

Experiments Without Borders: biology in the labs of life

Date: 15 June 2006
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Chair: Professor Nikolas Rose

Professor Rose

Well good evening, everyone and it is very nice to see you here. I have been informed by those sociologist colleagues of mine who do something called cultural studies that there is some major cultural event going on this evening and I very much regret that us non, uncultured or non cultured people, myself included, did not check out the World Cup schedule 9 months ago when we chose this date in consultation with our speaker Professor Jasanoff and fixed this event and the event will be just as significant to us with an intense and dedicated audience who you are.

So I am delighted to welcome you all to the annual lecture from the BIOS Centre for the Study of Bioscience, Biomedicine, Biotechnology and Society, wish I had never chosen that long list of words. My name is Nikolas Rose and I'm the Director of that Centre and I am absolutely delighted that for our annual lecture this year we have one of the people who can truly claim to be a founding "mother" if I can put it like that, a founder of the whole enterprise of research and investigation and theorisation that has come to be known as science and technology studies. Sheila Jasanoff is a Pforzheimer Professor of Science and Technology Studies at the John F Kennedy School of Government at Harvard University and also has an appointment at the Harvard School of Public Health and she is also affiliated with the Department of the History of Science and previously she worked for many years at Cornell University and she was the founding Chair of Cornell's Department of Science and Technology Studies.

What I didn't know before I started researching for my little introduction to this session was that Professor Jasanoff's first qualification was in maths from Harvard College, that she also holds a masters in linguistics from the University of Bonn, a doctorate in linguistics from Harvard, a JD from Harvard Law School and she was admitted to the Bar in Massachusetts in 1977 and actually worked from '76 to '78 with an environmental law firm in Boston. So she has a daunting span of disciplinary involvement and for those of us who like to think that we are inter-disciplinary we mostly don't span from maths to linguistics to the social studies of science and technology and to law. I am sure many of you will know that Sheila Jasanoff has had a very significant role within the development of sociology and social studies of science and technology in particular, served on many advisory panels in the United States, the US National Science Foundation, the National Academy of Sciences and the Institute of Medicine. She has also been engaged as policy consultant with many organisations including the OECD, the Office of Technology Assessment, the National Research Council, the National Science Foundation and many others and I think it's a real testament to the work that she's done that it doesn't just have such high value within the academic world but is also constantly sought after within the policy world.

As everyone here I think will know her long standing interest has been in the inter-relationships between law, science and politics especially in democratic societies and in particular on the role of law and in particular recently on questions of regulation, risk and risk management and indeed Sheila quite regularly comes here to the LSE where she is involved in the activities of the Centre for the Analysis of Risk and Regulation at the LSE. She is the

author of a daunting number of books and I did actually print out her CV but in deference to allowing her some time to give this talk I won't read it out but from *Controlling Chemicals: the politics of regulation* published some 20 years ago to the most recent book that many of us will have seen and been influenced by which is a book called *Designs on Nature: Science and Democracy in Europe and the United States* that was published by Princeton just this year I think or at the end of last year and I know that book and the argument within it has had very significant consequences not just in general but specifically for those who are working in our BIOS Centre.

So the title of Professor Jasanoff's lecture tonight is Experiments Without Borders: biology in the labs of life and I'm delighted to welcome her here to give the BIOS annual lecture.

[APPLAUSE]

Professor Jasanoff

Thank you very much, Nik for that wonderful welcome which leaves one more or less speechless. The obvious way to come out of that speechless condition on tonight of all nights would be to make the appropriate reference to that cultural event that you described outside. I really wish I had my daughter somehow tucked underneath the lectern, or our daughter I should say since my husband is in the audience, because she has been a football fan every 4 years ever since I started doing comparative research, and it was from her I learnt that it wasn't just 1-0 the other day but that the 1 was a particularly ignominious 1 for England because it was an "own goal" as she explained to me from the other side of the Atlantic. So I wish she had been able to deliver the appropriate opening joke instead of me. I will just have to continue as if we are here to celebrate BIOS, as we should be doing, and not whatever the England team is doing outside of our borders.

