HOUSE OF LORDS

Revised transcript of evidence taken before

The Select Committee on Science and Technology

Inquiry on

GENETICALLY MODIFIED INSECTS

Evidence Session No. 1 *Heard in Public* *Questions 1 - 15*

TUESDAY 13 OCTOBER 2015

10.40 am

Witnesses: Dr Paul Burrows, Professor Tim Dafforn and Ian Meikle

USE OF THE TRANSCRIPT

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

Members present

Earl of Selborne (Chairman)
Lord Cameron of Dillington
Lord Fox
Lord Hennessy of Nympsfield
Lord Hunt of Chesterton
Lord Kakkar
Lord Krebs (co-opted)
Baroness Manningham-Buller
Lord Maxton
Duke of Montrose
Baroness Morgan of Huyton
Baroness Neville-Jones
Lord Patel (co-opted)
Lord Peston
Viscount Ridley
Lord Vallance of Tummel

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Lord Taverne

Examination of Witnesses

Dr Paul Burrows, Executive Director, Biotechnology and Biological Sciences Research Council (BBSRC), **Professor Tim Dafforn**, Chief Scientific Adviser, Department for Business, Innovation and Skills (BIS), and **Ian Meikle**, Head of Agriculture and Food, Innovate UK

Q1 The Chairman: Welcome. We are very pleased that you have been able to join us at this, our first evidence session on this inquiry. Thank you very much for joining us. Would you like to introduce yourselves for the record first?

Dr Burrows: I am Paul Burrows. I am Executive Director of Corporate Policy and Strategy with BBSRC.

Professor Dafforn*:* I am Tim Dafforn, Chief Scientific Adviser at BIS.

Ian Meikle: I am Ian Meikle, Head of Agriculture and Food at Innovate UK, the UK's innovation agency.

The Chairman: Thank you very much. Would any of you like to make an initial statement before we go into our questioning?

Ian Meikle: Would it be useful if I just gave a little background to Innovate UK, so we are talking about a business context and so on? Would that be good?

The Chairman: Yes, please do so.

Ian Meikle: Innovate UK is the Government's innovation agency. We translate the research that comes out of our academic institutions to public benefit and for growth within the UK economy. We have been working for about the last eight years. We have invested

£1.5 billion in UK companies. That is co-invested with the companies, because they have also invested £1.5 billion, so between us we have co-invested £3 billion in innovation in UK firms. For every pound we invest, we return about £6 to the UK economy, and every company we work with on average creates seven new jobs. In summary, we help the UK stay productive, help the UK remain competitive through innovation and prepare us for future growth. This is very much part of our agenda, helping pull through the academic research.

Q2 The Chairman: Thank you very much. If there are no other introductory remarks, let me start with perhaps the first question. First, I must remember to declare my interests in this first session. I have to declare that I am a fellow of the Royal Society, a fellow of the Royal Society of Biology, a farmer and horticulturalist and vice-patron of the Royal Entomological Society. If I could ask rather a general question to start, could you tell us how research and development of GM insect technologies is currently funded in the United Kingdom? Do you consider that there is a reasonable balance between funding for the basic research and translation, and particularly field trials? We would be interested in hearing, if the technology has moved to that stage, whether you feel funding would be in place for that stage of the technology development.

Dr Burrows: There are several opportunities for funding of GM insects in the university, academic and general business systems in the UK. There are the research councils, of course. It depends very much on where the research is in its development and its application. There are the research councils; BBSRC, MRC and NERC are primarily the important ones there. We have Innovate UK, and I will let Ian say a little more about Innovate UK's approach to the funding of GM insects. It could also potentially be funded, of course, by European funding or by other government department funding, although I am not personally aware of any funding coming from other government departments at the moment. That is more or less on the public side of things.

On the private side of things, there are of course big trusts and foundations. The Wellcome Trust, I notice, in its submission has said that it has funded GM insects to the tune of just short of £1 million in recent times. There are then large international foundations such as the Bill & Melinda Gates Foundation. That is broadly the funding environment in the UK.

Overall, the research councils, over a five-year period ending in 2014-2015, have invested around £50 million in GM insect research, although it is important to draw a distinction. There is the use of GM insects as a research tool in laboratories, which is where the vast majority of research goes: for example, genetic modification of drosophila, the fruit fly, which is a very useful model organism in biological research. It is used in genetics, in understanding cellular development and many other aspects. These are the research tool applications. There is no indication that those would ever be deliberately released; that is not the purpose of the research. It is the fundamental science that is interesting there. That is against the smaller proportion of funding that so far has been invested in GM insect research that would fit more in the interests of this inquiry. In that period, it is about £3.8 million from BBSRC and MRC together.

The Chairman: Innovate UK, would you like to tell us something about your funding?

Ian Meikle: Yes, certainly. Our funding follows on from that. As I said in the introduction, we translate that academic research to business benefit and support businesses that are

doing research and development in this space. Our funding in the broader biocontrol space has been about £3.2 million thus far, and about £1 million of that £3.2 million is in this GM insect space that we are talking about today. It is all to one company, which we will be talking about a little more; Oxitec is the one we funded. We find that there are not that many companies in this space. We will continue that conversation later. Oxitec is the only one that we have been funding, because it appears to be the only one in this space at the moment.

