Was there a question after it?

Baroness Young of Old Scone: The question was this: do you think that, irrespective of the name "moonshot", there is a merit in trying to pull off some of these targeted research programs?

Sir Paul Nurse: If we can deliver them well, yes, definitely. The difficulty is delivering them well, and we do not have a tradition in this country of doing that in the way that you said. That is what has to be solved. I do not think anybody has a problem with it—at least I certainly do not—but delivering it is a bit of a struggle.

Q68 **The Chairman:** Paul, you are allowed to have more rants. I was going to ask you to tell me one thing that you would like to see in our report—a strong recommendation—that will help to drive the strategy or improve it. But you can have five short sentences.

Sir Paul Nurse: We need a proper life strategy, so we need an additional add-on. We need more strategic detail to solve some of these problems, which have been correctly identified—we have noted some of them as we have gone through—but which require greater strategic thinking as to how to deliver them in the context and the culture of the UK. That is required if we are going to implement this at all effectively.

Now I will go to some specifics. Genomics, in which of course the UK is a world leader, is fantastically good to promote. It needs connection to other data, which I think the NHS can provide, both for clinical outcome and for the environment. The third is difficult: it needs research. It is not something we can do now but we should be planning for that.

We need to think back to the corralling point you made of how we can get all the different parts of the community working together. Obviously money helps there, but there is something to do with the chemistry of individuals. We think that, if we take a scientist, a clinician and an

engineer and mix them together, they will all get on. The reality is that they are trained in rather different ways. Scientists are a bunch of anarchists who, if they do not know an answer to a problem, will sit on the fence and say, "We need to do more experiments". You do not want to go to your doctor for them to say, "Come back to me in six months when you have developed something else and I will tell you what to do". They operate in a completely different structure. It is a hierarchical structure. It is one that has to come to decisions quickly with the real situation.

You mix these people together and we need some sociology, in my view, to get them to talk properly together. That is an interesting thing that we could do here. We have several clinicians around the table. I am not sure that teaching our highly trained clinicians to handle small quantities of liquid, which is what we do in laboratories most of the time, is the best use of their skill set. I am going off the point here. We need to get different types of people working better together and that requires other things besides just mixing them and giving them money.

The Chairman: Do you think the strategy is likely to succeed?

Sir Paul Nurse: The objective of the strategy is a good one. I said that at the very beginning. It has identified important problems but, if it is going to succeed, it needs more work on implementation and how it will deliver things. If it does not get that, it will not succeed. If it gets that, it has a chance of succeeding.

The Chairman: On that note, thank you very much for hosting us and for this session. It has been most interesting.