



HOUSE OF LORDS

Science and Technology Committee

Corrected oral evidence: Engineering biology

Tuesday 14 May 2024

10.15 am

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Members present: Baroness Brown of Cambridge (The Chair); Lord Berkeley; Lord Borwick; Lord Drayson; Lord Lucas; Baroness Neuberger; Baroness Northover; Viscount Stansgate; Lord Strasburger; Baroness Willis of Summertown; Baroness Young of Old Scone.

Evidence Session No. 7

Heard in Public

Questions 71 - 85

Witnesses

I: Dr Clive Dix, Executive Chair, C4X Discovery; Lord Willetts, Co-founder, SynBioVen; Creator, Synthetic Biology Leadership Council; Dr Sara Holland, Partner - Patent Attorney, Potter Clarkson.

USE OF THE TRANSCRIPT

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

Examination of witnesses

Dr Clive Dix, Lord Willetts and Dr Sara Holland.

Q71 The Chair: I welcome our witnesses to the committee's seventh session of our inquiry into engineering biology. This morning we are hearing from Dr Clive Dix, the executive chair at C4X Discovery; Dr Sara Holland, partner at Potter Clarkson; and Lord Willetts, co-founder of SynBioVen.

The session is being broadcast on parliamentlive.tv and a full transcript is being taken, which will be sent to you shortly after the session for you to make any minor corrections. Should you think of anything that might be useful to us or, afterwards, anything that you wish you had said we would be very pleased to receive that as formal evidence to the inquiry.

Again, thank you very much for coming. We are looking forward to this session. We have heard a lot in this inquiry about the challenges companies face in scaling up beyond the start-up/SME level. We would be interested to hear from each of you what you think the major barriers are at that scale-up phase that are particular to the engineering biology sector.

Lord Willetts: Thank you very much for the opportunity to give evidence to your committee. For synthetic biology, the scale-up challenge is a vivid example of the wider British problem. I put it in three parts. One is substantial funding. The fund that I co-chair has a total of £20 million, of which £5 million goes to SynbiCITE, so we have £15 million to invest at an average of about £1 million an investment. When the companies do well they look for £10 million or £20 million. It is hard to find that kind of funding in the UK.

Secondly, the other form of scaling up is the infrastructure and facilities. We have a biofoundry at SynbiCITE. There are six across the country; there should be more. I think you will hear from the CPI later, but we need more capacity to get close to commercial scale of production of synbio products. There is still an enormous gap between what you can do in the lab and the volumes you need to be commercial.

Thirdly, the other scale-up problem is technicians—people to operate the kit. It is wonderful that two CDTs are being funded in the latest round of announcements, but we need technical people who can operate the kit, with a City & Guilds recognised qualification in operating the equipment. So technicians, funding and kit are the three challenges.

The Chair: That is lovely and clear.

Dr Clive Dix: Thank you for inviting me to give evidence. I caveat everything I say by the fact that I am not an expert in synthetic engineering. My background is drug discovery and everything I say is related to my experience of starting and growing drug discovery companies, but most of the issues are very similar.

I would like to say that the three things that stop growth of companies are funding, funding, and funding, but there are other things too. Funding is not as simple as having cash; it is where it comes from and the people who do it. The most important thing is sophisticated investors who understand what they are investing in and that they are there for the long term. It is too easy for somebody to come in and think they can, basically, make a quick buck, and soon they are trying to get out of the company, or trying to move it on and change it. Funding is very important and I am sure we will get on to talking more about it.

The facilities for drug discovery are not such an issue. We are getting a bit short of lab space now, but there are some ongoing initiatives that look quite promising. There is the Precision Health Technologies Accelerator in Birmingham. The Birmingham campus is building a lot of laboratory space. That is happening and has happened across Oxford, Cambridge and other big universities, so the start-up facilities are still good. Eventually moving on to manufacturing is a little bit different but the companies have to do that themselves.

It is only those two things, although everybody talks about entrepreneurial management: people with the right culture, the right knowledge, and the right attitude to building companies. The UK does not have a lot of success in that area, so we do not have a cadre of really fantastic management. We have some and they have been very good, but compared with the US—they paw all over you when you go there—the amount of management in the UK that can do this sort of stuff and grow companies properly is quite poor.

The Chair: I think we used to call that patient capital “Luxembourg grannies” many years ago.

Dr Clive Dix: They are very important.

The Chair: Neither of you has mentioned regulation as an inhibitor.

Lord Willetts: It is true that it looks complicated to an outsider and that there is a range of bodies with regulatory responsibilities. I am not convinced there should be a single overarching regulator. Although I am a shameless remainer and very much regret Brexit,

this is one of the areas where Brexit does bring opportunities. We have an opportunity to be much bolder than the rather cautious interpretation of the precautionary principle. In the days when I used to go the Competitiveness Council, there were some deep cultural and historic reasons why some EU countries were very wary of genetic modification and synthetic biology. We are relatively free of that. Our regulatory regime is not currently high on my list of problems.

Dr Sara Holland: Thank you for asking me to be here today. I was going to raise regulation. The caveat to what I am going to say is that most of the clients I work with are very much at the very early stage. I watched one of your evidence sessions and the scale-up size of companies those witnesses were talking about was 500 employees. Most of my clients are lucky if they hit 20 employees, so I am very much at the very early stage.

On the regulation, there is so much that we could do if the regulators would allow it, especially in the context of GMO. Take a company such as FOLIUM, which is engineering the microbiome of livestock to remove certain pests. This year or maybe next it is planning to launch in Brazil because it cannot launch here. It is a shame, not just for the companies that they are not growing but for us as a country that we cannot benefit from a lot of these products and services that we could if we had different regulations.