The Chairman: In the written evidence, we have had a number of observations made about the difficulty of getting funding of field trials, for example—this, of course, up until now would have been overseas, but also within Europe and Spain—reliance on high-net-worth individuals and rather precarious funding lines; concern about the lack of clarity on regulation; and other inhibitions on investment. Would you like to comment on that?

Professor Dafforn: Certainly, that is an issue in this area. To allow you to do these sorts of large-scale trials, any company or academic getting involved in this needs to understand whether the regulatory environment is correct for that sort of trial. Partly because the insect research itself has moved quite quickly, in that it is regulated under regulations that are more related to the use of GM plants, there is some confusion, and it can make it challenging to provide funding and to generate these trials in the UK.

Dr Burrows: To answer your question about the field trials for GM insects, my personal impression is that it is still very early days for those. There are precedents of research councils funding trials for GM crops and environment trials. That is not for the commercial development of those crops, but to gather further data to test the performance of those crops in the field environment. There have been a couple of examples in recent years of GM wheat at Rothamsted and a GM camelina at Rothamsted with modified oil content. There are other examples as well of where we have done that. Where there is a proper programme of research—and funding a field trial is part of that—then the research councils will do that, but, for GM insects, it is still very, very early days.

Q3 Viscount Ridley: I am sure this will come up later, but, just to follow on from what Mr Meikle said about there being only one company in this space in the UK, do we know of other people who have wanted to start companies in this area and have failed to find funding because of the political and regulatory risk, or indeed of other projects that are stymied because of this?

Ian Meikle: It is probably worth saying it is one company that we know of. There may be others but our research does not reveal others, and I do not know whether anybody else has found any others. We do not know that others have been stymied, as it were. One of the things that Paul and I have been discussing—there is a very good link between BBSRC and Innovate UK in this space, and broadly between the research councils and us—is that we could start talking to some of those universities that receive funding. Oxford University and a number of others have received funding. A great starting place would be to speak to those universities about which companies are interested in the research that they are doing. That would be a good starting place in the academic arena.

Lord Peston: You may be coming to this, but part of the Lord Chairman's question was to ask you whether we are spending enough, and you have not answered that yet. The numbers seem very low to me, if the subject is as important as we are being led to believe.

You may say that, essentially as officials, it is not your job to say whether we are spending enough. I hope you will not say that. Unless I have misread them, the numbers seem ridiculously low, considering the potential benefit.

Ian Meikle: Which numbers have you seen?

Lord Peston: For example, BBSRC spends £2.8 million, it says here. If you look at what we fritter £2.8 million away on in other parts of the public sector, this seems absurd to me. I am ignorant, so I am just asking you the question.

Dr Burrows: Let me deal with the research council side of things, first of all. We have not to date necessarily prioritised funding for GM insect research. The amount that we spend is a product of the number of grants that academics come forward to us with, and then how many of those get through the peer-review system. We have a very encouraging system: we have open doors; we have responsive mode. The academic community is free to come forward with applications to do research on GM insects. The fact is, at the moment, we are not seeing many of those, and that is why the spend is relatively small. If they want to come forward, they are very welcome to do so, and we have the mechanisms by which they can do that.

Q4 Lord Hunt of Chesterton: You have touched on this, Mr Dafforn, and I had some briefings; some of us were not at the previous meeting. The use of the word "GM" is very problematic, and other words have been used. The House of Commons had a committee on this, and the conclusion was that we need to change the words. Now, when you change the words, you are into a different regulatory regime. The word that was mentioned was "vaccine", as opposed to "GM insects". "Vaccine insects" sounds highly obviously attractive. Is this being considered?

Professor Dafforn: I cannot say it is being considered, but I think people are very aware of this. The phrase has ended up as being quite emotive among the public. It describes directly what is happening. It is a genetic manipulation or genetic modification of an organism of some biology.

Lord Hunt of Chesterton: But that is the process, not the end product. The end product is a vaccine, for example.

Professor Dafforn: Absolutely, yes. There has been discussion—this is quite important—about the product, actually using the product, its phenotypes and what it does as being the important part of what you are making. As you say, a vaccine can be genetically modified and it is a vaccine, which is what is important. We have not found the right phrase for this sort of technology yet. It has been called RIDL, which really describes what it does, but it is not easy to explain that, necessarily. You are right; nomenclature can be quite important.

Q5 Baroness Morgan of Huyton: Dr Burrows, in your experience of the academic community, do you think it is influenced at all by what it may consider to be the difficulty of the regulatory environment? What is the point of doing research if it will not be able to go anywhere?

Dr Burrows: I think, once it is at the very basic stage and they are just investigating cellular mechanisms, for example, not so much. Anecdotally, though, we hear from the research community that it has found it increasingly difficult, particularly in the GM crops space, to get commercial investment in their research. At one point, I believe that that was quite a

significant part of what helps them along the process and into the Innovate UK space, because companies have, perhaps understandably, stood back from the uncertainty that they see in the GM regulatory regime within the European market. There are examples of some really fantastic research going on in UK universities, and it may well find its application first in North America, rather than in the UK.

Q6 Lord Kakkar: Occasionally, research councils decide to have strategic initiatives to drive research interests. Has that happened in this particular area for the research councils or would they consider doing it in the future?