You detect in the title "Experiments Without Borders" an obvious reference to organisations like Doctors without Borders, and others that have formed themselves on that analogy. I think that we are living in a time when a foundational premise of the way in which one should be conducting biotechnological experiments has completely worn away. This is the premise of *containment*. If you think back about 30 years ago, the molecular biologists who were launching the era of biotechnology got worried about the potential consequences of their new science; and they got together at a conference centre called Asilomar, in California, and they came up with a set of guidelines for how to do biotechnology safely. The central conceptual move that they made at that meeting was to talk about containment. If experiments in biotechnology were done under principles of containment, the scientists concluded, then there was nothing to worry about at all. What I want to suggest today is that that idea of containment from Asilomar has, in the intervening years, been blown out of the water. There is no possibility of such a thing any more. More specifically, any imagined distinction between an ivory-tower science that can carry on under containment—whether it is physical containment, conceptual containment, political containment, or moral and ethical containment—and an applied technology that only selectively and manageably breaks loose from containment, simply doesn't hold any more. And yet many of our institutions for assessing the implications of biotechnology, and how we receive biotechnology into our lifeworlds, are still premised on a very old-fashioned confidence in the possibility of containment. That is the argument that I want to develop in greater detail for the rest of this evening.

Now, when you stand at a lectern like this one it is often useful to have a “text,” as we know from the dominant religion of this society—which (as it happens) also provided some of the background for my own early schooling. So, I would like to begin with a text, and in this case it is useful to begin with one put forward by none other than the Prince of Wales. Many of you are familiar with the fact that, at a controversial time in the development of crop biotechnology, or agricultural biotechnology, Prince Charles offered a set of 10 questions that were widely talked about. They represented, as I have argued elsewhere, a way that Everyman might be expected to challenge biotechnology. Only, it so happens that in this case the Everyman was the Prince of Wales. Much was made of his 10 questions, and the first three are especially relevant to the theses that I will be developing later.

So these were three of the Prince’s questions:

- Do we need GM food in this country?
- Is GM food safe for us to eat?
- Why are the rules for approving GM foods so much less stringent than those for new medicines produced using the same technology?

The third one is the one that provides the jumping-off point for what I want to say. “Why are the rules for approving GM foods so much less stringent than those for new medicines produced using the same technology?” Many people were reluctant to engage the Prince directly on this issue, but not so Professor Derek Burke, who has been an ardent advocate of biotechnology, agricultural biotechnology in particular, and has frequently spoken out on this topic, including at meetings where I have been with him in person. When I saw his answers, one in particular, namely, his answer to the Prince’s third question, leapt out at me:

- The answer is clear: the rules are not less stringent, they are different and the same as used elsewhere in the world. Drugs are tested on animals at hundreds of times their clinical doses; that is not possible with food, so different ways have been devised. *But if you really want to start trials in humans, 300 million Americans have been eating GM soya for several years now without any ill effects.*

As Professor Burke says, it is clear why we have different systems of assessment for medicines and food, and the point is that “the rules are not less stringent, they are different and the same as used elsewhere in the world.” There seems to be, in his view, universal harmonisation around the idea of safety. And then his last sentence is especially provocative: you know, it’s not the case that there has been no clinical trial of agricultural biotechnology, because after all “if you really want to start trials in humans, 300 million Americans have been eating GM soya for several years now without any effects.” Well, I think the 300 million number was perhaps a little exaggerated, since in the total American population, there must be some babies who don’t eat soya products yet, and so on. But even if you adjust Burke’s estimate, it’s obviously a fairly high number that remains. Some of you may be familiar with the American poll results that showed how only about 25 percent of those polled think they are eating any GM products at all. So, if Professor Burke is right, then three-quarters of the adult American population have no idea that they have been involved in a massive clinical trial for 30 years, so that British food can be regarded as safe.

