



Science and Technology Committee

Oral evidence: [GM foods and application of the precautionary principle in Europe](#), HC 328

Wednesday 15 October 2014

Ordered by the House of Commons to be published on 15 October 2014.

Written evidence from witnesses:

- [GM Freeze](#)
- [Professor David Baulcombe](#)
- [The Royal Society](#)
- [Greenpeace](#)

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Members present: Andrew Miller (Chair); Mr David Heath; Stephen Metcalfe; Stephen Mosley; Pamela Nash; Graham Stringer; David Tredinnick

Questions 1-56

Witnesses: **Professor Ottoline Leyser**, Fellow, The Royal Society, **Professor Sir David Baulcombe**, Regius Professor of Botany, University of Cambridge, **Dr Doug Parr**, Chief Scientist and Policy Director, Greenpeace UK, and **Liz O'Neill**, Director, GM Freeze, gave evidence.

Q1 Chair: Good morning. Thank you very much for coming in this morning. I apologise for the fact that we are running a little late, but we shall move on if we may. I would be grateful if, for the record, the four of you would introduce yourselves.

Professor Baulcombe: I am David Baulcombe, professor of botany in Cambridge University.

Professor Leyser: I am Ottoline Leyser. I am director of the Sainsbury Laboratory at Cambridge University, but I am here representing the Royal Society.

Liz O'Neill: I am Liz O'Neill. I am the director of GM Freeze.

Dr Parr: I am Doug Parr. I am the chief scientist and policy director, Greenpeace UK.

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Q2 Chair: Before we start our formal questioning, Dr Parr, is there a reason why Greenpeace have not responded to our correspondence and were very reluctant, it seems, to attend?

Dr Parr: The reason is a little complicated. As I said in my written remarks, I have not been working on GM for almost a decade, so I put in that context any comments that I can make to the Committee. I sought to find someone from another part of the organisation to come over and address the Committee, but I understood the deadline was too difficult so that was not possible. In the end, I concluded that the best thing I could do to assist the Committee was to come along to give a general perspective on Greenpeace's position, even though I would not for one moment claim to be up to date on every latest development.

Q3 Chair: I was curious, because we have only had to write blunt letters to two organisations. One was Greenpeace, and the other was the *Daily Mail*—on an entirely different subject.

If I may, I shall ask each of you to explain briefly what your position is on the agricultural use of GM, and how this position has evolved as more evidence about the risks and benefits has become available over the last decade.

Professor Baulcombe: I have been working in science that is related to GM since the early 1980s. I published my first papers on genetically modified disease-resistant plants in the mid-1980s, so I have been involved in the field since it started.

I was an enthusiast for the potential of the technology when it first emerged, and my enthusiasm for the technology has not diminished since. What I have seen over the years is progress in various areas of science, so that we now have the potential to generate GM crops that will contribute enormously to developing a sustainable and sufficient agriculture. For example, we can have crops that require fewer inputs that are resistant against diseases. We can have crops that are tolerant of various stresses, including water and temperature stress, which are becoming increasingly important during climate change. On salinity, we can develop crops that make better use of nitrogen and phosphate fertilizers, and we can have crops that have more efficient photosynthesis.

These are things that are emerging from the science. Many of these projects are either ready to be released in the field, or are in the laboratory and poised to make the transition to field trials and, one would like to think, eventually to commercial release. I have been immensely frustrated by the roadblock in the regulatory process, so that the potential of this technology cannot be fully realised.

Has my view changed over the years? It has not in essence, although I have benefited greatly from interactions with a lot of different stakeholders in this area of technology and agriculture, and I have now begun to appreciate that industrial agriculture by itself is not the answer. We can have a much more nuanced and a much more sophisticated agriculture, making the most of traditional and organic agriculture, and linking it with

what biotechnology has to offer. It is immensely frustrating that those of us on the biotechnology side have not been able to get our heads together with people on the environmental side and think our way forward to developing this sustainable and sufficient agriculture.

Professor Leyser: I echo some of those comments. It is frustrating, because almost everybody in this space wants the same thing, which is a secure and environmentally sustainable supply of safe, high-quality food and other agricultural products. A number of us are of the view, and the Royal Society is of the view, that GM has the potential to make a contribution to that incredibly big and difficult goal. I would not claim that it is any way a panacea, but the difficulties of achieving that goal are so huge that we need to keep all the options on the table. In so far as GM can be a solution in particular cases, it should be available and not disproportionately disadvantaged compared with some of the other options.

How have things changed over the years? When this whole science started in the 1980s, there was a lot of excitement about it, and in the meantime I would say that two major things have changed. One is that when it started we did not have many interesting genes. We could put genes into plants, but the genes we had available to us were not all that exciting. In the meantime we had the genomics revolution, and we now have a much better understanding of plant genetics in general, and a much wider range of useful genes is available to us. I would highlight disease resistance as an area which this technology could be particularly useful in addressing.

The second thing that has changed is that our understanding of genomics has given us a much better understanding of what we do in conventional breeding. There has always been the interesting question of how different is sticking a gene into a crop from what we do through conventional approaches. The more we understand about genomes and how unstable they are, the more we realise that there is no scientific justification for treating conventionally bred crops and genetically modified crops differently, because all the risks and uncertainties that people associate with GM are equally applicable to conventional breeding.

Liz O'Neill: GM Freeze is a membership organisation. Our members came together to work on the issue of GM. It is a sceptical organisation. We do not call for a ban but for a moratorium until certain conditions are met. The members include environmental groups, scientists, farmers, retailers and concerned individuals.

The conditions under which GM Freeze felt that a moratorium could be stopped—where GM could be grown safely and without causing concern to the members—are still a problem. We need a system in place so that people can have the right to choose not to consume GM, and where the public are involved in decision making. We need a system to prevent genetic pollution of the environment, with strict liability laws and independent assessment. All those conditions are still not met by the GM that we see.

Q4 Chair: By the word “consume” did you mean to eat, or does your view apply to foodstuffs but not, for example, to cotton?

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Liz O'Neill: GM Freeze works largely on food. Yes, cotton would come into it; some people's concerns would cover cotton, but some would not. As a membership organisation, we represent a range of concerns and, certainly in terms of environmental damage, cotton would come into it. We do not get involved in medical use; it is food and farming. That is our position.

We are calling for a moratorium on GM crops until those conditions are met, and, as I said, that has not changed. We hear a lot about new developments in the technology itself, but the crops in the fields have not changed. The crops that are currently waiting for approval in the EU are not new varieties. They are exactly the same types of crop that were involved in the farm-scale evaluations in the 1990s, when the UK decided that it was not beneficial to plant them. We are concerned about the mixing up of those issues. The one absolute position that we hold is that we believe that genetic resources are a public good and should not be owned by anybody.

Dr Parr: Greenpeace would come to this thinking about the delivery of global agriculture in such a way that it meets sustainability and equity needs, and it delivers nutritional food across the board. That is the starting point. Then what are the political, institutional and economic conditions under which those needs can be fulfilled? Beyond that, one has to consider what is the role of Government, what is the role of economic actors, and what is the role of farmers and of companies in the seed industry. One would then come to particular technologies.

Our starting point, as has been recognised by 160-odd Governments around the world in agreeing the Biosafety Protocol, is that we believe there are particular risks that apply to GM crops and foodstuffs. We therefore see no case for releasing them into the environment. We believe that, if properly contained, GM can be a valuable research technique, and we also believe that some biotechnologies, such as marker-assisted breeding, which is already providing a great deal of valuable crop varieties, not just in rice but in things like early millet, maize, cassava and so on, offer significant advantages and do not come with those associated risks. The risks are not simply associated with the gene but with the situation into which it comes. By that I mean, what is the technology being used for, what are the traits being developed, how are they being used and how do they contribute to long-term sustainable agriculture?