Dr Burrows: Not in the case of GM insects. You are absolutely right. We do prioritise. We do have initiatives, particularly where we see the need to encourage research in a particular area or build a research community. We have not done that with GM insects. There is no reason in the future why perhaps we should not, but we need to wait to see the outcome of the spending review. It is unlikely that we would have a specific initiative in GM insects. It is likely that, if we were to do that, it would be framed in a much broader sense of alternative control mechanisms for agricultural diseases or something, so it would keep the options open. There is no reason why, technically, we should not prioritise this type of research in the future, along with all the other priorities that we have and our future budgets, if it was considered to be a priority.

Lord Kakkar: I should declare my interest as UK business ambassador for healthcare and life sciences.

Viscount Ridley: Could I also declare my interest as a fellow of the Academy of Medical Sciences and the owner of a farm?

The Chairman: Is there anyone else who would like to do so?

Lord Hunt of Chesterton: I am a fellow of the Royal Society.

Baroness Morgan of Huyton: I am a member of King's College council.

Lord Patel: This is supplementary to the question that Lord Kakkar asked. Before that, I am a fellow of the Academy of Medical Sciences and a fellow of the Royal Society of Edinburgh. It is not about whether you are financing research into insect gene editing; it is about whether you are financing research into the science of gene editing, which is what we are talking about when we talk about insect modification. It is whether you are funding the science, not specifically about insects.

Dr Burrows: Gene editing in insects is an application of those gene editing technologies, which, incidentally, BBSRC published a positon statement on last year, recognising that these sorts of biotechnologies are moving incredibly quickly. The gene editing technologies are moving, at the moment, more quickly than the regulatory framework can keep up with. I understand the Commission is about to publish an opinion on whether the gene editing technologies are part of the current regulatory process. Similar conversations have been had in other regulatory authorities around the world.

It comes back to the point that Tim made earlier. At the moment in Europe, we have a regulatory framework that regulates the process by which the modified organism was created. From a scientific perspective, the logical process is to regulate the end point—the characteristic or the trait of the organism at the end.

Lord Patel: My question relates to whether you are funding the science, not the regulation.

Dr Burrows: Yes, we will be funding the underpinning science, absolutely.

Q7 Lord Hunt of Chesterton: The UK is said to be a global research leader in the field of GM insects—a comment about that would be useful—and yet there is only one British company active in this area. How can this be accounted for? Apropos of this, is the research leading to significant IPR? Secondly, is the UK research at the moment very fundamental, or is there in fact a good deal of applied research that does not lead into companies?

Professor Dafforn: Coming back to Paul's comment that you can break GM insect research into two sections, one is this specific application we are talking about with Oxitec, which is for crops or for protecting against thing like dengue. Then, on the other side, you have far more fundamental research, which there is much more being put into at the moment and has generated significant insights into healthcare. At the moment, we have a balance between those two going on.

On the question about the UK leading in this area, scientifically we lead or are close to leading in insect molecular biology, which covers both of these: the fundamental and what Oxitec do. You have to remember that we have one company that leads; it is the only company in the world as well. It leads not just the UK; it leads the world. It is one company. One might have to wonder about whether this is an industry, if it is only one company, so you have picked a very specific example. There is no reason why we cannot have more examples in other areas, as and when people have an idea about how to use this technology.

Q8 Baroness Neville-Jones: May I declare an interest as a member of the Engineering and Physical Sciences Research Council? I would like to pursue a little the implications of what has happened with Oxitec, which, as we all know, was taken over by an American firm, Intrexon Corporation. I would be interested in the comments of the panel on the implications of that. Presumably, the takeover would not have taken place if it had not been regarded as a worthwhile asset, so there must be something of value there. It is very curious that you should have a valuable company that seems to stand alone in the field.

I would be interested in two aspects. First, what do you make of the takeover and what do you think the future will be? Will there go on being continuing investment, or is this a way of wrapping up that kind of activity? Secondly, where do you see the real problem as being? Is it in the regulatory environment, or is it other factors that inhibit more companies getting going?

Ian Meikle: It is important to point out that Oxitec has been doing research since 1995, when it was still part of Oxford University. It spun out of Oxford University in 2002, moved into its own premises in 2005 and started on business funding through us in 2010, so this has been a 20-year journey. It has not sold any products in that time. It is still in its R&D phase. It has been developing IP, to talk to the comment there. Having visited Oxitec, as we do all the companies we fund, it has to raise funds to be able to do that. It does not have sales that it is generating off the back of it, so it continually has to raise funds, and it is generally philanthropic individuals, who have a social conscience but also want to make some money as well, who have been investing thus far.

The journey that companies take is that they are generally trying to grow a business, and then they will need a significant injection of investment at some stage. That is either an IPO,

where they float on the stock market, or a private investment. Oxitec has got to that stage. After 20 years, it needs that large scale of investment. The company that has taken it over is not planning to re-headquarter it. It is not planning to relocate it. It will still be based on UK soil. It is planning to grow its footprint because of this investment on UK soil. The headquarters will also remain in the UK, as we understand it as such.

We could see this as inward investment, really. In many ways, we could look at it in the way that we have Nissan up in the north-east. It is a foreign company, but it is based there because of the academic and engineering environment we have in that area. It creates jobs; it creates investment; it creates taxes for the UK economy. In some ways, when we work with UKTI, we think of inward investment as not such a bad thing. We have to be careful that we do not think of it as a bad thing. I think you are right: if they purchased it and took of it offshore, that would be another matter and one that we should be concerned about.