This text made me begin to think, since I was one of the 3 million Americans in question: How did *I* feel about the fact that I had been unwittingly involved in a clinical trial so that Britain can now safely launch into the development of GM crops on the basis of our US

experience? Because, after all, that's what Burke is arguing about our role in the grand experiment of biotechnology. And if we are in the field of science and technology studies, of course we also think about the nature of modern science itself: for instance, how does science acquire its authority, through what kinds of procedures, and why do we place trust in scientific authority? The experiment, or the trial, is of course a centrepiece of doing science, but it turns out that not everybody shares Derek Burke's sanguine attitude toward the idea of being involved in an experiment—let alone unknowingly. This picture is just one example of a random, or perhaps not so random, poster created by the Pure Food Organisation, suggesting that food is an area in which we should be specially reluctant to engage in uninformed experimentation. Clearly, there is not a public consensus that this kind of population-wide clinical trial was an authorised activity, or even a good and desirable activity, for science or society.

Let's think a little more about experiments. What we all know about experiments, if only from having done baby science in school, is that experiments are at the heart of the scientific method. We can bring to bear on our understanding of this concept some of things that we have learned from the systematic social study of science and technology over many years. First of all, to borrow a little bit from Thomas Kuhn's idea of normal science, one can imagine that "normal experiments" are part of the wherewithal, the machinery of normal science. Just as normal science happens within a paradigm, so the experiments that are part of normal science also happen within those paradigms. Those paradigms act as conceptual structures, theoretical frameworks, that tell you how to do your science credibly and responsibly. They provide the questions: you know, how do you *know* what is an interesting study in a scientific field? They establish the methods by which you should carry out your activities. And, very importantly, paradigms also provide the rules by which you interpret the results of the experiments that you have carried out. One very early finding of the sociology of scientific knowledge was that, in the absence of paradigmatic agreement about how to interpret experimental results, you are liable to get an infinite deconstruction of the results. People will go back and back and question every piece of your experimental design, in a move that has been called "experimenter's regress." Without the paradigmatic envelope—the containment, if you will, around the experiment—that is the kind of relentless unpacking that you can expect to get in a controversial field.

Normal experiments in biotechnology are carried out under both physical and biological constraints. This is the idea of containment that I mentioned before. Both the lab and the field in which trials are conducted are areas of containment in that sense. And not least important is that normal experiments today get done under a variety of ethical constraints as well. For instance, if you are going to use animals in research you have to abide by many conditions relating to animal welfare; all the more so if you are going to use people in research. Informed consent has become the absolute *sine qua non* in human subjects research. If I have an undergraduate student who is going off to do a research project somewhere in the world—like, say, in Chile or in China—they first have to get permission from Harvard's human subjects committee before they can go and ask any systematic questions. They have to make up an approved questionnaire to set in front of the people they are going to interview in other countries. Even for undergraduate social science projects there is a limit to how intrusive or demanding the researcher can be, what questions she may ethically ask, how she may use the resulting information, and so forth.

Then, of course, there are also categories of banned experiments. We don't usually talk about them under that rubric, but for instance if you wanted to run an experiment to test for the

efficacy of a bio-terror agent, you would probably have considerable difficulty getting it past a university IRB (institutional review board), although you might be able to do such a study in a military lab. By contrast, the kinds of experiment that we find in biotechnology today, the ones I am calling “experiments without borders,” defy most of these constraints and conditions.

First of all, experimental designs are themselves unbounded. The experiments often don’t originate out of any simple conceptual structure or scientific theoretical paradigm. Physical containment is almost an impossibility. A very important point is that the effects of working with biological organisms can move through generations, so there is no temporal containment either. You don’t know instantly after you have done an experiment what the results are. It is not self-contained in the sense that it goes on working through time. Another respect in which biotechnological experiments are “without borders” is that the many of the things that we produce through manipulating genetic materials and other biological entities sit uneasily among the conceptual categories that we have for naming and regulating life. So, for instance, what is a “surrogate mother”? You may think there is a self-evident answer to that question, but why is the surrogate mother actually called a “mother” when she is, under most nations’ laws, denied the basic right to rear the child she has borne? What is the “human kind” that we have created here? What is a clone? What is a “designer baby” who is brought into being with certain preordained, useful characteristics (a means not an end), and what indeed are transgenic animals? When we name something a “geep,” what is that thing? It is a cross between a goat and a sheep, we know that, but such constructs can be quite troublesome when they cross the categories in which we have learned to organise the political world and the regulatory world. Not insignificantly, many products of biotechnology also cross over lines of political authority. So, when a partnership of American researchers and funding agencies produces an entity called “golden rice” that has been engineered so as to become a vehicle for Vitamin A production in the body, but it is being designed for potential eaters in Africa and Asia, that product is originating in one place, but its users and the consumers, the potential recipients, are somewhere else, living under other political and social circumstances. And, of course, you are all familiar with the fact that many medical experiments, or clinical trials, today are done across national boundaries. The drugs we use as “safe” may have been tested first on bodies for which we and our governments share no collective responsibility.