One of the things you asked was how things have changed over the years. As I outlined at the start, I am possibly not the best person to ask about that for the last decade, but my impression is that things have not changed an awful lot. The first media interview I did on GM crops was 20 years ago, yet I look at what is going on and see that many of the issues are predominantly the same. When I compare that with how energy has developed—I now spend more of my time on the regulation of chemicals, nanotechnology and obviously on IT—things have changed quite extraordinarily, yet when I look at GM, at the actuality on the table, it is not a lot different from how it seemed a number of years ago.

Q5 Chair: So that we can try to draw some lines in the sand, so to speak, let me explore this with Ms O'Neill and Dr Parr. Do you have the same reservations or opposition to other forms of artificial plant breeding, such as mutation breeding?

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Dr Parr: It is fair to say that we are not keen on mutation breeding. It has risks associated with it, although I am given to understand that it delivers mostly gene deletions, which can happen ordinarily and naturally. I would not say that there is a clear black and white on mutation breeding; I think there are risks associated with it.

Liz O'Neill: I certainly echo that. It is certainly not something, as I understand it, that members of GM Freeze are keen on. It is not what my organisation is working on. That is all I can say.

Q6 Chair: What about non-agricultural uses of GM? One example is the use of GM bacteria in commercial insulin production, or medical gene therapies.

Dr Parr: That's fine. Our concern is about release to the environment. We are perfectly happy with and indeed supportive of stuff that involves properly contained use. There might be some difficulties around waste-streams, which we have seen in the past, but if it is properly contained we have absolutely no issue with it.

Q7 Graham Stringer: I listened carefully, but I did not hear an answer to Professor Leyser's point that, essentially, there is no difference between GM modified crops and natural variation. We are all the product of natural variation over millions of years. What is the fundamental difference in doing it on purpose rather than doing it at random? Why should we be concerned about that?

Liz O'Neill: There are several levels to look at. On the molecular level, the process by which something is achieved can have a significant impact. Just because you are trying to do the same thing, just because you are dealing with the same expression, does not mean that you will have the same results. The amount of time that it takes to produce a viable crop is in part because of the number of things that can go wrong along the way; there is mutation and transformation due to mutations. The very process allows something that you might almost think of, in layman's terms, as genetic scarring. Because you are intervening at that level, there is more that can go wrong. That does not mean that it necessarily has gone wrong, but it is important to have a level of safeguard in place that you would not need if you were breeding conventionally.

On a broader level, the process and the commercial environment around GM is very different. GM crops are patented, and non-GM crops are usually subject to a royalty. That makes a big difference to the way that the crops and seeds are controlled.

Q8 Graham Stringer: I understand the capitalist point, the commercial point, but I am interested in the science. What is the real difference between random mutations, which produce all sorts of good and bad things, and genetic modification? That is the real point that I think Professor Leyser was making, and I do not understand your objections.

Dr Parr: Let me try to explain. As we see it, the techniques of genetic modification involve a quite different process. The insertion of additional genetic material can deliver

variation that is outside the conventional variability envelope that flows from conventional breeding. That is why we are supportive of marker-assisted breeding, which as I said is delivering things on the ground, whereas the GM process—as recognised by the Biosafety Protocol and in various statements by scientists, such as the ENSA statement, for example—creates different and out-of-context variation in the sort of impacts and traits that will develop from a genetic modification, including those that come from genes that have been taken from outside the gene pool that would normally pertain to a particular species.

Q9 Chair: There's fierce shaking of heads on the other side of the table.

Professor Leyser: I would make two points. It is absolutely right that you can introduce genes that are not present in the normal gene pool, but that is not a requirement for the technique; it is something you can do. Again, that comes down not to the technique but the trait that you choose to introduce. There are interesting questions about that, but it is not an inherent objection to the entire process.

You then come down to the question of insertion. I would point out that one of the things that we know now, which we did not know at the beginning, is that the genomes of all the major cereal crops that we eat are stuffed full of thousands of transposable elements that admittedly are mostly kept inactive by endogenous mechanisms, but they are not completely inactive. Every Rice Krispie you had for breakfast this morning is probably genetically different from every other Rice Krispie through the insertion of a piece of DNA at some point in the genome that we do not know and never will know. The idea that it is inherently more risky compared with what we now know about all the conventional approaches that we use is not tenable based on the current science. I am not saying that it is risk free, but nor is conventional breeding.

Professor Baulcombe: One could emphasise that point with a real live example. One could consider a genetically modified potato plant that is resistant to late blight because it carries a gene from a potato relative. GM has been used to transfer the gene from the potato relative into a potato to give you a potato plant that is resistant to late blight. Any gardener will know about this disease, and it is a big problem for farmers.

You could, in principle, produce a conventionally bred variety that carries the same gene, but it would take you a long time to do it. If you did it, by the end of the decade or so that it would take, the new variety would have the same gene as the GM variety. It would also have several thousand other genes that had been brought in from the wild relative. The degree of uncertainty associated with this is something that we have managed, but it is orders of magnitude greater than the degree of uncertainty associated with the GM crop, and I have not heard a convincing answer from Greenpeace, GMWatch, GM Freeze or anybody else as to why one should consider the GM crop in that particular instance as being any more risky or subject to uncertainty than the conventionally bred variety.

Dr Parr: You may be aware that nearly 300 scientists signed up to a statement that there is no consensus on GM safety, pointing out that a number of the effects were still the subject

of considerable concern. As I said, I have not been working on this for a number of years, but there is plenty of scientific opinion out there that takes a different view.

Q10 Chair: There is plenty of scientific opinion that would disagree with you and me over climate change, but that does not make them right, does it?

Dr Parr: I'm sorry, I am not quite sure what you are saying.

Q11 Chair: You find a group of people that are on your side, and you say that therefore your position is rock-solid, and you can defend it. I do not understand that.

Dr Parr: That becomes a question of how one manages uncertainty in the innovation process, and what the objectives are in the outcome.

Chair: Absolutely. We agree about that.

Dr Parr: And whether the risks are acceptable and appropriate given what is intended.

Liz O'Neill: The comparison is often made between climate change denial and GM scepticism. We do not deny that GM exists, so it is not a fair comparison at all. GM is a technology, and GM Freeze was started by a group of people including working scientists. It is not the same as saying that it does not exist. It is an argument about the safety of a particular technology at this point in time.

Q12 Graham Stringer: Were you going to say something about this, Professor Baulcombe?

Professor Baulcombe: I still have not heard a convincing answer to my question as to why the GM potato should be considered any more risky than the conventionally bred equivalent. I could come up with a list of scientists, including Nobel prize winners, who would support the idea of extrasensory perception, but it would be folly to base communications policy on the idea that we can transmit ideas from one to another because a bunch of scientists say that. You have to look at the evidence. If you look at the evidence for the health risks associated with GM crops, and for the environmental risks, it is quite clear that there is nothing inherent about GM that causes concern for human health or the environment.

Q13 Mr Heath: A phrase has come up, Chair, that you and I and the Committee have talked about before. We talk about “the technology” as opposed to applications of the technology. I have difficulty with that. It is like saying that biochemistry is dangerous because some applications of biochemistry are dangerous. I do not understand how a whole technology can be treated as one, rather than the risks of any particular application being properly assessed and then either agreed or rejected.