Finance and funding are obviously always key for everybody, but something needs to be done at the other end. A lot of the companies I work with are very mission driven; they are trying to save the planet and change the world. They are producing products that are more sustainable but are not cost-effective and cost-comparative to oil-based products. If I was an investor, why would I invest in something where, even if we get over the physical scale-up of being able to manufacture lots of it, it will still be more expensive and there is no market because people will not buy it? There is a massive inevitability about engineering biology. It has to happen, but we need to push it forward to happen sooner.

A lot of the companies that I work with are not planning to scale up. They plan to get to a certain point and be acquired, or move on and do something else. A lot of them have scientist founders, who are excited about the science and want to move on to the next thing, so they will take it so far and sell it to whoever—we hope in this country, but maybe somewhere else. I personally do not expect to see lots of scaled-up engineering biology companies—not at the moment, anyway.

Q72 **The Chair:** That is an interesting point at which to ask the other

part of my question. We are seeing quite a few companies getting to a certain stage in some of our key hubs, such as Cambridge, and then ultimately moving and floating abroad, particularly in the US. Is there anything the Government could do to reduce or prevent this and keep them here?

Lord Willetts: I should declare an interest in a different technology. I am on the board of Darktrace, which is currently going through exactly this process. In an ideal world we would have the capacity to grow all these companies fully and keep their ownership in the UK, but there is a fallback, which is at least for Governments to support them sufficiently before the Americans turn up and buy them. I remember one American investor saying that Britain grows the world's best corporate veal: the Americans turn it into beef; we grow the veal. That is their view of us. When the Americans inevitably turn up and buy a company, by then it should be sufficiently well-established and have sufficiently deep roots in a British ecosystem that it is a rational decision for an American investor to leave a large part of the operation here. Those are the assurances we have had for Darktrace. I regretted DeepMind being sold to Google. When you ask Demis Hassabis he will say, "We needed approximately £1 billion of compute power a year to do our work. There was no way we were going to find that from the British public or a private source. At least Google have kept a lot of activity here." That is a reasonable ambition in synthetic biology: for us to be such a lively global centre that, even if it is American VC funds that understand the value better than British investors, they do not shift them all to the west coast.

The Chair: We heard at the British Business Bank breakfast the other day that one of the other things you get from large companies elsewhere is more corporate venturing and investment in these countries. That is something we really are not seeing very much of in the UK and might be helpful in keeping companies here. Is that just our lack of large companies, or is it something about our tax or incentive system that means companies do not do that?

Dr Clive Dix: I could probably answer or give some insight into that. Within the drug discovery field and the pharmaceutical sector, the corporate venture arms are very active. They tend to be active in the start-up companies—the companies that come out of universities and are 20, 30 or 40 people building a promise through some science, a target, some novel biology or whatever. They do invest, but the problem we face is that, like every other start-up, it ends up in America.

There is a huge number of reasons for that. One is market forces: that is where the market is. You nearly always need to do your

clinical development in America because you cannot get on to the American market unless you have, and that is the main market you are aiming for. On top of that, these corporate ventures carry on with them, but as part of a much bigger funding that comes from big US funds that basically insist that you must be in the US. They really do not like flying across the Atlantic to see companies.

There is a real pull to America, even if you grow a business that has some important technologies. Paul—Lord Drayson—was part of that when I took on PowderJect. I built that company to carry on with that technology, which was tens of years in the making, coming out of some fantastic science at Oxford University, but it was bought by a big pharma, which happened to be Pfizer, which took it all in-house and then took it abroad. I do not know what the answer is, but big companies like to pull things in. It is very hard to have a big enough footprint for them to say, “We can’t get rid of this”. Pfizer was here and closed the whole of the Kent site, which was massive. Big companies really are not that bothered about keeping things, and we have no way of stopping that. I do not think there is any government intervention that can stop that.

The Chair: On that depressing note, I shall move on to Baroness Northover.

Q73 Baroness Northover: Expanding further on what Dr Dix just said, we have heard about the struggle to get investment—he just addressed that—particularly to build infrastructure, which Lord Willetts just mentioned, which VCs will not necessarily fund. Who are the investors who can provide capital at this scale? Are there success stories that we can learn from?

Lord Willetts: I think it is one of the responsibilities of government to help with that kind of shared infrastructure. It is what our network of catapults has done. The Cell and Gene Therapy Catapult is one of the reasons why we are very lively in that sector. The highest level of clean room that you need for work in that area is a very expensive investment for a single SME, but if you share it around and get it for free or charge it at cost it is viable. It can be done.

For our VC funds—I am happy to be corrected by the experts—the issue is, as one person put it to me very vividly, that if you are going to raise money for a tech company in the UK you take your CFO and if you are going to raise money in the US you take your CTO. The Americans are interested in the technology story. Because of the financialisation of our investment model in Britain, scientists and technologists find themselves constructing fantastical accounts of cash flow three years out, which everybody knows is a

totally unpredictable and strange world, but the Americans want an explanation why there is something special about your technology. Personally, I think this goes back to early specialisation in schools. A lot of the people you are pitching to in America are much more likely to be comfortable with science and tech, and have some tech-savvy capacity. One of the things that the technologists say to me is that the US conversations are at a completely different level: they are sophisticated people who want to get their heads around the technology, rather than people with financial training who want to know exactly what your EBITDA forecasts are.

If that is the analysis, what could you do? There are little practical things we could do. With the whole lifelong learning entitlement—four years of entitlement to learn—people who are studying biochemistry or whatever at university could also have a year when they do an MBA. One of the things that SynbiCITE does is provide basic mini-MBA training for great scientists who, for the first time, find themselves in a commercial environment. That could help.