Baroness Neville-Jones: Which they would be able to do, as owners.

Ian Meikle: Yes, if they own it.

Lord Vallance of Tummel: As a matter of interest, do you know whether Oxitec approached Intrexon because it was looking for a parent and capital, or was it Intrexon that approached Oxitec?

Ian Meikle: I am not sure whether I can report that. I had a conversation with them around that. I cannot remember the order of it, but I believe you are seeing Oxitec in a couple of weeks, so they will be able to give you a better insight. What I remember of the conversation was that one of the questions was dealing with US versus UK investors. One of their comments was, "Actually, investors did not get us, be they UK or US". It was a particular individual in this organisation that "got them", to put it colloquially.

We have talked about philanthropic individuals investing thus far. It was somebody with a particular insight in this organisation that bought Oxitec. It was not because they were US or whatever; it was because of the insight of that person who saw this match come together.

Professor Dafforn: It is worth adding as well that it is not just a financial transaction that you are looking at there. Intrexon has a significant amount of technology in the synthetic biology arena, which will enable its company to grow and enable Oxitec to grow. Without that, it may have foundered, so it is one of those really classical joinings of two companies with two separate technologies, which together can really have some distinct benefit.

Dr Burrows: The bigger piece here, of course, is that the challenge for all of us, while it is a sign of success, seeing this inward investment and the recognition of these globally competitive companies coming out of our science base, is retaining the value in the UK, in terms of them paying their taxes, creating jobs and so on. It is a rather big, philosophical point, but I think the best way we can do that is to maintain the excellence of our science base, our infrastructure investment and our skills, so that those other companies coming in and buying our small biotech companies recognise that they are already embedded in a really permissive, high-tech environment and there is no incentive to move them on.

Q9 Duke of Montrose: I declare an interest as a livestock farmer and as president of the National Sheep Association. This whole framework we are operating in is a European one, with European regulation. Do we know how other countries are approaching the question of GM insect research, or are we the only one taking a big interest in it?

Professor Dafforn: The only knowledge we have is that there have been attempts to have a trial in Spain, and the negotiations had been rather protracted. Probably our colleagues in Defra are better placed to describe how that has gone.

Duke of Montrose: Germany is not interested in GM insects.

Professor Dafforn: Not to our knowledge.

Ian Meikle: Oxitec has been doing trials in Brazil. It points out that, when it talks to other countries to sell its technology, the fact that we are not trying it in our own back yard can be a bit of a tricky conversation if it is talking to prospective customers.

Q10 Lord Fox: I will declare my interests as an employee of GKN and shareholder in Smiths Group, neither of which, I think, are active in this particular area. You talked about retaining value in the UK, and, in another conversation, we talked about the need, when companies get to a certain point, for the injection of money. The other way of retaining value in the country is for there to be a source of that investment and capital. Is there any evidence that the landscape for biotech companies at that level is better in the USA, for example, than compared to the UK? Are there other countries that we would look up to when it comes to that level of biotech support and development?

Professor Dafforn: Anecdotally, certainly in certain sections of the US—one would think of California—there are significant amounts of extra capital there: a lot of private capital and rich individuals who are able to invest heavily. I am part of a group working on synthetic biology. We did a UKTI trade mission to California and it was very clear that the investment environment was good in California, not across the whole of the States, and one must remember that. It is quite patchy.

If you need to look at the long piece, the knowledge base since the Lambert review, more than 10 years ago, has been moving slowly towards more applied research. This is a super tanker you have to move gently. We are seeing really good feed-through from the research councils and Innovate in encouraging academics to see their work not just as pure research but also with an eye to market. In many ways, you are now seeing, with Oxitec and other companies coming through, that we are getting that sign of growth, which is a really good sign: companies moving into the £80 million to £200 million requirement for investment. Even more encouraging is that our own financial institutions are beginning to see that happen. Neil Woodford has just put together a fund, which is half a billion, to put into high-tech, late-stage, research-based companies. We are seeing the products and companies are beginning to change the overall fiscal environment in the UK for developing new tech, which can only be a good thing.

Lord Fox: Is there anything you can do to encourage that?

Professor Dafforn: I think the best way of encouraging it is to see good science coming through as good products with a good market. That is happening. Funding the research base, not cutting off the research base in terms of funding, is key to that flow-through. All the mechanisms we have with Innovate and the research councils seem to work well at the moment in ensuring those products and ideas come through and then letting the environment, which is the financial environment, pick them up, because, if they see a good bet—if they see a good company—they will invest.

Q11 Baroness Neville-Jones: Can any of you comment on the following? Oxitec in a submission, when it was talking about the funding of biotech SMEs in the UK, said that the advantage and benefit of its activity "can be substantially eroded for an SME as they lose the research and development tax credit on all grant-related activity regardless of the level of grant funding". You say the real answer is good science, but what about the fiscal regime; what about the tax context?

Ian Meikle: Basically, the tax incentive and grants are both within the state aid regulations, so they cannot take both; otherwise they would be getting too much public funding.

Baroness Neville-Jones: This is a European regulation.