Liz O'Neill: I agree entirely. GM Freeze is not for or against—

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Q14 Mr Heath: You are asking for a freeze on the technology.

Liz O'Neill: No, we are asking for a freeze on the application of the technology until a certain set of conditions is met. Both Doug and I have mentioned that we felt there is evidence that the technology is inherently more risky than others. That is something that people argue over.

I am not a PhD scientist. Unfortunately, the Committee was not able to be flexible about when GM Freeze gave evidence, so you are not able to have our working scientist here—you've got me instead. I cannot argue in the same terms as professors in the field, but I can tell you that there are contrary views.

Q15 Graham Stringer: To labour the point, I want to ask a different question of Dr Parr. Do you think that the technology is inherently unsafe? I would like a clear answer.

Dr Parr: Inherently?

Graham Stringer: Yes.

Dr Parr: It depends what you mean by inherently. Our view is not and has never been that every GM event is going to be hazardous. It is that there are risks associated with the GM transformation technique, and we believe that some of those will be hazardous. In fact, the old-style way of dealing with GM was to have a large number of events and then try to screen the ones that produced the desired effect. The others could produce some quite random effects. Our position is on the ability to screen out the impacts that could be delivered and could or would be deleterious, given that this particular technique is about biological organisms being released to the environment that are self-replicating, and therefore that the barrier for those potentially damaging events needs to be set very high.

Q16 Graham Stringer: I listened to a discussion on the “*Today*” programme this morning about golden rice. Greenpeace have been accused of having blood on their hands because they have taken legal action to stop the development of golden rice. One of the questions that I wanted to ask, I don't think was asked on this morning's programme. The point Greenpeace made was that golden rice does not exist as a commercial product at present. Why put so much effort into stopping it being produced, when it looks as though it will have, at least for some people, probably in an urban environment, enormously good beneficial health outcomes?

Dr Parr: First, I would question that we are putting an enormous amount of effort into stopping golden rice. I do not think that is true.

Q17 Graham Stringer: Can you tell us how much money?

Dr Parr: I have no idea. This is all going on in the Philippines. But that is not the impression that I get from what is going on there.

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Q18 Graham Stringer: Fair enough. We are grateful to you for coming here this morning, given that you have not been doing the job for 10 years, but there are press reports that a terrific number of legal actions have been taken around the world by Greenpeace on golden rice.

Dr Parr: It is news to me, I have to say. I am not saying that they are wrong—I am just not aware of it.

The point that I would make, which is supported by a number of Filipino farming groups, is that they see this in quite a political context. My take on golden rice is that it is a last resort. It is the least favourable option, given the challenges of nutrition across the spectrum. It is not just about vitamin A, although that is important, but zinc, iron and essential fatty acids, and golden rice will deal at best with only one of them. People who are on the ground dealing with this in the Philippines see the focus and attention on golden rice acting as a disincentive to dealing with some of the other more serious and cross-cutting issues.

There are existing techniques. Marker-assisted breeding, which I mentioned earlier, has achieved biofortification in some crops, and we are happy to support them, but even for those we would have to say that the strategy is not the right one. It is a stop-gap and a sticking plaster for a much deeper problem. They see the deeper problem being entrenched by a focus on this technology, which is predominantly, although not in this case, under the control of companies that they see as the enemy of delivering those longer-term solutions.

Q19 Graham Stringer: That sounds as though you could help a few people, but until you have a utopian situation you will not help anybody. Is it not the case that about 2 million children are dying or being blinded by vitamin A deficiency around the world, and that if you could get to some of those children by developing golden rice it would be a help, even if it did not cure all the problems of food deprivation in the world? Greenpeace are taking a highly ideological position, not a scientific position.

Dr Parr: I shall come back to that. There appears to be an issue, which as I said is adopted by some of the Filipino farmers groups; they see it as potentially distracting or depriving other solutions from being able to go forward. We know that the World Health Organisation regards supplementation as one of the most cost-effective things that they can do, and that the focus and attention on golden rice as a solution is potentially distracting from delivering the real-world alternatives that exist.

Professor Baulcombe: I point out a couple of inconsistencies in Dr Parr's evidence. There is no way that you could use marker-assisted breeding to produce a variety that has the nutritional benefits of golden rice. It is just not possible.

A second point is that there is so much emphasis on golden rice, and it is a distraction, because of the resistance to it. If the people involved in developing rice could just get on and do it, we could move on and start dealing with all the other problems that confront the unfortunate people who have poor diets.

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Dr Parr: May I point out that one of the farmers groups has developed its own rice, which has a little bit of vitamin A in it, so it is not true to say that there is no vitamin A in the rice genome?

Professor Baulcombe: No, I said that you would not be able to match the current golden rice by marker-assisted selection. I think that is true.

Dr Parr: That is probably true.

Professor Baulcombe: Thank you.

Q20 David Tredinnick: In your written evidence, GM Freeze and Greenpeace point to a European Environment Agency report entitled “Late Lessons from Early Warnings.” Could you explain what you consider the early warnings to have been in the case of GM? That question is for you, Ms O’Neill, and for Dr Parr.

Dr Parr: I would say that the early warnings in this case were the recognition that unintended effects do happen associated with the GM technique, and that random insertion during the process of genetic modification produces unpredictable outcomes that can potentially lead to unpredictable effects when released into the environment.

Q21 David Tredinnick: I am going to ask the professors to come in on this in a moment, but would you agree with that position, Ms O’Neill?

Liz O’Neill: Certainly on a molecular level, that seems to be in tune with the advice that GM Freeze has received, but we also have to look at the real world level. The phrase “early warning” almost seems ludicrous in this instance, but if we look to north and south America, where a large amount of GM is grown, we have seen a huge growth in pesticide-resistant weeds, a massive decline in the monarch butterfly, and a large number of serious contamination incidents. A form of bentgrass that was developed for golf courses is growing wild along American watercourses. In Switzerland, there is herbicide-tolerant oilseed rape growing alongside roads and railways; it is not even permitted to be imported for animal feed in that country, so it does spread. When a transferred gene offers a competitive advantage in the environment and if it gets out into the world, it will be extremely difficult to contain. Our own farmstead evaluations showed that GM farming is damaging to wildlife and biodiversity. They are not really even early warnings; they are huge red flags.

Q22 David Tredinnick: Professors, if you could answer these specific points in your contribution I would be grateful: the issue of weeds that are resistant, the decline in butterflies, the problems of the special grasses being grown for golf courses and oilseed rape growing along railway lines. It would be helpful if you were able to comment on each of those specific points.

Professor Leyser: I would like to comment in a general way, rather than going into the detail of exactly how many of these and how many of those. All the things that you

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mentioned, absolutely all of them, are not to do with GM. They are to do with the trait that has been introduced. If one takes herbicide tolerance, for example, and all the issues about weed resistance and so on and so forth, there are non-GM, single gene, herbicide-tolerant crops out there. There is no scrutiny whatsoever before they are put in the field, just the standard breeding applications. They have exactly the same, or possibly slightly worse, issues associated with them. This is exactly the point.

If one is concerned about particular environmental issues, such as the spread of herbicide tolerance, campaigning against GM is the wrong way to go, because it is not caused by GM. It is caused by herbicide resistance. If your concerns are those environmental issues, you should be campaigning against herbicide resistance, however it is introduced. We need a regulatory system that looks at traits, however they are introduced, not GM. Banning GM tomorrow will have no impact whatsoever on any of those problems, because there are other ways to achieve those things.