Dr Clive Dix: I agree totally. You can see the demise of that funding model in the UK, and which the US has. Ten years ago there were funds—pension funds mainly—that had sophisticated healthcare teams that invested. They had healthcare analysts, so when you went to speak to them they were far more interested in what you were going to do than the money. Now when you go to these same funds they have turned their back a little bit on high-risk biotech and life sciences, but if you do get in the door they scrutinise your financials. They do not ask any questions about the fact that you may have the best drug in the world to cure something, which is really depressing when you leave the room. Anybody can do financials, in the end, and you can put anything you like in them because they will change within five years anyway because you will be moving things in different directions. It is almost the wrong thing to look at. There is an attitudinal difference in investment in the UK.

The venture community is not like that, as it happens. Some of the top VCs—the likes of Schroder Ventures, where Kate Bingham is—have really good scientists. They get very excited by your offering and do not talk about the money until the end. There is a difference, but if you are talking about the main markets there is no sophisticated investment thesis based on the technologies. I am not sure what they base it on; I think it is on outflows and inflows of currencies. That just does not work for the biotech sector.

Dr Sara Holland: I cannot speak to the financial side for infrastructure, but we have a lot of really good infrastructure in our

universities. It would be useful for early stage companies to access what is in a university on an ad hoc, quite quick basis, without getting stuck in years of discussing IP terms, which is what happens. People can use some bits of kit in Imperial College and other universities. That would really help the early stage. Not every engineering biology company is a spinout. There are programmes such as Carbon13 and Entrepreneur First, where people meet and set up a company with an idea, but they then need to get the data. They need that ability to go somewhere cheap to get that data. If I wanted to set up a biotech company now, I still would not have a clue, even with all the contacts I have. If I did not have my own personal funds to set that company up, I would not know how to start.

Q74 Baroness Northover: You have addressed to some extent the potential lack of knowledge in science and technology among investors and whether people are risk-averse because they do not have that. Lord Willetts did that just now. Could I also ask about the fact that the UK does not have many large companies that could pull these investments through from SMEs to mass production? Is there anything the Government could do? I will also bring you back to one of the original questions: can we point to any success stories in the United Kingdom for this? We have heard a great deal about the limitations, but are there any success stories that you can point to?

Lord Willetts: On success stories, this is a technology that is still at quite an early stage and on a long journey. It requires patient funding: biological processes will, over the course of the next decades, replace many conventional manufacturing processes and the use of carbon fuels, but it will take time. I can speak about SynbiCITE, which I know the best. It is the centre for commercialisation attached to Imperial. I checked the figures again recently: of the companies it has helped—that is a combination of helping them by letting them use its kit plus some business advice and support—its valuation of the 30 companies it has provided the most help to is now up to about £800 million. That is what it tells me. They are not yet massive primes that have become unicorns but there are some that are on the journey and making progress. That can be achieved.

There are other players in the sector, but I will talk about one of the things that we try to do at SynBioVen, which is only small. SynBioVen does not have a deal with Imperial where there is an automatic requirement that the companies going to SynbiCITE must go to it: it is an open system; it is not a closed requirement that it gets the right to invest. What it does get is two Imperial

professors sitting in on our investment committee meetings. We try to have a conversation where the professors are questioning and trying to understand the technology, and not an investment committee that is entirely dominated by the financials. That is a deliberate attempt to operate while applying the analysis that Dr Dix and I gave earlier.

Baroness Northover: Are you linking in with any of the business schools in Britain? You just pointed out that people who might do a biochemistry degree and then go on to do an MBA have a particular set of skills. As you said, you see that in the States. I know there are many international students in the business schools here but are the business schools here geared in that way?

Lord Willetts: We draw on the expertise of Imperial in the short courses that SynbiCITE runs. I would not like to comment more widely. This is certainly an area where business schools could help. There is a separate story of the incentive structure for business schools. That itself has perverse effects because it is brilliant research that gets you up the citation indices and the prestige, rather than being useful in applied research. There has been quite an open and lively debate in the business school community about some of the perverse incentives it faces.

Dr Clive Dix: You asked whether there are any examples of success stories. Oxford Nanopore is a success story. It was almost forced to list on the FTSE in the end: it was going all over the place to try to raise money and missed elsewhere, but it has managed. You should look at its history. It took so long and the company went through some really difficult times. The people who invested in it had a long view and they stuck with it, and now we have a billion-pound company in the UK. Sadly, I cannot think of any more. They have nearly all gone.

Dr Sara Holland: To follow up on what Lord Willetts said about business education and people who are coming out of university, I work with a lot of academics while they are still in university and people who have recently left the university as PhDs or post-docs. I was a post-doc until I was 33. I knew nothing about entrepreneurial skills. I was literally told to be in the lab and do my research. I did not even think about other careers.

I do not think that has changed that much. I do a lot of IP talks to academic institutions and mentor various accelerators and incubators. It is good that people are starting to turn up, so there is a shift in that people in academia are starting to think more about commercialising, but you can tell that they really do not understand anything. We need to upskill even a little bit, in the

context of IP at least. I found it a massive learning curve coming straight from a life of pipetting to learning about IP. A founder needs to learn about IP—albeit not in as much detail as me—finances, marketing and all that stuff. There is a role for somebody to do a lot more and consolidate it a bit. Like I said, I speak on so many different things and I say the same things to a lot of different, small amounts of people.

On whether we have big companies, we need to remember that engineering biology covers every sector: electronics, engineering, materials. We do have companies, but maybe they do not know about engineering biology. I think the engineering biology vision spoke about having a roadshow to bring in big companies. An electronics company might say, “I’m nothing to do with biology. What’s that got to do with me?”, but there are solutions for those companies.