Ian Meikle: Yes, exactly. There is a choice for companies of whether they take the tax credits or come for our grant. As a rule of thumb, companies need to go to their tax advisers to understand this, but if the funding level is above about 40%—and, again, you would need to get proper advice on that—then it is probably beneficial to come to us for grant funding. Of course, there are other benefits as well of coming to us for grant funding, because they can meet other collaborators, people that they might want to work with. It is also a tick in the box for when they go to investors later that we have endorsed that. We go through a process of competitive funding. We have assessors who are knowledgeable in the field, so there are opportunities there.

I do not think we should look at it as stopping them from doing something. They are both under state aid. We try to support companies to the maximum that we can, but we cannot go beyond the state aid rules, and companies have to make a decision as to whether they go for the tax credits or for the grants option. That is a choice they have to make themselves.

Q12 Lord Kakkar: I must declare a further interest as professor of surgery at UCL, an institution that may be involved in this area of research. The regulatory framework for genetically modified organisms in the UK is driven principally, as we have discussed so far, by EU directive, and has been referred to in some of the evidence we have received as serving to prohibit innovation. I wanted to explore what your views were on the balance between regulation and innovation being struck currently, whether it is fit for purpose and how we might provide recommendations going forward on how to avoid stifling innovation in this area by overregulation.

Dr Burrows: Broadly speaking, the regulatory framework for genetically modified organisms in Europe, as it is drafted, is a reasonable framework. It allows for evidence-based risk assessment, post-release monitoring and scientific advice through the process. The regulation itself is, broadly speaking, okay. There are some caveats, which I will mention in a moment. It is the way, essentially, it is applied across the 28 European states. It is not applied as an evidence-based risk assessment for harm to human health and the environment. In my view, there is too much politics and other things that are brought to the table, so it does not work, and undoubtedly that impacts on innovation within Europe and the willingness of other global companies to invest in the European market.

I have mentioned two of the main issues with the regulatory framework already. The biotechnology is moving more quickly than the framework can keep up with at the moment. We need a trade-based process, rather than a method-based process. Most significantly, it does not really permit risk and benefit to be taken into account in the decision-making process, which is of course common with medicines. Where you have a serious disease, I

think the public's appetite for risk is a bit higher than if the disease is less serious. The same principles apply to the risk-benefit ratio in weighing up, and nowhere is that brought into higher contrast than in the area of GM insects. If there is a major public good in the release of a GM insect to supress malaria in an area, then how is that weighed up with the risk of doing the release of the GM insects? That is a really gritty philosophical question.

Chair: Do either of you want to comment further on the regulatory aspect?

Professor Dafforn: I think Paul has put it perfectly.

Lord Kakkar: It is very interesting to hear you say that part of the problem is the way that this regulation is drafted, that there is no mobility to look at benefits in doing a proper risk-benefit analysis. You also mentioned a view that there is a lot of political interference, that the ability to apply a framework independently, based upon scientific advice rather than political interference, does not appear to exist at the European level. Would that be an appropriate interpretation?

Dr Burrows: I think it would, because, in the way the voting mechanisms are set up around the directive, one can get a positive scientific opinion on an evidence-based risk assessment to human health and the environment, and yet the voting procedures in committee continue to delay the approval. In fact, I am sure the Committee is aware that the Commission has just changed the rules in many respects, in that one would still have Europe-wide marketing approval for a genetically modified product, and yet the member states can individually opt out if they wish to. That has not yet been tested in committee. Whether that would help the member states give a positive opinion by qualified majority in committee, knowing that they could then step out afterwards, or whether the objections are more fundamental and ideological than that remains to be tested.

Lord Kakkar: To follow up on that point, do you think there is now increasing confusion around the area of regulation, as those new mechanisms and opportunities for member states to opt out individually are about to be tested? Would it be right to conclude that the area of this confused regulation at European level now is one of the greatest roadblocks to adoption of this technology in our part of the world?

Dr Burrows: I do not know if there is greater confusion; there is certainly greater complexity in the process than when it was first envisaged and, anecdotally, it must be correct that the uncertainty of the regulatory process in Europe for the deliberate release of GM technologies generally is impacting investment in Europe. It is difficult to believe otherwise.

Baroness Neville-Jones: Do I understand correctly that what you are saying is that the regulatory regime is not really suitable and the solution at European level is to allow people to opt out of it?

Dr Burrows: Please bear in mind that Defra is the competent authority here. I have some past experience.

Baroness Neville-Jones: You have said that there is both drafting and practice, but there is a shortcoming in the approach because it does not allow benefit. Even within its own terms, what you seem to be saying is that we have a bad regime or an inappropriate regime and, instead of reforming the regime, we allow people to opt out of it.

Dr Burrows: In my opinion, the regulatory regime, as it is drafted, is an adequate framework; it is just not being applied properly. When I say an adequate framework, it could perhaps be

better if it was permitted to take risk and benefit into account—if it was a trait-based system rather than a process-based system. We have to recognise that we live in the real world, and the prospect of throwing the European regulatory regime up in the air and renegotiating it fills a number of individuals with horror, because there is a distinct possibility that we will end up with something worse than we have at the moment.

I personally agree with the line that Defra has taken in its evidence, that the priority at the moment is to try to get the regime, as it is currently drafted, working properly.