One has to be really clear about this, and a lot of what we have been discussing is exactly the kind of problem that has happened over the years. GM has attracted, as a magnet, all the issues that people are concerned about in agriculture. They are real and important issues, but none of them has anything to do with the technique. As a result of the absurd focus on GM, we are ignoring all these broader issues, and the problems that we would like to address are going unaddressed because everybody is banging on about GM.

Professor Baulcombe: I would agree with that. It has been highly unfortunate that herbicide-tolerant crops have been mismanaged in the United States. I would have been happy to join a campaign that argued for the environmentally sensitive management of such a valuable trait. It is wrong to argue against GM herbicide tolerance as such. One should be trying to develop a rational strategy for the management of the trait. On the question of the butterfly, it may be a correlation—

Q23 David Tredinnick: I chose butterflies because, as a politician, it is an emotional issue. We see butterflies floating around. We love them. The fate of the butterfly, in a sense, is something that my constituents in Hinckley and Bosworth can identify with, and if they hear me talking about it here it is something that is very understandable. Is it good for the butterfly or not?

Professor Baulcombe: Industrial agriculture is bad for butterflies. Intensive agriculture, where you have a monoculture without wildlife in the farming environment, is bad for butterflies. Herbicide tolerance has given you very good weed control, it has reduced the number of wild plants in the agricultural environment, and in north America it may be associated with the decline in the population of monarch butterflies. That raises again the question of the management of technologies, so there is a discussion about intensification of agriculture. If one combines that with a strategy for land sparing—setting aside land for wildlife—we could maintain the diversity. It is the wrong issue to argue against GM crops. Again, if one wants to save the butterfly, one should be arguing about the management of industrial agriculture.

Q24 David Tredinnick: Are you saying that the GM crop is a problem for butterflies or not?

Professor Baulcombe: I am saying that an agricultural environment which has very few weeds in it is a problem for butterflies. GM and non-GM herbicide-tolerant crops will give you such an environment, because they allow the farmer to get good weed control. Do we want farmers to be able to grow their crops with good weed control? Yes, we do. Do we want to keep butterflies in the environment? Yes, we do. Can we find a strategy to manage to reconcile the two? Yes, we can. That is where the focus should be, rather than on opposing one part of the equation, which is a technology to give one particular agricultural trait.

Q25 David Tredinnick: Finally, and this is for all of you, can you see in the future any scenario in which GM might be able to make a positive contribution to global agriculture? If not, why not?

Dr Parr: I shall answer that question, but I want to pick up on the traits question, and why I was particularly keen to draw a distinction between the molecular side, which we have covered, and the traits that are delivered by GM. When one looks at what is actually on the table rather than at the theoretical potential, it is very much the traits that are supporting what we could call a quite industrialised agriculture—heavy input agriculture is how I would describe it. Concern about GM is not restricted simply to the GM technique; it comes from what social scientists have called the technology constitution. What comes along with it? It is not simply a technique; there is a structure for how it is going to enter society.

In the case of GM, which has heavy intellectual property protection, it is nicely set up for delivering some of those traits, which are essentially about homogenising the environment around the crop plant. It is particularly well geared for large corporations to deliver those kinds of outcomes with the seeds that they choose to produce, in many cases to reinforce their existing chemicals businesses. Separating out the traits from the GM technique is not quite as clean and straightforward as it might first appear. Sorry, I have now forgotten your second question.

Q26 David Tredinnick: It was simply this. Is there any way in which you see GM making a positive contribution to global agriculture?

Dr Parr: It could. At the moment, we continue to see the problems that I have outlined, but foretelling the future is a dangerous game. We will see what happens.

Liz O'Neill: Absolutely. The crops that are currently awaiting approval in the EU are all herbicide tolerant and insecticide expressing, so the traits are very connected with the technology at the moment. GM Freeze would have difficulty imagining how those could be used in a positive way, but the technique could be used for all sorts of good. Indeed, our memorandum and articles of association delineate what needs to be done to make that happen. It is about open access, liability regimes and protecting choice. We are certainly

not against the technique—the technology—on its own terms. It is the reality of what is being done with it in relation to farming today.

Professor Baulcombe: May I make a point about the technology constitution? It is not inevitable that GM would be linked to large multinational corporations, to an oligopoly in the food chain. GM is highly compatible with an entrepreneurial culture in which you could have non-governmental organisations and charities all developing GM technologies that would help us to drive the economy and the agricultural environment, producing more sustainable crops and food. There is no reason—well, there is one reason why this is not happening right now, and that is the regulatory process. The roadblock in Europe on the regulatory process is such that nobody wishing to invest in a start-up company would do it in the GM area at the moment because there is no route for them to get their product out into the field.

Q27 Mr Heath: I am thinking about what you were saying about the technologies coming on to the market that are based in this—herbicide resistance and so on— and that they all involve higher input levels. I give an example.

The blight-resistant potato is now almost ready for market. People are working on it in Norwich. I have been to see them and they are doing a good job. I am not sure that I recognise that as falling within the categories that you just mentioned. There is lower input because you have less requirement to drench, and I do not see that it follows the traits that you find abhorrent, so why would you necessarily and theologically be against the blight-resistant potato, which could make a significant contribution to an increase in supply?

Dr Parr: I would not be theologically against a blight-resistant potato. That is an example of where it has escaped the block, which is predominantly what is on the table with GM.

Q28 Mr Heath: You would be happy with the blight-resistant potato, provided it passed environmental tests.

Dr Parr: Yes, although there is the molecular aspect.

Q29 Mr Heath: Thank you. That is helpful.

Liz O'Neill: May I speak about the potato? First, on the question of whether it is almost ready for market, we have not yet seen the full report on the open trials, and there will be a significant delay after that. What is on the market, already for sale on the national list, is the Sarpò blight-resistant potato, which is resistant to a large number of forms of blight, as opposed to the GM potato, which is resistant to only one. The organisation that is developing the Sarpò potato currently has a crowdfunding appeal on their website. That is how small and under-resourced they are. One of the broader issues around GM is that it is currently sucking up a huge proportion of research and development money, so other possible solutions are not given a chance to grow and develop at anything like the same pace.

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Q30 Chair: Professor Leyser, you are shaking your head.

Professor Leyser: Again, this interesting issue about resources comes up a lot. It maps on to the question of the technology landscape, which is widely discussed, particularly in the social science literature. To me, it is a misunderstanding about what GM science is. It is the tip of a very broad science-based iceberg, where all the work leading up to the development of a GM crop is about basic plant biology that can be equally well applied to conventional breeding. The amount of money that is spent actually developing the GM crop across the general piece is quite small. The amount of money that is often attributed to so-called GM science is just science, which can be applied in whatever way you like.

There are indeed very interesting questions about why particular solutions to particular problems are being picked, and it would be interesting when we come on to issues of regulation and patenting to explore why that might be, but I do not think it is the case that currently many solutions to problems are being ignored because everybody is opting for this one very expensive approach. That is not what is happening. I do not know why it is that people are picking this over that, but it is not because of money.

Chair: Before we move on to Stephen Metcalfe, I am conscious that Dr Parr has to leave at 11 on the dot. We understand that, so nobody is to read it as some rude act on his part when he leaves. But we will, Dr Parr, follow up some of the questions in writing.

Q31 Stephen Metcalfe: I want to move on to the question of regulation within the EU, particularly the EU's use of the precautionary principle. I understand that the precautionary principle is to be applied when there is insufficient scientific evidence, or when there is a particular risk or danger to human well-being. Do you agree that that is what the precautionary principle says? Secondly, do you think that those conditions are currently met for the process of genetic modification?