Dr Clive Dix: The one thing I would add on the skill base for running small companies is that I am a great believer in learning on the job. Successful small companies normally have a very strong management team. That whole team learns on the journey. You can spot them; you can see them. Those people spread out and become the start of new companies because they have all learned together. There is nothing better than learning on the job, because you see it day to day. If you have a good CEO with a good team—a chief business officer, a chief finance officer, a chief scientist—each one of them could easily become the start of a new business. That does happen in successful businesses.

Q75 Baroness Willis of Summertown: I want to follow up with Lord Willetts on his comments about MBAs. I am based in Oxford. Our MBA is incredibly expensive and goes nowhere near this area. I have taught on a biological sciences degree for the last 30 years and most degrees now have a MBiol—they have an “M” attached to the fourth year. You said that we need CTOs rather than CFOs, and that we need to join them together. Do you think there is a space that we should be exploring in the education sector for a specific MBA that is for these sorts of spinouts? I do not think an MBA will necessarily do what I think I am hearing you say that we need.

Lord Willetts: I agree with that point. I should be clear: for SynbiCITE, which is the commercialisation centre of the UK, its MBAs are mini-MBAs. They are sometimes literally a few weeks, just to help people get familiar with the way markets work if they are thinking of doing an IPO. It should be a lot shorter than a full-blown MBA. I was speculating, because with the lifelong loan entitlement—these four years of funding—you could imagine

integrating one year max of business study alongside a biochemistry degree.

The other thing where things are getting better—this follows on from what Dr Holland said—is doctoral training and the centres for doctoral training. It is important to communicate, as the centres for doctoral training have expanded, that it does not follow that the only career option if you get a doctorate is becoming an academic. Indeed, looking at the shape of the career pyramid, there is no way that people going through centres for doctoral training will all become academics. The whole idea of the centres is to have more people with a doctoral qualification going out into the big wide world. Increasingly, the centres for doctoral training involve business and some business training as part of their doctoral programme to prepare people not for going on to be a post-doc in academia but for going on to a job in business. There are several stages when we can do something.

Q76 Baroness Willis of Summertown: The question I was going to ask was for Dr Holland about IP. You specialise in intellectual property in this sector. We would be interested to hear what some of the challenges are. From personal experience, I found that one of the big challenges is that many scientists do not understand what IP even is. I would be interested to hear whether that is true more broadly or whether there are other challenges in their way.

Dr Sara Holland: That is true. Like I said, I do a lot of education. My first slides are, "This is IP. This is why you should care. You're not going to not make it as an academic, but chances are you're not. How about spinout and thinking about other things?" A lot of it is getting the scientists founders to appreciate this, and to understand it is really valuable: it is the core of their business. I know the team is important and all that sort of stuff, but if people are going to buy you it will be for your patents, your trade secrets and your IP.

A key challenge in biotech and life sciences more generally is that you need data to get a patent. In engineering, if you come up with a new widget you can just draw a picture of it. As long as the laws of physics make it make sense and it is going to work, that is enough. You do not need to spend lots of money renting out lab space. Biotech is very different because biology is unpredictable. Patent examiners want to see the data. The first hurdle for a lot of the companies I work with is getting that proof of concept data.

There is this awful chicken-and-egg, but a three-way chicken-and-egg, that you need the data to get a patent, but you need the money to get the data, and you cannot get the money because

investors are increasingly pushing to get a patent or at least have something on file. A lot of the companies I work with are doing quite well on innovate funding, so that is there at least and that is how they are getting this proof of concept. It takes ages. It would be great if they could just pop into a lab and do their work. A lot of it does not have to take long if it is on microbes—we were talking earlier about plants—and you do not need much data for an application. You just need to be plausible. That is one of the main challenges.

I am not the person to talk to about this but I know people who are, but something that may be a problem for companies at some point is the Nagoya protocol. A lot of companies use strains that may have come from overseas and which the Nagoya protocol applies to. Digital sequences are also a big problem. The companies I work with probably do not know that is a thing that might happen. I do not know enough about it, but if you have not looked at it you might want to.

Baroness Willis of Summertown: There is another challenge I was keen to explore. You talked about labs and that there should be greater use of university labs, but many universities have restrictions in place that commercial businesses cannot use the labs. Also, as a scientist, the pressures are on to publish. Do you come across that?

Dr Sara Holland: That is mainly restricted to academia. As soon as people leave academia they are happy to say, “I’m not going to publish. I know the reasons not to publish”. It takes away a lot of the strategic piece around it. A lot of companies rely on subject matter that they will get patents for and trade secrets. If you are in academia and you have to publish, because that is what your entire life is built around, the potential to keep that as a confidential piece of information has gone. If you are going to publish you have to file quite early. Sometimes it is enough: you have the data and you have the invention. There is quite a big strategic gap.

The way patent attorney firms normally work with a tech transfer office—again, this is just for universities—is they will have that initial conversation with the inventor early on, draft and file the application, and after that they very rarely get to speak to the academic inventors again. I have had cases where we have done this bit, we prosecute it and talk to tech transfer and to media, which presumably speak to the investors and pass on their comments, then all of a sudden they are spinning out but no IP strategy has been put in place. These spinouts then talk to

investors and they do not know anything because they have not had the education. A lot could be done in that middle bit.

I would add that a lot of innovation in universities is not being captured because people do not know to come forward. The tech transfer officers are not funded enough to go out and actively speak to people. It makes me wonder what there is in our academic labs that we never get to benefit from.

The Chair: I am afraid we are going to have to hurry up a little bit because we have quite a few questions still to get through and we are half way through our time.

Q77 **Viscount Stansgate:** I will shorten the questions. How easy is it for the law and the relevant authorities to keep up with rapid developments in a field such as engineering biology?