Lord Hunt of Chesterton: May I take you up on this point and try to elaborate? There is concern about risk. That is the point. My wife is a landscape architect and she is always saying, "How do we know this is not going to affect the lesser spotted this or that?", and quite reasonably. I know that in France, because I go there a lot, they are very, very concerned about what effect any of these kinds of technologies will have on wildlife and ecology. My question really is: are we doing enough research on these risks? I speak to people in the lab and they grumble about these things. They want to focus on the pure and then they want it to be released. There does not seem to be half the amount of research on the potential risks in the environment for all sorts of ecologies, and that is the focus of our European colleagues.

I have the feeling that in Britain that is not considered a very gutsy thing to do. You want to do your pure stuff; you will get your money; off you go and here is a product, whereas the Europeans are all doing this incredibly detailed ecological risk stuff. Is that a ridiculous way of putting it?

Professor Dafforn: You may be casting the scientists in a slightly negative role. I think there is a distinct drive, particularly among the younger scientists, for a new way of doing research. There is a responsible innovation proposal or framework, to which we now adhere when we are doing research, where we look at that side of things. The idea that we just go forward, generate new insects and new varieties and think, "To hell with the consequences" is not what is going on. Again, you get tied up with the regulatory situation, because you can consider how an insect might affect an ecosystem but, in some ways, you need to test it. If you have a regulatory framework making that difficult, then people will stop doing the research in the first place. Given we have only one company, which is Oxitec, one might say that could be an inhibiter, but it is very hard to tell when people do not do something.

Ian Meikle: Also, in the Oxitec experience, the technology they are using is self-limiting. It dies out. They are also using marker dye as well, so you know which insects have been released, so it is a failsafe technology. It is important that we are seeing that responsible innovation coming through from the company that is taking part at the moment. You are right; we need to be wary of that and ensure all companies that take part are similarly responsible.

Lord Kakkar: Do you think that, rather than having a wholesale redrafting of these directives and regulations, a recommendation for this may be to further solidify the role of independent scientific advice in this particular area of European activity?

Dr Burrows: I think we have a good regime of independent scientific advice at the moment; it is just that, in many instances, that advice is not necessarily listened to. If one could build into a regulatory framework more of a requirement that that advice was listened to, to harden that part of the regulations, then perhaps that could help.

The Chairman: As the GM insect debate warms up, as it might well as people become more aware of the scientific opportunities and threats, I suspect that some of the concern will relate to the possibility that resistance, for example, to gene drive mechanisms might occur. The BBSRC have said, Dr Burrows, that you are in response mode. You wait for people to come and, if the application is appropriate and of high scientific quality, then you will fund it. Are you convinced that these concerns, which probably have not yet been identified but will almost certainly be coming up over the hill, are likely to be met by this response mode?

Dr Burrows: The example here of how we address the concern of various publics about new technologies is exemplified by the way we have gone about looking at synthetic biology.

Professor Dafforn: Your concern is correct, and, again, we come back to the change in the way that scientists behave. I have been leading on syn-bio, synthetic biology, which includes things like gene drives, as being a new area of science that might provide opportunities but also will provide some risks. In the development of that area of science within the UK, probably for the first time ever, the scientists have been involved from day one, looking at the negatives that might come out of this, engaging with non-scientists—so the various publics that are around—to discuss what the science is, what the opportunities are, what the risks are. From day one, we have been engaging with regulatory experts as well and the people who are defining the regulations for syn-bio, the idea being that you need these conversations to define where the risks might be, to understand where risks are real and where risks are non-real, where there may be mitigation strategies that can be put in place, whether it is regulation or whether it is the science itself. One would expect, with gene drives, that this should happen as well. It does seem to be a pathway that scientists are generally engaging in now. It is a new pathway and it is central to the way we do research at the moment.

Q13 Lord Krebs: I should declare interests as a member of the department of zoology at Oxford, where Oxitec started, a fellow of the Royal Society, a fellow of the Academy of Medical Sciences and an advisor to the Wellcome Trust. I want to follow up on Lord Kakkar's question and Dr Burrows's response about the role of scientific experts in the risk assessment. Could you just clarify for us, Dr Burrows, who actually carries out the risk assessment in the European context?

Dr Burrows: In the European context, it is EFSA. As to the individual member states, I can speak particularly for the UK, because I know the Committee has the Advisory Committee on Releases to the Environment and the Advisory Committee on Novel Foods and Processes, so the individual competent authorities take their own expert advice as well. I had some experience in a previous life of working very closer with ACRE, the Advisory Committee on Releases to the Environment, which is the main committee that advises Ministers on releases of genetically modified organisms. ACRE gave its advice to Ministers. Ministers, of course, do not have to take that advice, but the way it was couched at that time—I am talking about10 years ago now—was that, if Ministers did not want to take that advice, they had to have a very good reason for not doing so. As a statutory committee, my impression—please bear in mind that I am only giving my impression; I have not been in this field for some time now—is that that requirement to have a very good reason not to do so is softer in the European system than it necessarily was in the UK at that time. While you get positive scientific opinions, the applications and the dossiers still do not progress through the system as they are intended to do in the drafting of the legislation.

Lord Krebs: If I may ask another question of Dr Burrows apropos the point that Lord Hunt of Chesterton made a few minutes ago on the ecological research related to the environmental risks, while it is probably too early to look at ecological research in relation to GM insects given the early stage of that work, if we think of GM crops, am I not right in saying that the UK has sponsored quite a significant amount of ecological research in this area? I am thinking of the work carried out by Professor Michael Crawley at Imperial Colleague and the very large farm-scale trials of GM crops that looked at the ecological consequences for two or three different crop varieties.