Professor Baulcombe: The precautionary principle is applied by the European Food Safety Authority in a slightly more heavy-handed manner than I think is necessary. They have a process that I would argue is a little heavy-handed, but nevertheless it is reasonably effective. The problem comes when the decision-making process goes beyond EFSA, when the decision is in the hands of the European Parliament and its committees, when precautionary principle and any evidence-based or science-based decision making go by the board. EFSA operates according to a reasonable but slightly heavy-handed interpretation of the precautionary principle. The problem with the regulation is when the decision making goes beyond EFSA.

Dr Parr: I shall make some overall remarks about the nature of precaution and the precautionary principle. One of the things that is problematic about taking the precautionary principle and simply saying, "Here is a product. How do we apply the precautionary principle?" is that it treats the process of delivery of the product as a black box that just happens, and then one has a product that one has to deal with. A better understanding of precaution goes back to the innovation process, and the needs and

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outcomes that are being sought. A plurality of potential inputs and processes can deliver innovative solutions to the requirements. That is a more productive way of thinking about precaution than, as I said, having a product and saying, “How do we apply the precautionary principle to this?”

Take blight resistance, for instance. There is a variety of ways to tackle it. Breeding is one, rotation is another, and fungicides are obviously another. There are a variety of ways to deal with it. A holistic approach to looking at how one might deal with the problem of blight, and in process terms delivering a lot of inputs from all sorts of different perspectives, should deliver a much better outcome. There is extensive literature on ways in which that might be done and the tools that can be adopted by policy makers in delivering useful outcomes.

With that caveat on simply talking about it in this way, I would make a couple of further observations. One is that judgments about how to deal with scientific uncertainty, systemic uncertainty and, indeed, social uncertainty about the impacts of a product are inherently political, because decisions to do, to stop or to agree are political, and those judgments should be made transparently by decision makers. The role of scientific advisory committees is to radically appraise—I shall explain that—the nature of uncertainty and ignorance as it pertains to the science in a particular instance. By “radically appraise,” I mean not simply, “What are the probabilities around this specifically identified risk?” but “What is the nature of the systemic uncertainties around the paradigms of knowledge that we currently use to think about this particular product?” I tend to think that being able to do that, and having scientific committees that are in a position to do that through a wide range of inputs from different disciplines, gives a much better perspective on the nature of the uncertainty, and better informs the decision maker as to how to apply precaution in practice.

Liz O'Neill: I go back to the original question. I and GM Freeze would entirely agree that the precautionary principle is a tool for dealing with uncertainty. It is not a way to cry wolf every time there is something you do not like. There has to be a plausible threat. It is applied when the classic risk-management process of multiplying impact by likelihood cannot be done, because you simply do not have the evidence. It will not surprise anyone here that I argue that that is the case in many instances of GM—there are risks that cannot effectively be quantified, or there are hazards about which the impact or probability cannot be effectively quantified.

Professor Leyser: In many ways, I would agree with an awful lot of what has been said by those on my left, but once again to me it emphasises the peculiar position we are in: we are talking about it as though it is something to do with GM when it is not. It is something to do with how you solve particular problems in agriculture, and that absolutely needs addressing and looking at. We need this holistic assessment—an agreed solution that meets both the practical challenges and the socio-political landscape into which the whole process is proceeding. The endless discussion about it, as though it were to do with GM, slows down the point where we can arrive at a situation where we have a governance framework where problems can be addressed in a sensible way.

From a precautionary principle point of view, what it comes down to is that it is bound to be relative. That means is there more risk than with the other alternatives currently available? I think there is no evidence that that is the case. The other thing that has to be wrapped in is the risk of doing nothing, which we currently do not do very well. Those two things go hand in hand.

Q32 Stephen Metcalfe: Do you think that it would be useful when applying the precautionary principle to separate the process from the product, so that you look at the process and say, “Okay, we have applied that, and therefore the process is acceptable within that framework,” and then look at individual products? It is about the trait as opposed to the process by which you get to the traits. Would that be a useful step forward?

Professor Leyser: The Royal Society and a number of the other committees that I have been on have looked at this and, in my opinion, a good way forward seems to be to move to a regulatory system that is based on product, based on the trait that you have introduced, however you introduced it. This, for example, will address some of the issues around herbicide tolerance, because you are just looking at herbicide tolerance. It is not a tremendously popular approach, because it widens the regulatory landscape; it widens the number of new crops or even new agricultural practices that are subject to that kind of scrutiny, but if we really want a system that defends the environment and, as far as possible, protects the integrity of the food chain, we have to do that. It is crazy at the moment that crops with identical traits, with identical environmental and health risks, are assessed in completely different ways.

Q33 Stephen Metcalfe: Does anyone else want to pick up on that final point? Do you think that it is right that they are assessed in different ways?

Dr Parr: To some extent, it is going over ground that we have already covered, but if one accepts the difference of opinion on the GM process I certainly do not have an issue with incorporating GM in an assessment of agricultural traits and the impact of that on the environment. What was illustrated by some of the farm-scale trials is the impact on wildlife of the intensification that has gone on.

Q34 Mr Heath: Would it be fair to say that one of the reasons for this distinction is that a lot of the thought processes around genetic manipulation are based on a very early period of genetic manipulation, when it was largely exactly as it is characterised—taking a gene from a totally different species, sometimes even a different kingdom, and inserting it without a clear understanding of the genomic structure and detail? The processes are now very different from what they were when the technology was first being investigated, but the regulatory framework has stayed the same. It has stayed locked in a time warp from 30 years ago.

Dr Parr: That would clearly be the argument of the people to my left. All I can say is that the view of the people I have been talking to recently, in view of the fact that I was coming to the Committee, is that things have not changed that much. But I think we’ve covered that.

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Q35 Mr Heath: I agree with you about some of the release criteria. Essentially, I am not talking about that; I am talking about the way GM fits into the greater picture.

Professor Leyser: The other thing that has not yet been addressed by you, Doug, is what I raised at the beginning. One of the things that we have learned in the intervening time is not how we improve the process of genetic modification; it is what an incredible mess conventional breeding is, yet we are happy to deal with it. Yes, you listed risks and uncertainties that happened during the process of generating a GM crop, but there are at least as great if not greater risks and uncertainties, with unintended consequences, unexpected side-effects, nasty toxins coming in from the wild relative and all those kinds of things from conventional breeding. It is the comparative justification that is important, not just saying, yes, there are risks. It is a key issue.

Dr Parr: I hear what you say, but that is not the advice that I have been getting.

Professor Baulcombe: I want to respond to Dr Parr's point about things not having moved on over 20 years. They have moved on enormously over 20 years. You are getting poor advice if it is telling you that it has not moved on. We now have genome sequences of all the major crops in the world. We have available to us all the genes from those crops to move around by GM in a way that we did not have available to us 20 years ago. We have a much more sophisticated understanding of the genetics on how the plants work, so the potential to develop new technologies is enormous. We described in a report for the Council for Science and Technology earlier this year a GM update, a list of traits that have emerged or are emerging that are available in the research pipeline. To say that things have not moved on over 20 years is a complete travesty. It is totally wrong.

Dr Parr: Let me come back to that by saying two things. First, what appears to be on the table in terms of actual potential releases does not seem markedly different from what it was when I was dealing with this some time ago. Secondly, the proof of the pudding has to be in that, because I remember sitting in presentations in the mid-1990s when people, experts from food companies, were saying that by 2010 we would be having broccoli that would stop us getting cancer. It just has not happened. Frankly, these promises have been made before. I'll believe it when I see it.