When I began my research career, more than 20 years ago as Nik reminded us, it was a truism in the American chemical regulatory community that clinical trials on people were more easily done in Europe, whereas animal testing could be done more easily in America. Multinational companies were actually shaping their testing strategies so as to take advantage of these differences in cultural norms. Well, the ethical problems of that sort of choice are now much more clearly on the table, with the kinds of uncharted experiments that I am talking about. The experiments lead into territories that are morally unmapped, whether through ethical guidelines or, at a still stronger level, through law and public policy.

I want to show you, first, a couple of images to remind ourselves that we are trying in various imprecise, non-formalised ways to deal with the border-lessness of the grand experiment of biological manipulation. This is a picture of Dolly, not at the moment of her birth, but at the moment of her public unveiling, which came 7 months later, in the leading scientific magazine *Nature*. This was the cover picture. It is interesting that although Dolly was a “first of kind”—an animal produced by cloning from the cell of an adult mammal, and not from embryonic materials—nevertheless nobody raised questions about the ontology of

Dolly. That is, no one asked, what kind of entity Dolly was. Now, my suspicion is that various kinds of insecurities bubbled away under the surface, and this is a picture that somehow illustrates that uneasiness, and how people felt it necessary to comfort their uneasiness. This is a picture from the *New York Times*, a couple of years after the first announcement of Dolly's birth, in April 1999. The caption says, "Dolly who made news in 1997 as the first clone of an adult animal reappeared last week with her new born lambs in Scotland. They were conceived the old-fashioned way from a ram named David." So we know that this alien being has now been normalised by being brought into ordinary reproductive cycles, "the old-fashioned way," as opposed to the new-fangled manner of her own creation. She is able to have children, which is one way of representing her normality. And that she achieved motherhood "with a ram named David" is a further sign of normality: the resort to naming here is a reassuring device. And so I think the picture tells us something about the anxieties that were not expressed overtly at the time of Dolly's creation. But of course the anxiety lasted throughout her life and into the period in which she died, because Dolly died too early as judged by the normal life-span of a sheep. And that premature death has contributed to people's uncertainties about whether cloning should be allowed, and if so to what ends, and for what organisms, and so on.

The next pair of images exemplify a case in which I think the insecurities and uncertainties have not been very well contained as yet. I am showing you here a picture, taken from the *New York Times* just last October, and in a way you can see it as a depiction of a very political scientific experiment. It is a political experiment in two senses: first, in that it responds very specifically to the politics of the present American administration, as spearheaded and articulated by George Bush; but second, in that it also tries to deal with the foundationally unsettled questions of American politics around abortion, and it tries to do this with science. George Bush, as many of you know, has said in supporting his administration's rather restrictive policy on stem cell research, that he will not promote science "which destroys life in order to save life." That's a trope he uses a lot of the time. It's very interesting that he, with that sentence, undercuts what the Supreme Court has said about life, because the Supreme Court has refused to agree as yet that life begins at the moment of conception. Instead, the Court has dealt with abortion as a matter of women's rights, which are guaranteed for some indefinite period following conception. So, when George Bush says that the life of the foetus and the life of person who is going to be saved through possible therapeutic cloning are equivalent, then he is in a way doing an end run around the Supreme Court's refusal to say—as a matter of law—that lives entitled to full constitutional protection begin at the moment of conception.