Dr Burrows: Yes, that is correct. Historically, BBSRC and NERC have had joint initiatives looking at horizontal gene transfer, for example, in the natural environment. There is a history of the research councils funding those types of research. The farm-scale evaluations that you referred to are, of course, government-funded, with a combination of government and industry funding. They were at the time, and I believe still so, the largest ecological trials of their type of herbicide-tolerant crops in the world, and we really were ahead of the thinking at that time.

Q14 Lord Hennessy of Nympsfield: May I declare I am a fellow of the British Academy and a professor of contemporary British history at Queen Mary University of London? Genetically modified history is in its infancy, but it is better to over-declare than under-declare. My question builds on Lord Hunt's question a moment ago about perceptions. Ipsos MORI's *Public Attitudes to Science* of 2014 is full of good things, but there is one very striking statistic in there that is relevant to today. Scientists in university labs are trusted by 90% of the people to tell the truth, where it goes down to 60% if you are in industry. What are the roots of all this? Does it go back to Rachel Carson's *Silent Spring* nearly 55 years ago now? It seems to me that there is a great problem that, if commerce is involved in the private sector, a whiff of *Dr Strangelove* comes into it and quite often it is the same people. What can you do about that? You have touched a little on it in the new pathway you have been describing, but it seems to me that it is a deep-set secular problem of probably 50 years' duration. Do you have cunning plans, please, to put it right?

Ian Meikle: It is about benefits. Some of this technology we are looking at is applicable both in health—things like transfer of malaria—and in agriculture. If the consumer sees benefit, then they are more likely to understand it and take it on. For instance, if we are using GM insects to tackle malaria, you and I may have a benefit of not catching malaria as well as the health service of not having to treat malaria. We can clearly see the benefit for us as individuals.

The problem with the GM debate, which links with what you are saying about big business and GM working together, is that the benefits were generally seen to be for the producer and not so much for the consumer. As we are developing this, if we can build on the syn-bio approach, as long as we can build in the benefits to consumers, that is where we need to start getting. The benefits to consumers are things like: potentially we could reduce or take to zero the amount of pesticide residues on some of our crops. That is the sort of thing that is being pulled through. People are looking for more sustainable practices, so a lot of Marks & Spencer's advertising, for instance, is based on its green approach to the products that it produces. Of course, there is cost. If our crops get decimated by pests and disease, the price can go up.

That is a start of what the benefits might be for the consumer. They can be quite long-term. For instance, costs might be a 10-year horizon. What we have to do is really start from the benefit for the consumer, because that is the way you sell a product and that is the way you sell an idea. You have to start from the why and what it means for me.

Professor Dafforn: I should make one other comment, which is that a figure of 90% is incredibly high for any profession. Aspiring to 90% would be excellent, but somehow academics have ended up at 90% and that might be part of the problem. Inherently, you are looking at a different being in industrial science, or a perceived different being, because industrial scientists—and I run a small biotech firm myself—are not just looking at purity of science, which I think the public really gets; we are looking at purity of science and the need to make some money, because that is what a company is about. That is an inherent difference. You cannot get over that difference. If the public are unhappy with that—60% is not bad—I do not know that you can change it too much. It is a real struggle.

Lord Peston: I am a bit fed up that I do not have any interests to declare. I suppose the reason is, whenever I am asked to do anything, I always automatically say no, and so on. Do we not have an example here? In asking the question, "Why do the public appear to mistrust industrial science?", is the correct answer not that they are right to? If we look back at the history—let us take the tobacco companies as the classic example—long before Richard Doll did his work and published it, they had done all the research and had supressed it. That creates what economists call an external diseconomy, namely that that also reflects badly on the honest people and so on. Therefore, one ought to be supportive of the honest people; the trouble is that, with somewhat dishonest people around, what can you do? Do you have any views on that?

Dr Burrows: I hesitate to tackle this question, knowing the expertise that is sitting behind me at the moment. I am sure in the next session these are exactly the sorts of questions that it would be good to explore. I would question the premise that people naturally distrust industrial science in its entirety. It is highly contextualised. Your smartphone is industrial science; your tablet computer is industrial science.

There seem to be particular areas of science that raise the hackles in a way—a visceral concern—particularly where it seems that we are interfering with nature. People value naturalness in many respects. They are particularly concerned about where there are interventions in what seem to be complex ecosystems, unanticipated events and unanticipated side effects. I found the Sciencewise submission to this Committee very illuminating, in the way that it has systematically gone about having a conversation with the public about being transparent and honest in the reasons for having that conversation. If the publics, in plural terms, think you are trying to force something down their throats or sell something to them, rather than having a proper dialogue in listening mode, you are immediately at a disadvantage in beginning those kinds of conversations. In answer to your question, what can be done about this is open, honest, transparent conversation.