Professor Baulcombe: Potential releases have not moved on for 20 years because we still have applications that were made 20 years ago in the EFSA pipeline. For 1507 maize, it was something like 18 or 20 years when the application was put in, and it is still not resolved. Nobody is going to go to the trouble of putting an expensive application through a process if there is no prospect of getting something out at the other end. If you look at the science and the potential, and also if you look at what is happening in the USA, where more GM crops are coming out, things are changing. Do not use the output of the European approval process as a benchmark for how vibrant the science is and how much the technology has moved on.

Dr Parr: Yes, but I was referring to the global situation on traits, and what is coming through. I was not talking about Europe, because we know what is going on in Europe.

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Liz O'Neill: It is vital to differentiate the theoretical possibilities and the early lab work on the one hand—the things that are being done that may well allay all my fears; I really look forward to that day—and the crops that are awaiting approval in the EU. In the terms of reference for this inquiry, and looking through an awful lot of the evidence that has been presented to you in writing, those two are completely mixed up and meshed. You cannot on the one hand focus on new developments and precision and say that makes everything okay now, and then use that as an argument for why the current European approval process is not working. As Professor Baulcombe said, the crops that are waiting are from the 20-year-old technology, so we cannot mix those two elements. It is vital that people see that there are two different things on the table.

Q36 Stephen Mosley: I want to ask about the approval process. Of course, any GM crop needs the European Food Standards Agency effectively to assess it and approve it. Do you think that process is scientifically robust?

Liz O'Neill: What concerns me about the scientific process is that there is no independently commissioned research; all research is submitted by the applicant, who could be cherry picking. We do not know if they are, we do not know if they are not, because they are entirely in control of what evidence they put forward. That concerns me greatly; it does not feel transparent. There has been a recent improvement, in that one can now access the dossier, but there will never be a way of accessing research that companies commission and choose not to put forward.

There has also been a lot of talk recently about 90-day feeding studies, and the impact that they may have. However one feels about the efficacy of that kind of animal research, there is a subchronic study showing that 90 days is not long enough for chronic impacts to show up. There are gaps in that risk assessment process.

Q37 Stephen Mosley: Talking about the process as a whole, what do you think, Professor Leyser?

Professor Leyser: I should say, up front, that I am not an expert on regulatory processes. From where I am sitting, there is a huge amount of discussion about feeding trials. I would like you to show me the feeding trials for all the food I can currently buy in the supermarket. You will not be able to, but I can tell you that there are things on the shelves that will kill people because they are allergic to them. Again, it is a question of comparative risk.

The idea that you put in a process that looks in an arbitrary way at absolutely anything is fundamentally problematic from a risk assessment point of view. People who are expert in risk assessment will tell you that that is not a rigorous risk assessment; you have to have hypotheses. The hypotheses are, once again, related to the trait, not generic. I am absolutely in favour of a sensible risk-based assessment that looks at the trait, considers the hypotheses that might come from that as a possible downside or negative, and then assesses whether or not those things are the case, as is quite commonly the case with allergy testing for GM-related products. As for the idea that it is a GM-specific activity,

there is no justification for that, specifically for a crop that was made in a particular way. It is arbitrary, which is not a good way to do regulation.

Professor Baulcombe: I refer to a paragraph that I happen to have in front of me from the European Commission's statement on the precautionary principle from the year 2000. This is not orchestrated. It says in paragraph 5.1: "It should however be noted that the precautionary principle can under no circumstances be used to justify the adoption of arbitrary decisions."

We have an arbitrary decision-making process; the decision as to whether or not a crop or a product goes into this process is arbitrary at the moment. Somebody has made an arbitrary decision that GM crops generically go into this process. It does not have a rational basis. Ottoline is absolutely right. Let's face it, what we are about here is not point-scoring or whatever, it is developing a sustainable and sufficient agriculture. It is making things better than they are at the moment. While we are messing around doing all this sort of stuff, we are getting in the way of having better agriculture.

Q38 Stephen Mosley: We on the Science and Technology Committee are looking at the scientific side of things. Ms O'Neill, you mentioned the 90-day feeding trials. Do you think that there is a scientific basis for doing those feeding trials, or is it arbitrary, as we heard from Professor Baulcombe?

Liz O'Neill: I would be interested in hearing the two professors' view on whether their position that it is arbitrary applies to the technology of 20 years ago. We already know that the crops that are in that process at the moment are not using the same techniques as you are looking at in the lab today. They are using the original GM. We have heard a lot about how things have all moved on and "We're sure it's all safe." I'm sorry. Obviously I'm paraphrasing; I cannot remember exactly what people were saying.

Q39 Stephen Mosley: Specifically on the 90-day trials, you have not seen any scientific evidence to show that those trials aren't required.

Liz O'Neill: It is not something I am qualified to offer a judgment on.

Q40 Stephen Mosley: I turn to the two professors. Are you confident that the process has the capacity to detect unintended effects?

Professor Baulcombe: I think it would do more. It would detect unintended effects, but it probably should be applied to—one has to ask what is the basis for looking for these unintended effects? In terms, let us say, of toxicity to human beings and animals, I would argue that evidence that there is anything generically about GM that introduces a risk of toxicity to humans and animals is non-existent. Even in the studies of the existing GM crops produced 20 years ago, the evidence that those are toxic to humans and animals does not stand up to rigorous assessment.

One has to ask oneself, do we need to have these feeding trials? If there is not a rational reason for thinking that there is a risk, why are we doing this? Even Professor Perry, a member of the EFSA GM science committee, who produced a written submission to your call for evidence, has argued against the need for these 90-day feeding trials, and whether or not they are useful.

Professor Leyser: There is a general point, too; in a Rumsfeld sort of way, you are talking about unknown unknowns. It is not possible to test for all unknown unknowns in a rigorous way. It is not the case that any new anything is risk free. We just have to live with that. We have to do our damndest to assess what risks there might be, to consider all the possible things that could go wrong, and which might be the known unknowns, but the notion that we can have a regulatory system in place that eliminates risk is wrong, and nobody should pretend that we can have one.

Q41 Stephen Mosley: I know that this was mentioned earlier—I cannot remember whether it was you or Dr Parr who said that all the evidence has been produced by the companies. It is the case across the board in environmental monitoring that our regulation system relies upon companies, and that if there is an issue for health and safety and so on they report it, but they only report the issues. What alternative are you proposing?

Liz O'Neill: There are specific barriers to independent research on GM instances because of patenting. One simply cannot do independent research. Even if one were able to get funding from elsewhere, it is not possible. There is a lot of head shaking, but Monsanto licensing agreements specifically preclude research on their seed, so it is not something that can be done in another forum. I am not sure what my opinion would be in other areas of legislation, because that is not what I deal with, but where there is a specific barrier to independent research it has to be a matter of concern.

Professor Baulcombe: I do not have the reference at the top of my head, but I would be happy to send the Committee a reference for independent scientists looking at the toxicity to animals in both short and long-term feeding trials of Monsanto-derived varieties. They have been used, and I would be happy to circulate them.

Liz O'Neill: There are some, but the number is minute compared with those commissioned by the companies, because there are specific barriers to carrying them out.

Professor Leyser: I do not know the details, but I do know for example that there has recently been this enormous analysis of cattle—literally billions of cattle—before and after GM, and no differences have been detected. I do not think that was Monsanto funded.

Liz O'Neill: No, it was not.

Professor Leyser: It is public domain data, so people can do those kinds of analyses.