Dr Sara Holland: My understanding is that the law would be quite easy because there is new science all the time. In patents at least, patent officers see what people are filing. From my understanding, the regulators maybe do not know what is coming. This is just from speaking to one person the other day, but I had not realised that the regulators are not able to reach out to specific companies because there is then a perceived conflict in asking. They have to wait for the companies to come forward to say, "This is what we want to do: if somebody made an engineered bacterial biosensor, what are the regulatory pathways?" I do not know if the regulators are fully aware of what engineering biology can and will be able to do and how to filter it down.

Viscount Stansgate: DSIT's research shows that the UK is third for investments in engineering biology but sixth when it comes to patents granted, which is comparable to Switzerland. Why do you think this is, how concerned should we be about it, and what do you think the Government can do about it?

Dr Sara Holland: From what I have seen, I do not think that those datasets are comparable. The dataset for investment was maybe over five years and the dataset for patents was over 10 years. They might have been pulled from different sources. Maybe this is another reason why we need more scientists in policy; I do not think you can reach a valid conclusion from those datasets. Very tiny start-ups that I took on two or three years ago are now starting to file their first patents, because it takes ages to get the data. As soon as they get the data they can file. I am not particularly concerned. I do not think there is a problem with people not filing patents; maybe that dataset just does not correlate as well as it looked like it did.

Viscount Stansgate: Are IP concerns preventing SMEs and start-ups working with bigger companies to scale up their products? If so, what could be done about that?

Dr Sara Holland: I do not think so. Engineering biology is very collaborative. A lot of my clients are starting to work together, which may end up being a conflict for me at some point, but it is quite nice to see everybody working together. They are actively seeking out the bigger companies; they want to work with them. I have examples of people working with L'Oréal and Croda. There is an appreciation that, as a small start-up, you cannot do it yourself. You need to reach out to these bigger partners. As long as they are sensible, they have their NDAs in place and, preferably, they have filed something on their own technology before they enter these more detailed discussions then I do not see it holding people back and preventing them having the discussions.

Q78 **Viscount Stansgate:** My final question on the review of university spinouts, which recommended a less controlling approach to IP by universities. Do you support this and what more could the Government do to help this aspect of commercialisation work?

Dr Sara Holland: Universities need to work out what they are there for. If it is to make money that is fine, they can keep the IP but they should do it properly in a way that makes sense to investors. If they there to have impact, they should let it go: let the markets and small start-ups take that IP and do stuff with it. Trying to straddle both is part of the problem. It takes a long time and we could have so many more spinouts.

Dr Clive Dix: I could add one thing to that, which is the American model for IP: the inventor, whether at university or not, is the main owner of the IP and they can do what they like. They need to work with the university but it is their call. Things move much more rapidly in America when it comes to forming companies from innovation.

Q79 **Lord Drayson:** I note for the record that Dr Dix and I worked together at PowderJect Pharmaceuticals. I would like to focus on Lord Willetts to start with, to benefit from his experience in government. We have already heard from witnesses in this inquiry that back in around 2014 the UK led the world in this area, in part because of the investments in the creation of the biofoundries, but over the last 10 years the rest of the world, which at that time said, "Wow, that is a fantastic model; we should copy that", has massively invested in the space and overtaken us. Looking back, what is it that the Government did wrong during the past 10 years?

Lord Willetts: That is a big question. To some extent this was just other people spotting the opportunity that UK academics and researchers had been on to early. I regret that there was not the scale-up funding investment early. We will hear from the CPI, which is an excellent centre, but we need a network and we need to hold the costs down. We now have stories of companies that have started up in the UK doing the scale-up elsewhere, where there is greater access to the facilities they need for fermentation on a larger scale. Even the excellent vision that was published just at the end of last year asks questions; it says, "We need to consult on what kind of investment in further infrastructure might be necessary". It is blindingly obvious: we need more biofoundries, we need more fermentation capacity that is not quite fully commercial, and we need to get on with it. That is the first problem.

The second thing is that there was a bit of pushback. Acting on official advice and learned experts, we identified the eight great technologies—key technologies that we should invest in. Some of my successors were wary that Governments should do this, that we were bound to get it wrong, that it was all hopeless and asked why we should do it. I have just published a review, 10 years on: the eight great technologies were not perfect but it is still a respectable list. It shows it is not an absurd exercise.

Lord Drayson: Could I push you on that point? We have heard from other witnesses that there has almost been an ideology that the Government should continue to invest in very high-quality science and it should be left to the market to pull through that science to create commercial success and build economic growth in the UK. The lack of active intervention by the Government has been at the heart of this. Would you say that is a fair criticism? Is the lack of any form of effective implementation of an industrial strategy at the heart of this?

Lord Willetts: There were people, and some Ministers, who had those anxieties. It just became clear to me that everybody who starts off thinking they will just have horizontal policies to help everyone ends up finding they have vertical policies to help particular people and particular technologies in particular places, because that is how so many decisions are taken. What I always say to people in my party in particular is that this is not some bit of left-wing ideology; it is what they do in America. This is what Republican Presidents and Republican state governors do. Of course these things eventually end up in the market, but our public support stops sooner than in most other advanced western countries, before things are fully commercial. We then beat up on ourselves that we are risk-averse when government is not bearing

some of the risk that federal agencies bear in the US. I am only suggesting we should do what the US DOD, the Californian state and large American federations do.

There was also a hiccup for a time when the way out from backing technologies was that the only thing that mattered were challenges and missions. Challenge and mission thinking is also very helpful, but there was a point when all the funding for synthetic biology in UKRI was about to come to an end. I was arguing, "Hang on, this is getting quite risky and dangerous", and I remember one senior person said to me, "Oh, but synthetic biology is not a challenge; it's a technology". As it was a technology it should not be funded, because in the new doctrine you only fund challenges. Again, eventually people were more pragmatic and they saw it was okay to support technologies. There were those ups and downs. In the last few years, we are back in a much better place.