Q15 Lord Patel: We had several comments made about the state of the science, about the state of the regulatory framework, whether it is needed or not and at what stage we should give thought to the regulatory framework. My question is related to all these areas. The US National Academy of Sciences has set up a group to look at the state of science, of things like gene editing using CRISPR, even synthetic editing using endonucleases, to inform them of whether there is a need to look at the regulatory framework as it is now and what it ought to

be, recognising that GM insect modification could be used in benefitting the treatment of diseases and of course improving crops, but it could also be used for quite dangerously harmful effects. Do you think we should set up such a group to look at the science and the regulatory framework?

Professor Dafforn: Our American cousins are often very good at looking ahead. They are perhaps slightly more ahead in the gene drive technology. It is a revolutionary new technology.

Lord Patel: The technology is no different from gene editing, where we are way ahead.

Professor Dafforn: Yes, okay. The other thing is, as a scientist engaging in discussions about new technology as it comes forward and getting people to look at it more closely, if it is a new technology that is disruptive like this, this is valuable. This is something we should do. It is not for me as a scientist to initiate those larger-scale conversations regarding committees, but it may be something that is worth looking at, certainly.

Lord Fox: It goes back to where you said you wondered if this was an industry, as I think one of you put it. This was really my question: is the problem regulatory, in that it is too hard to make this an industry, which seems to be what you have said, or is it actually the application, in that the main application for which you could get regulatory approval is one in public health, which tends not to be in developed countries? I wondered if that was one aspect.

Ian Meikle: I can start to answer that question. We still have pests and diseases. The amount of chemicals we can use to tackle those is being diminished by regulation, so companies are starting to look at other approaches. When we look at the radar, we are looking at two big disruptive technologies coming through. One is precision agriculture; that is using things such as satellites, drone technology and sensors on the back of tractors to figure out exactly where your problem is, and then using very precise methods to use some of those chemistries in much smaller amounts. The other space we are looking at that is very disruptive coming through—and both are growing at about 15% or 20%—is the biocontrol space, of which this GM insect technology is part, but it is part of a slightly bigger sphere that includes insects that prey on other insects, the use of waxes and funguses to kill insects that are destroying grain stores and those sorts of things. There is this broader biocontrol sphere that is coming through.

It is the only company in this GM insect space. There is a bigger biocontrol sector that is starting to emerge, and it would be surprising if, given the success of Oxitec thus far, it does remain to be the only player there.

Dr Burrows: Building on that, is this an industry or not? With the exception of Oxitec, we are still at a very, very early stage. With GM insects in particular, it would be my view that the unhelpful regulatory environment we have around GM generally in Europe has not really impacted yet that excitement of the initial research. Also, if we look at the major initial applications of GM insects, they are probably outside the UK in other markets anyway.

Lord Patel: I am not so sure that is a correct comment. First, the reason I think we are not investing and we do not have such a strong science base in GM insects is that we have not funded the science specifically for GM insects. The science itself is as common to humans as it is to non-human organisms. If we do not fund it, we will not get biotech companies developing, because they normally develop from scientific institutions, as happened in Oxitec from Cambridge. We might be wrong in thinking that it is outside this country that it

will be useful. Brazil is not the only country that has crops destroyed by insects and therefore requires genetic modification.

Ian Meikle: You are correct. In this country, the soft fruit industry—strawberries, raspberries—had got to a point whereby it reduced the pesticide residues on those crops down to zero. It now having to use them again, because of a pest called spotted-wing fruit fly; there is probably a Latin name for that that I do not know, I am afraid. This technology could be used in the UK, and one of the frustrations for Oxitec is that to be able to do trials in this country would be within the UK jurisdiction, as it understands it to be, but to release it as a commercial opportunity would need EU clearance. What it would quite like is to just be able to do the trials in this country.

Building on your comment about going from a responsive mode to being targeted, that is something where we would look for the results of this inquiry, certainly in the Innovate UK space, and we always work in partnership with the research councils. If the results of this inquiry are positive, we could certainly do something that was more targeted to draw through more.

Lord Peston: I do not know whether you saw the evidence we took before the House rose, when we started this inquiry. Have you read that?

The Chairman: It was a private seminar.

Lord Peston: Just let me put the point to you. It may well be that our scientists and our country make the great contribution, but what really impressed me was that the real beneficiaries will be in the poorest countries in the world, and therefore we should place this, surely, within the aid context. We will save the lives of an enormous number of very poor people who deserve not to die if we make good progress in this area, notwithstanding the risks, let me add. That seems surely a context in which we ought to place the whole of this inquiry.

Lord Fox: That is the point to which I alluded at the end of my question as well.

The Chairman: I had better make clear that that was not on the public record, because we were having a private seminar.

Baroness Neville-Jones: I want to come back to the question you asked right at the beginning about field trials. Just a moment ago, you said that what Oxitec would really like to do is at least have the field trials in this country. What is stopping that?

Ian Meikle: Its understanding of the regulations is that it is a UK decision as to whether we can have field trials in this country. I am not sure what the mechanism is; I am not an expert in that.

Dr Burrows: They could make the application.

Baroness Neville-Jones: What is holding them back, do you think, then?

Dr Burrows: That would be based on the advice from the Advisory Committee on Releases to the Environment to Ministers, and Defra is the competent authority, but there is nothing stopping Oxitec technically putting a dossier together and applying to do field trials in the UK.

The Chairman: We have run out of time on this session. We are most grateful to the three of you for a very informative session. We clearly have a lot more work to do, and we will

have some further interesting sessions. Thank you very much for having got us off to a very good start.