Liz O'Neill: As I understand it, that study uses public domain data that focus on the things that are reported anyway. There has not been any primary research commissioned as part of that study. We are looking at data that is in the public domain about the agricultural requirements for crops. It is about yield and those sorts of factors; there is no toxicology

element to that wider study. Also, the animals included do not reach their natural life span. It is a piece of information that is interesting, but it is not proof positive that nothing could go wrong.

Professor Leyser: Something that I promised myself I would not do when I came to this Committee was to get sucked into a detailed argument, because the detailed arguments are not relevant. What we are talking about is the notion that there is a reason for treating a particular technique differently from all the other techniques that we use. There is no such reason, so one can make exactly the same arguments that you are currently making about GM about non-GM.

What we need to think about is a regulatory process and a patenting process that treats all these approaches equally and that is open to scrutiny in the way that we would like—an overall governance system that delivers what we want from our food production chain. We spend so much time arguing about “He said,” “She said” on this or that study, when the solution is to zoom out to look at the thing in the round and move forward. You are Members of Parliament, and you have the power to shift the laws into a position where the governance arrangements are much more sensible, and deliver what we want from the food chain.

Q42 Pamela Nash: I would like to explore the area of research a bit further. It is not unusual for the Committee to hear accusations of bias in research, particularly in controversial areas of study. We have seen these accusations on both sides in the evidence that has already been submitted to the Committee. In your opinion—I would like to hear all your views on this—has there been sufficient independent research on the safety of genetically modified products? I would also be interested to know who could conduct that, and who would be universally respected by both sides as being independent.

Liz O'Neill: It is fairly obvious that GM Freeze does not feel that there has been enough truly independent research. I do not feel qualified to answer about who would be considered adequately independent, but I could certainly come back to the Committee on that.

Q43 Chair: Would you discount the people on your right?

Liz O'Neill: As individuals? No, of course not. They are extraordinarily skilled and—

Q44 Chair: Independent. They are not in the pockets of Monsanto.

Liz O'Neill: I am sorry, but I have not had the opportunity to read their conflict of interest statements to the Committee, but I presume that the Committee has. Perhaps you could tell me. I really do not know. I certainly have no objection to them.

Q45 Pamela Nash: It is a crucial point. In any campaign, there has to be an answer to that. I hope that you will come back to us later in writing. You cannot call for independent research but not have a view on what it constitutes.

Liz O'Neill: I am not a research scientist, and I do not want to say something inaccurate, but I can certainly get back to the Committee.

Professor Leyser: I am a plant biologist; I do not do feeding, toxicology or any of those other things so I would not be a suitable person to conduct such things, but I find it difficult to understand the rationale for these kinds of calls, given what we know, because there is no basis for imagining that, generically, there is an issue. People seem to be of the opinion that you will be able to resolve the question of whether GM is safe or not safe to eat, based on some kind of magic independent trial. Since there is nothing generic that you can say about GM, nothing that distinguishes it critically from non-GM, it is a vacuous desire at some level.

One example would be lots of anxiety about the possibility that some particular herbicide-tolerant varieties might cause cancer in rats—we can argue about that, but, as I said, I do not want to get into the details of “He said,” “She said” on that—but there is also a very nice study showing that GM tomatoes that produce increased levels of flavonoids actually protect rats from cancer. You have two GM things, some of which have been argued to cause cancer and some of which have been argued to protect against cancer; the arguments are about the herbicide and the flavonoids, not about the GM. The notion that you can do some magic trial, and solve the question of whether it is safe or not, is not even worth thinking about, because it is not intellectually coherent as a concept.

Professor Baulcombe: I agree with that, but I would say that it is always worth doing the experiments. It is always worth having a look. As far as I can tell, studies have been done on animal feed, although it is not my field, and the ones that are statistically robust and experimentally well designed failed to produce any evidence that there is generically a problem with the GM crops. You then have to combine that with the thinking a priori: is there a reason why you think these products would do something bad to rats or people? The answer is no. You have the evidence that says no; you have the a priori assessment of the situation that says no, so the logical thing seems to be to move on.

Q46 Pamela Nash: I have a final question on this. Much of the research that is often quoted about concerns over the safety of these products has later been discredited. Do you agree with that? Are you aware of any studies that you could send us that have not been discredited?

Liz O'Neill: I assume that you are referring to Professor Séralini’s research.

Q47 Pamela Nash: I have lists—it’s not just that.

Liz O'Neill: It was extremely controversial, and I don’t think there is any benefit in discussing it. I can certainly send the research that we have available, that I am aware of, but I cannot recall stuff—it is not at my fingertips at the moment. Are you asking for the

independent research that we are aware of that raises concerns? I just want to make sure that I understand what you'd like.

Q48 Pamela Nash: Has GM Freeze shared its concerns about the quality of research that has caused controversy but has later been discredited? Are you aware of high-quality research that has not been discredited that shows risk from the consumption or usage of GM products?

Liz O'Neill: We are certainly aware of research that raises red flags, and I can provide that to the Committee.

Q49 Pamela Nash: Can I ask our other witnesses as well? It is not just on this; in other areas of research, a controversial study has been published and caused problems and fear among the public. The study has later been discredited, but the genie is already out of the bottle. Do you have any thoughts on how we could prevent this, and perhaps raise the threshold on what is published?

Professor Baulcombe: It happens in science all the time that things are published that later turn out to be incorrect. There is a process whereby they get corrected. This work is part of that whole process, and no different from anything else. As far as I am aware, there is no conspiracy among the scientific establishment. I am not sure if I am part of the scientific establishment, but if I am nobody has included me in any conspiracies to make sure that this work is discredited. It is part of the normal to and fro in the scientific process.

Professor Leyser: At the risk of sounding like a stuck record, even in Séralini, if you read the paper, nowhere does it say that the problems that they think they have detected are caused by GM. It does not say that; it says that they are caused by the herbicide or the biochemical activity of the herbicide-resistant gene in the plant. The way that this is subsequently sold as "GM is bad for you" is a real problem. That is something that we are in a better position to address than previously. We have the wonderful Science Media Centre, which helps us with communication between scientists and the media, hopefully to improve the position.

That is one thing. The other thing that we need to do, as I have also said previously, is to get over this obsession with GM, and start instead to talk about how people can provide their opinions, their input, on how the integrity of the food chain should be protected, what traits we want in agriculture, and how we would like our agricultural system to work. If we can stop spending all our time and effort arguing about this technology and instead start discussing the kinds of farming systems we want, hopefully people will feel more engaged and less frightened. It would be a better environment in general, and also the environment and the safety of the food chain will be genuinely protected rather than not, as is currently the case.

Q50 Stephen Metcalfe: I want to talk about the creation of food security, and perhaps alternatives to it. To gain food security, do you agree that we are going to have to intensify our farming methods to get higher yields?

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Professor Baulcombe: I chaired a working group for the Royal Society a few years ago, and our report was called “Reaping the benefits.” We referred in the title to sustainable intensification of global agriculture. In doing so, we were referring to the global situation. We were aware that we will need to produce more food in future—precisely how much we do not know, but probably a lot more than we produce at the moment.

We have no more land globally, in general terms, to produce this food than we have at present, so it stands to reason that what you have to do globally on that land is produce more food. There has to be global intensification. I suspect that the optimal strategy will vary from region to region. In some places there will be heavy intensification of agriculture, hopefully linked with land sparing in order to preserve biodiversity and ecosystem services. In other regions, it may be beneficial to have a mixture of intensive and extensive agriculture. It will vary from region to region, but the technology that we are talking about is compatible with both intensive and extensive agriculture.

Globally, yes, we have to intensify. Locally, it will be some intensification and some extensification, but what you want to do is make the best of whatever agriculture system you have.