Lord Drayson: Looking forward to the next Government, whoever they may be, what would be your recommendation as to the areas the Government should invest and intervene in to achieve the type of success that can move the dial for the UK economy? The Prime Minister mentioned Novo Nordisk yesterday; what would you recommend that the next Government do to make sure that these companies grow and stay here in the UK, and contribute to the UK economy?

Lord Willetts: You could update the eight great technologies. Of course, Kwasi Kwarteng, the then Secretary of State, had the seven technology families. We currently have five critical technologies, which is a slightly odd list. It has three important general purpose technologies—AI, synthetic biology and quantum—and two quite big business sectors, telecoms and semiconductors. You can sense it was put together by DCMS and BIS; it does not have anything from green tech.

I do not think it is the last word, but equally I would say to any Government, "Don't tear up everything you inherit. You'll find some effective programmes on quantum and I hope a good programme on synbio, but have a broader range of technologies: some dry digital tech things, some wet bio genomic synbio cell therapy things, and some foundational things, which, in my original list, were advanced materials and energy storage". If I may say so, when I arrived as a Minister in 2010 I was happy to draw on work that I inherited, including an excellent plan on space that you yourself had written and which I then implemented. There will be work that can be drawn on but I do not think the five critical technologies are the last word.

Lord Drayson: That is kind of you. Dr Dix, on this point about the opportunity of ensuring these companies grow here, what would be your recommendations to the next Government?

Dr Clive Dix: I will be slightly controversial and think broadly about how the Government operate, as opposed to any specific thing. Having had the experience of being the deputy chair and then chair of the Vaccine Taskforce, I saw the inside of the Government working under immense pressure, of course, and with a lot of urgency. What I was appalled by and worked around was the wrong people in the Civil Service being involved in the whole thing. Those are the same people who are now involved in making all these government policies work. I do not think they are fit for purpose. There are very few people from the STEM background there. When we take policies on and push them out we need people who almost mirror what is going on in the commercial world, who act on behalf of the Government but understand it too—not some very bright, young graduates who have come out of politics sitting there doing it. They really do not have the experience and the understanding. It is almost like there is a block from what the Ministers want. I did not expect to feel sorry for Ministers, but I just did not think they were getting the right support, the right information and the knowledge base. There were not people with that cadre of understanding.

My recommendation for the next Government is to reinvent the Civil Service around business and have many more people with industrial experience and science experience. There will be people who could stand up in public and speak it as well as the industry. They would be thought leaders in themselves, even though they are civil servants. Without that you will keep hitting that same sponge. It is a sponge; it is a blob.

Q80 **Lord Lucas:** Picking up on what you just said, Dr Dix, having solved the problem of how to improve the Government, how do we improve the City—or at least, what can the Government help do about it? When I was in the City we had no trouble at all in funding innovative technology on a large scale. The whole mobile phone rollout was just the next thing you did and a lot of good advice was available.

Dr Clive Dix: I can only give you my view on the life science, healthcare, drug discovery sector part of that. It is structurally difficult because, basically, we have NICE, which pushes down the price of drugs, so the UK is not the place people want to invest in. Big pharma does not like the UK. The UK is almost like an enemy to big pharma: it knows it has to battle to get the pricing right every time. It is not open to having a partnership with the UK

Government because it spends all its time fighting them on pricing. That is a huge issue that needs addressing. If big pharma has to give these big rebates back to the country and keep the prices down, why would it invest in this country when it could invest in other countries that give a better deal? That is a big factor.

We have only two companies that are UK-domiciled, GSK and AstraZeneca. Both are on the American exchange and I am sure that, one day, they will jump up and go, because they do not see the UK as the place where there is a market need. That is an issue. Then, because that is an issue, all the big funds have literally turned their back on the UK. They have all gone to the US, because that is where they can ply their trade, invest their money and get returns.

How do you fix that problem? It has been a 10-year demise. There must be a 10-year growth again and a series of things put in place where we see the industry as partners and friends, not adversaries. As a country, we are seen by the industry as an adversary. That is not good for getting growth; you need to work together. We did that during the task force: we went to the industry with open arms and said, "We know we want you to do this. This is what we can help you with", and my God, they came and they worked. They said, "If this is the future, we'll do more of that in other areas", but it has all gone again. That takes an attitudinal change within government. It is not single things with the market or regulations: you need to pull those people back in, then maybe the pension funds will see that the UK is a good place again.

Lord Willetts: When you look at the scale-up funding challenge and you look at an investment of, say, £50 million, you want investors for whom £50 million is not almost literally betting the bank. That £50 million will need to be a small part so that you can spread your risk around. That means you need some big funds. What the Chancellor is now trying to do to aggregate pension fund pots and get some bigger funds that can, in turn, make those type of scale of investments is the right thing to do. It needs to carry on and go further and faster.

The other thing the Government can do is that you hear from our tech companies that one of the questions they get abroad is, "If you're so good at this, why aren't you selling to your own Government?" Sometimes they try to sell to an overseas Government before they have a UK contract. We had some new legislation go through the House, but UK procurement rules still make it virtually impossible to pay for something in advance, for example. It is quite hard to buy data in advance. When you go to

US tech conferences, you will ask companies how they are funded and they have the ideal non-dilutive funding: "I've already sold my first 20,000 widgets to the DOD. I haven't made them yet, but I have a prototype and they like it, so they bought 20,000". That is pretty much contrary to UK procurement rules. Synthetic biology has so many applications. You can imagine DESNZ having some innovative contracts with synbio companies that will replace conventional carbon-producing energy sources even before they are fully operational. If it ends up that companies cannot then deliver some of the contracts, that is not a political scandal; it is the risk you need to bear if you fund innovation.