It is a very American solution to try to get around intransigent political predicaments by creating a technological fix. In this case, the technological fix that people have tried to create is a stem cell extraction procedure which will not, by any definition, "destroy life in order to create life." This diagram in the *New York Times* illustrates how one cell can be removed from the blastocyst without interfering with its capacity to develop further, so that the "life that begins at conception" people get their foetal development trajectory, and the pro-stem cell research people get their stem cells. By doing this sort of highly technical manipulation, contained within science, supervised by scientists, you've managed to take one of the most intransigent fights that Americans have had in politics over the last 30 years and corral, or contain, it within science. Or that is the hope.

Now, I don't think that this strategy is actually working. One way you see that the anxieties remain is that everywhere you turn you get images of people's uneasy responses to the idea

of cloning. Cloning has escaped from the lab, no matter what scientists do to try to contain it there. There is a sort of uncontrolled movement of this technology into domains that are not proving to be containable. I chose this picture of androgynous cloned babies to illustrate my point because it appears on the front cover of a paperback edition of Francis Fukuyama's book, *Our Posthuman Future*, in which he argues for the regulation of biotechnology. But I also found the image, just by chance, back in January of this year, in a French newspaper which was reporting on Dr Woo-Suk Hwang's ethical misdeeds in South Korea. This particular image, of course, itself has a history; it is distributed by Getty Images, which controls a great many popular images that influence the ways in which we think about a lot of things. In any case, the global transmission this image suggests that no matter what scientists and political authorities try to tell us about our ability to control the process of cloning, there is enormous popular mistrust and scepticism about our capacity to exercise that sort of control in reality.

I turn next to the fact that there are various mechanisms in public policy for trying to produce moral containment. I want to run quickly through some of these and then suggest that, as far as people, or publics, are concerned, the methods of official containment are inadequate for reasons that I'll suggest. The first mechanism that many people by now are familiar with is an attempt to set down ethical guidelines that will provide justification for the kinds of experiments we are allowed to conduct. But principled bioethics of this kind has proved to be problematic in a number of ways. It can be politicised, and the history of the American presidential bioethics commissions illustrates this in detail. But more to the point, from an academic angle, creating bioethics bodies pushes certain kind of questions under the carpet that ideally ought to be deliberated openly in a democratic society: one such question is what we mean by "ethical" in the first place. When you set up a national bioethics commission, you don't ask anybody, "Well what do you think *ethical* means?" And yet most countries whose bioethics systems I've looked at have very idiosyncratic rules for deciding who even sits on these commissions: what clusters of people does a nation choose to represent bioethics; are lay persons represented; the professions; or only trained moral philosophers? Do these bodies include representatives of industry? Do they represent major religious groups, and if so which ones? The answers to all of these questions vary dramatically even across western Europe and North America, so what is ethical about biotechnology is by no means an issue on which there is universal agreement. Bioethics is almost always the end product of a political and cultural process, rather than the starting point of public moral reasoning.

What issues will be considered as needing ethical analysis? In America there has been quite firm opposition to the idea that patenting, for instance, involves any ethical choice. People say that patenting is merely the technical application of certain well-ordered rules of allocation to a very technical area. There are no ethical issues involved here. European law feels differently about this, and global public opinion feels differently too. Who participates, who can engage in debates with bioethics bodies, and how, are completely unsettled at the global level. How bioethics bodies are related to policymaking institutions is also far from clear. Their role varies from having no influence to quite a lot of influence. In Britain, for example, when scientists and others said, we really ought to have a national bioethics body similar to the one that Mitterand created for France, the government's initial response was negative. Thatcher's decision was not to constitute an official bioethics body *within* the government. So, the Nuffield Bioethics Council was formed, but it was a self-consciously private body sitting outside of government. Obviously, the implications of having a privatised bioethics body are significant. To take one important point, citizens have no

automatic rights of access to a body that does not have public status, as does the HFEA (Human Fertilisation and Embryology Authority) for example.