Q51 Stephen Metcalfe: Is intensification possible without the use of the technology that we have been talking about this morning?

Professor Baulcombe: It will be greatly facilitated. Getting the most out of intensive agriculture, and making intensive agriculture more sustainable, will be easier if we have available to us the sort of technologies that we have been talking about.

Making your extensive agriculture more productive would similarly be better if it used this technology. I visited an organic farm over the summer, where the farmer was fretting over a virus disease in his courgette plants. That was immensely frustrating, because in my lab 25 years ago, we developed technology that would be risk free and that this organic farmer could have been using. It would be saving him the angst and the loss of livelihood that he was going to suffer as a result of the virus disease.

Professor Leyser: There is a lot of work now on the issue of food security and the options available. It is a complex problem that requires input at multiple levels along the food chain. David’s excellent report from a few years ago examines that—how you prepare your land in the first place, all the stuff that happens before you ever put any seed in the ground, all the stuff that happens afterwards, right through to what you throw away from your refrigerator. It is huge. The idea that any one thing is going to be some kind of silver bullet or panacea—again, we have to get rid of that.

I am disappointed by the way the debate often goes: “We need more food, therefore we need GM. If you’re against GM, you are a luddite.” That is not helpful. We do need more food. We need to produce it in a more environmentally sustainable way. There are many things that need to be done to achieve that. David is absolutely right; it is incredibly frustrating if you know that there is a tool available that could solve a specific problem in a specific context, and that for some reason is off limits, but we have to move the

discussion on food security away from GM or not GM into looking at how you actually solve the food security problem.

Under those circumstances, it would be much easier for people to accept the idea that we have looked at this problem, that in this particular situation we happen to have a solution that involves GM and it should be deployed in this way, and we can ensure that outputs are equitably distributed. All these are the kinds of issues that Doug was talking about earlier. We need that complexity in the argument, rather than the yes/no on GM.

Liz O'Neill: I agree with an awful lot of what has been said. There is a danger with focusing on GM that you are looking for single trait solutions to solve complex systemic problems. That clearly is not going to make sense. There is a huge opportunity cost in focusing on GM as a solution, and the silver-bullet mentality that has been part of the promotion of GM—if we just fix this one particular trait, everything will be okay and we will have the crops we need; but it is way more complicated than that. There are real Cinderella disciplines that are essential to the development of farms as ecosystems, such as soil science and agro-ecological approaches, but they are not getting anything like the support and funding that they need. That is certainly what people are telling us.

Professor Leyser: Again, it comes out of the idea that there is a thing called GM science that is being funded, and it is not. Plant science, soil science and all those things are being funded, and the data and results coming out of that are being keyed into all kinds of solutions. For example, soil science is currently undergoing a massive resurgence, based on the genomic revolution and the ability to identify the micro-organism communities living in soil, and to start to characterise the role they have in supporting agriculture. The same genetic technologies are being applied across the piece, and the outcomes can feed into solutions across the piece.

Liz O'Neill: GM Freeze does not object to genetic research. It is about the application of GM solutions in the field; that is where our concern comes in. There is a huge amount of discussion about the commercial focus, certainly, but we often seem to forget that a farm is an ecosystem and we have to consider that in the round. Focusing on single traits is a big distraction. When you look at the reality of farming in north and south America, it has worked against it. That is not because of the science of the process by which it was produced. It is because of the whole package—the patenting, the commercial involvement and the rest of it. In its current form, it is presented to us as a crop, and the current instances of GM are part of that problem.

Professor Leyser: May I ask a question? Why is it called GM Freeze rather than agricultural benefit or something? Why is that you are focusing on GM, when you say that there is too much focus on GM?

Liz O'Neill: There is too much promotion of GM as the silver bullet. GM Freeze is an organisation that was created in order to pool understanding, and for organisations and individuals concerned about GM to come together. It is a single-issue campaign. If you object to the very concept of single-issue campaigns existing, then you will object to our existence, but that is what we are. It does not mean that I and our individual members do

not have a broader view, but that is the individual job that we have come together to discuss, and that is what I have been asked to come here today to talk about.

Professor Baulcombe: The silver bullet idea you did not hear from me.

Liz O'Neill: No, absolutely not.

Professor Baulcombe: In fact, from a lot of scientists you will have heard the very opposite. That idea is completely dead now. It is not a valid objection to GM.

Liz O'Neill: It is not dead on the commercial level.

Professor Baulcombe: The other idea, that there is no appetite for funding alternative strategies for developing sustainable agriculture, is just not true. I speak as a member of the BBSRC, which would welcome science-based applications that were looking at various approaches to developing science-based agriculture. They have to be science-based applications, but the idea that there is not an appetite for funding these other methods is just not true.

Professor Leyser: I agree that companies are, of course, commercial. You are objecting to the idea that companies are overselling their products, but that is what companies do, from shampoo to whatever. Companies will tell you that their product is the best in the world. That does not mean that anyone is listening to them.

Q52 Stephen Metcalfe: I have a final question for Ms O'Neill, following Professor Baulcombe's point about welcoming applications to look at alternatives to genetic modification. What applications do you think should be going in that would negate the necessity for that?

Liz O'Neill: I can only speak in general terms, because I am not an expert in that field. Obviously it is essential that there are developments in soil science—soil is the most precious resource in farming—and agro-ecological approaches. Basically it is systems research—returning to a respect for the fact that the farmed environment is an ecosystem. That is something we can all agree on.

Q53 Chair: You believe, in a world with perhaps 2 billion more people, that that is the solution.

Liz O'Neill: The biggest issue in terms of everybody having enough to eat is the way that food is distributed. According to one report, we already produce more than 2,000 calories per head of the world population than is required. That is roughly double the amount of food that we need, but it is not distributed fairly. It is a much broader issue.

Q54 Chair: Let me rephrase the question. I am sure that you will accept as a reasonable proposition that everyone currently on the planet is entitled to have the diet that you and I enjoy. How can you achieve that with conventional methods of agriculture?

Liz O'Neill: It depends what you mean by conventional. Agro-ecological approaches are outperforming GM approaches in many fields, and there are huge successes, but they are small scale. They are hugely successful but they are small scale, because they do not seem to attract the same level of funding. Whether that is because of commercial interests or other issues I do not know, as I am not an expert in that particular area.

Q55 Mr Heath: This will be my last question. I am very interested in this area. Wouldn't it be true to say that you can achieve intensification without GM, but to get sustainability built into the intensification, GM could make a significant contribution? It is not the only answer, and I absolutely agree with what you say, but it could make a contribution to making sure that when we intensify we do so in a sustainable way, by reducing inputs.

Liz O'Neill: Theoretically, of course it could, if it met the conditions that GM Freeze and other organisations have put forward, such as if it is shared fairly, but there are so many issues tied up with the current incarnation of GM that there is a real danger that phrases like that are used out of context, and the broader picture is not seen.

There is a huge mixing of possibilities and realities. People do not differentiate them, and it is incredibly important that the actual incarnations that we are faced with here and now are considered on their own terms, and that potential for the future is considered on its own terms. Of course, there is potential for any technology to be used for good. It is just a question of taking care that it is—

Q56 Mr Heath: The technology is not Monsanto, and Monsanto is not the technology.

Liz O'Neill: I am not sure that I am qualified to comment on Monsanto's ability to do good or otherwise.

Mr Heath: I make no value judgments on Monsanto.

Chair: We shall draw a line at that point. I thank the witnesses, including Dr Parr, for their attendance this morning. There may well be some follow-up in writing on some of the questions. Thank you very much for your attendance.