Lord Lucas: In terms of the capacity of the financial markets, are they queuing up for your fund? Are they knocking on the door saying, "When will you let us in?"

Lord Willetts: We would certainly like to expand, because £20 million is very small. We now have a track record; we have shown that it works. We have only been going for about 18 months and we have our first nine deals. Where we are unusual—and I would like to see more of this—is that we are a fund with a particular expertise in one technology. It is a general purpose technology, but nevertheless we are synthetic biology, just like Seraphim is space technologies. A lot of the City approach is to be a technology fund across a much wider range of technologies, so we are a rather unusual model. We would like to expand, and we have had one or two conversations about growing our fund significantly.

Lord Lucas: Would you like to see the public come in on this? You have some good stories there.

Lord Willetts: I am separately on the board of an investment trust—a biotech growth trust—which does have real retail investors, so it can be done. We are not legally a VC fund; we are a company making these investments. We would perhaps like to down the track, but there would certainly be a set of regulatory hurdles. This is early stage high risk investment.

Q81 **Lord Lucas:** A last question for Dr Dix. How is the MHRA performing? Are there things that it needs to do better?

Dr Clive Dix: It is performing very well. In fact, it is one of the gems in the UK when it comes to pharmaceuticals. A combination of that and the ability to do clinical trials efficiently should be put together as a selling point for the UK, and we should be attracting companies here to do that. We managed to do it during Covid. The MHRA worked phenomenally quickly without ruining any of the good practice. The setting up of the vaccine registry, which allowed

us to get people into trials very quickly, could be broadened out. It could be much broader. If the UK could be seen as a place for doing clinical trials and having strong but efficient regulatory oversight, which it does have, that could attract many companies to the UK. Patients could then see those things happening earlier and we could get better access for patients too. I am an absolute believer in that.

Q82 Baroness Young of Old Scone: Lord Willetts, you very briefly painted a vision of identifying the potential for engineering biology, and advance contracting by government to help bring it through in areas where it is not happening. How do we overcome the Government's antipathy to spotting winners? They are very reluctant to choose technologies even in the broadest scale. Is that something that can be overcome?

Lord Willetts: As I said in answer to Lord Drayson, we have gone through a cycle. There was a period when that sceptical view was not exclusive but dominant, but only for two or three years. For the last few years the Government Office for Science has been doing technology assessments for government. Oddly enough, the security and defence angle is having a big impact, because people on the defence and security side have always been doing horizon scanning and been very aware of what critical technologies need to be invested in. Security is now such an important part of any science and tech decision that it has brought technology assessment into the mainstream. A Cambridge tech entrepreneur said a few years back, "Why is it that the MOD is so clear about the significance of what I'm doing that it's very wary of me having any overseas dealings, but the Treasury so doubts that it could possibly assess the value of any technology it won't put any public money in?" That battle has basically been won by the defence people.

If anything, the challenge now is to work out how you do proper technology horizon scanning—the Government Office for Science and Innovate UK are the two key agents that are used—and then act on it patiently. The taboos on doing that have gone. Three of the five critical technologies are a great start but I would add some more. Fund them properly. For quantum and synbio, we are talking about sums of £2 billion over 10 years. That kind of patient, long-term commitment would work.

It is not all politicians; one of the other obstacles is academic peer review if this funding is distributed through an academic model. I can think of a real life example with antimicrobial resistance. One year, the bids for money for antimicrobial resistance work failed on peer review; they were not the best bids. The academics said, "We're not funding antimicrobial resistance this year because none

of the bids have had high enough grades on peer review”, to which the argument came back, “Hang on. This is a strategic priority. We ought to carry on doing it. We can’t not do it this year because they’ve done poorly on peer review”. The balance within the academic community between peer review assessment and strategic priorities is something that needs to be tackled. The problems are not just political.

Baroness Young of Old Scone: If we compare ourselves with other countries where the Government take a more proactive role, it would be useful to know where you think that is particularly well done. Should we adopt things such as the US public procurement programme overtly?

Lord Willetts: The US has incredibly deep pockets but, yes, we can learn from the US. What Israel does amazing; what Korea does is very impressive. In some areas the EU does well, but in this area it is small “c” conservative, cautious and worried about risk and the precautionary principle. One of the reasons for the UK placing some big bets in these biological sciences—cell and gene therapy, synthetic biology—is precisely the inhibitions within the EU for advances going down this route. I can remember when we legislated for mitochondrial donation and I met with a group of German MPs, who said that because of what the Nazis did with their attempts at perfecting humans it is pretty much impossible to license anything like this in Germany, which has a deep aversion to it. This is an area where the UK has some competitive advantage, as is GM crops.

Baroness Young of Old Scone: Dr Dix and Dr Holland, do you have any pin-up countries that you think we ought to emulate?

Dr Clive Dix: With healthcare, it is the US. It is streets ahead. It has a very vibrant community on the funding side, on the adoption of new drugs and on paying for them. It is struggling at the moment because it is probably paying too much, but it pays market price where we do not.

Q83 Lord Drayson: I would like to ask Lord Willets for his comments on what Dr Dix said about the expertise within the Civil Service. We have heard from other witnesses a concern that the UK Civil Service has struggled to retain expertise in particular scientific areas. Given you said you believe the taboo has gone then it is a question of effective implementation. What do the Government need to do to increase the capacity to effectively implement policies?

Lord Willetts: First of all, I understand Dr Dix's analysis. What you find is civil servants whose area of expertise increasingly becomes process. You get process briefs that are all about handling, parliamentary procedure and legal review, but avoid the crucial thing: what actually do we do? Where do we put this? What exactly do we procure to build? People are wary of those decisions, partly because of this deep anxiety that we will end up back in British Leyland, that it will all go wrong, that we will not be able to do it and that we will make a mess of it, so we avoid ever taking a view on a real think. Peter Thiel's book *Zero to One* is very good on all this.