Law is another means by which we try to put some limits around experiments without borders. But the law operates according to its own systemic concerns and considerations which are very selective about those things that it chooses to contain and those things that it regards as of no concern. I want to give you an example of a case that has been considered in both American and Canadian courts of law, to indicate how radically different the two settlements were, and what the differences imply about public morality and democratic governance. In 1980, the US Supreme Court issued what is surely one of the most important legal decisions of all time governing biotechnology. This was *Diamond v. Chakrabarty*, and the question it put before the court was: Is a life form patentable? The case involved a micro-organism, but the court decided the case using very broad language, saying in effect that patents can be granted for anything under the sun that is made by man. Well, “anything under the sun” is a very broad standard indeed, and it has been broadly interpreted. Seven years later, the US Patent Office granted a patent on an oyster and a year later still it issued a patent on a genetically engineered mouse. Since then, the Patent Office has issued patents on all kinds of mammals. Nobody in America asked, then or later, what “made by man” means. It was simply taken for granted that the criterion was satisfied so long as some human intervention was involved and the resulting thing did not pre-exist the human intervention. This is the common law’s classic “but for” test—the product would not exist but for the work of human hands. Thinking in this way, the Supreme Court and other courts in the country have held that, if you manipulate a single gene in a species of corn, what you get is “made by man”; similarly, when you manipulate a single gene in a mouse, what you get at the end of that process is something made by man. There’s no difference in hierarchy, as far as the Patent Office is concerned, between patenting a bacterium and patenting higher animals, including a mouse.

My own university provided the test case for the leap from micro-organism to mouse. Harvard gave birth, as it were, to the famous entity called the Harvard Mouse or the Harvard Oncomouse. It was a mouse manipulated to be specially susceptible to breast cancer, so that it could be used as a test species for various kinds of cancer therapies. The mouse itself was seen as nothing more than a container for the onogene, and because it was just the delivery vehicle for this oncogene, it could be patented. The fact that the mouse had any other traits or potential variability in relation to other mice, or any generational capabilities for traits other than cancer, all of this was unimportant from the standpoint of US patent law. Simply by inserting the oncogene throughout the body of the mouse, those who created the gene-altered mouse had taken something that was previously in nature and made it into something new in culture—and hence patentable as a human invention.

But 22 years later, the Canadian Supreme Court was asked to decide whether the Harvard Mouse was patentable or not. It had been patented, as I say, with no further discussion following the 1980 *Diamond v. Chakrabarty* decision in America, but the Canadian court reached the opposite decision. They said the mouse itself was not patentable. Of course, the process of gene insertion remains patentable in both countries. The dissenters in the Canadian case coined a lovely term—“murine metaphysics,” or the metaphysics of the mouse—and took their brethren to task for having engaged in such metaphysics. This was not the law’s business, they argued. But metaphysics was inescapable here, because in effect the question was how far experiments can go in altering our relations with nature, which necessarily required line-drawing between nature and invention. The majority of Canadian

Justices concluded that ownership rights in the mouse were inappropriate, because the same mouse would exist absent the injection of the oncogene into the fertilised egg. This was a radically different reading from that produced by the American judicial and patent systems.

For Americans analysts, the insertion of the gene made the animal a different thing, one that had never before existed in nature. For the Canadian court, the *same* mouse would have existed even in the absence of the oncogene; it simply would not have been predisposed to cancer. This little bit of comparative law suggests that ontological questions raised by biotechnology don't have unambiguous answers, even in a field like the law that is dedicated to deciding cases through the consistent application of principles. You really cannot predict which way legal judgments will come out, and what reasoning judges will consider appropriate, when such fundamental questions are at stake. From the standpoint of deliberative democracy, it is then rather disturbing to see the leading jurists of these two North American countries interpreting the same legal text to reach such different conclusions. The two courts interpreted the same English language and the same legal text, but their interpretations of the text in relation to the facts was entirely different. Since the judiciary, when all is said and done, is not accountable to politics, this kind of radical split on a deeply political question (how should we live with nature?) invites us to ponder how well deliberative democracy is functioning.