On what they can do, there is now real technological expertise in Research Councils UK, Innovate UK and the Government Office for Science. Sometimes the challenge is paying people sufficiently to keep them as experts. There is increasingly a Civil Service career model where you move around: you do three years on one subject, then you move to a different department and do something completely different for three years. Process expertise is the only thing you then show: "I've steered a Bill through Parliament", or, "I've drafted a White Paper". Paying people to stay put when they know their stuff would be a good change.

The industrial strategy challenge fund evaluations are a good example of what can be done. The original design was constrained. People went over to DARPA and they wanted DARPA directors, but the Treasury would not allow them to pay anything like that rate and it wanted a committee to scrutinise what they did every two months or something. In the end, the individual industrial strategy challenge funds are now scoring very highly on evaluation and they had expert challenge directors to deliver a programme not unlike what DARPA does.

Q84 **Lord Borwick:** Lord Willets, you have mentioned DARPA quite a lot but you have not mentioned ARIA. Are you optimistic as to how ARIA is starting, or does it need the implied orders that DARPA has by being part of the Department of Defense?

Lord Willetts: ARIA is a great initiative and I want it to succeed. My worry has always been that it condemns everyone else to being seen as boring and risk-adverse. I served on the board of UKRI until last year. Every time I heard a Minister say, "ARIA's going to do high-return, high-risk investment", I thought, "UKRI should also bloody well be expected to do high-return, high-risk investment. So should Innovate UK". It should not be that we have this one tiny body that is the only place where we allow proper risks to be taken. I would like the ARIA culture to suffuse much more widely across the much bigger research funding agencies as well.

Lord Borwick: One of the big things that gets the publicity in America is the DARPA challenges where they do not know when they start, but ARIA is not doing those big, flashy challenges in the same way. Is that a problem?

Lord Willetts: I am probably not as aware as I should be; I think ARIA is still at the stage of consulting on what its priorities will be. Challenges are part of it but they can sometimes play into this Civil Service anxiety about not having any substantive knowledge. Sometimes a challenge is a great way of hiding the fact you are ignorant about what the real technologies can do: "Let's just have a challenge and then it'll be technology neutral and we'll see what happens". Challenges are often used in the US on the basis of quite a good understanding of where the technology is heading and are used to speed up the advance of a particular technology. We are always told about moonshots. Kennedy's moonshot was formulated at least five years after they had already started investing in Saturn V rockets. It was to speed up the development of rockets. It was not someone sitting around in a Cabinet committee saying, "It'd be nice to get to the moon". In other words, challenges should be informed by an understanding of where the technologies are and be intended to advance them.

Q85 **Baroness Neuberger:** This is the final question, and not an unexpected one. Obviously the ultimate purpose of our inquiry is to produce a report with conclusions and recommendations for the Government and questions for the Minister. What would your three key recommendations be and what questions or take-home messages would you most like to put to the Government? We have a lot of things that have come out of the conversation today but let us have your top three.

Lord Willetts: The vision document last December was an excellent starting point but it is important—going back to the exchange we have just had—urgently to get on with the substantive decisions: exactly what kit are we now going to pay for to build? How will we promote City & Guilds to have proper technician training. Delivering that is the first one. The second is a focus on the scale-up challenge.

The third one, if I may, is an observation on the inquiries from the committee this morning. An area where I never got a proper answer—I tried to resolve it when I was the Science Minister—is the non-medical life sciences. One of the other problems we have had is as soon as you talk about anything to do with biological science or life sciences the medical stuff takes over. It is very powerful and very significant, but I remember asking the director of the Office for Life Sciences, "As the Office for Life Sciences, do

you only do medical life sciences or do you have any government responsibility for agritech or other uses of biological processes?" If I may say so, even in our exchanges today you tilt towards biotech and medicine—Dr Dix is the expert there. That is where there is a richer, stronger environment. It is non-medical life sciences that demand attention, so many life sciences strategies end up being medical strategies.

Baroness Neuberger: That is a very good point. I chair UCLH and you can see how that takes hold.

Dr Clive Dix: First of all, the UK should be congratulated on what it is doing in life sciences at the innovation level. We must keep applauding that because it is good and it is world-leading, but we must now focus on how we commercialise it. The key factors are along the lines of funding and the attitude within government to commercialisation. I do not think it is right; it is adversarial as opposed to partnership based. We need those two things to be done, while looking at how we can help with the funding—not necessarily funding it, but looking at why the funds are not here. Let us dig into the real reasons behind that. Nobody knows why they have all walked away but we need to find and fix that, and then have a Government who are fit for purpose in terms of the people who interact with industry.

Dr Sara Holland: I strongly agree with what Lord Willetts said about the assumption that as soon as you are talking about biotechnology it is the life sciences and the therapeutics. Most of my work is in non-therapeutic biotech. It is like the forgotten ugly sister and that upsets me quite a bit.

I would like to see us looking into using universities more and getting more from them—for the universities themselves as well, but also for the academics who are already there and the external companies that already exist. We talked about companies leaving the UK to go to the US but there is also a brain drain from the UK regions down south to the golden triangle. It would be nice to look into that in a bit more detail to have distributed manufacturing and to make sure the regions are supported, so that if you want to set up a biotech company in Nottingham you do not feel you have to move to Cambridge because that is what investors expect and that is where the money is. They are my key things.

The Chair: Thank you all very much indeed. That has been an interesting session and we appreciate your time. As we have said, you will be getting the transcript shortly after this session and we would appreciate any minor changes you need to make.