I have been talking about formal mechanisms of dissent and containment, but it is important to realise that, just as biotech experiments have crossed borders, left the lab, and escaped the field, as if they are modern genies, so dissent and public debate around biotech have also proved to be borderless, or trans-border, in various senses. I'll just very quickly run through a number of ways in which people outside the lab are providing critical commentaries on what is happening inside it. These are all informal modes of engagement and they have their pros and cons. We'll finish up by talking a little bit about those.

First of all, scientists remain each other's most powerful technical critics, and expert criticism can arise from domains that were not involved in the original experiment. In addition if people are experimenting with lifestyles, as for instance by altering the diet of 300 million Americans by feeding GM soya to them, then people can choose to adopt alternative lifestyles through which they, as it were, take themselves out of the experimental world. People can offer resistance (and I see back there Martin Bauer who has talked a lot about resistance to new technologies in his work here at the LSE, and George Gaskell as well, who has talked about localisation and public participation). People can mobilise, people can engage in symbolic politics, and people can leave the policy world completely and express their critique through other discursive avenues, such as art. I'll give an example or two of each of these critical moves.

In terms of expert criticism, one very powerful criticism levelled against agricultural biotechnology came from an experiment that was conducted at my previous university, Cornell. The study involved the Monarch butterfly, an iconic species, a sort of "charismatic mini-fauna," and it created a lot of excitement in America because people are very fond of this particular butterfly. The experiment questioned the limits of the original safety assessments that had been done on bio-engineered Bt-corn that had insecticide genes built in. In his study, the Cornell researcher John Losey fed the larvae of Monarch butterflies on their favourite crop, namely milkweed, which had been dusted with pollen from the genetically modified corn. Shockingly, about half the larvae died. This wasn't a weak signal; it was about as strong a signal as you could get that something was wrong. Monsanto, the

manufacturer of that corn, spent quite a number of years trying to explain why it was that Losey's experiment at Cornell was not a good counter to the company's argument that the genetically engineered product was safe. For our purposes, though, it is interesting that this debate only began after an independent researcher chose to undertake a counter-study in the first place. Interestingly, as well, Monsanto offered an argument suspiciously like Derek Burke's: we put all this Bt-corn out into the field, and there are all these Americans and all these Monarch butterflies, and they haven't died yet. But as in Burke's case it was a case of post hoc justification, on the basis of putative post-market studies that were never formally conducted.

In terms of alternative lifestyles, we can look at the ice cream company, Ben and Jerry's. It made the transition to this country a number of years ago. I still remember the naming campaign that resulted in their Cool Britannia formula. Ben and Jerry's had never before marketed an ice cream laced with strawberries and broken bits of shortbread. The appeal was to British tastes. But of course in America the company was long known as a politically and socially conscious company that was, for example, donating a percentage of its earnings to peace-related causes from very early on. They were at one time a small company based in Vermont, and they didn't want to use milk from cows treated with genetically modified bovine growth hormone. But when they wanted to advertise on their products that they didn't contain rBGH, as it was called, the US Food and Drug Administration (FDA) came down hard on them and said, "We (FDA) have found no difference between natural bovine growth hormone and the genetically engineered variant. If you put a label on your ice creams saying 'our products contain no rBGH' then, in effect, you are scaring the public by making an artificial distinction through your advertising, though we recognize none on scientific grounds. You may not do this, or we will take you to court under a false advertising charge." So Ben and Jerry's instead produced a more overtly political statement for marketing their product. After considerable legal wrangling with the FDA they came up with a label that satisfied the agency. The label says *not* that the product contains no rBGH, but that the milk is sourced from farmers who pledge not to treat their cows with rBGH. Of course, as a cautionary note the label also has to add that the FDA has said no significant difference has been shown between natural and GM rBGH, and no tests can distinguish between milk containing these two kinds of products, and not all the suppliers of their other ingredients can promise not to have rBGH in *their* products, etc. etc. Ben and Jerry's label, then, is a product of American legal ingenuity, but it also shows that it is difficult to carve out an alternate lifestyle once a technology becomes embedded and ingrained, and diffused through society, as agricultural biotechnology has become.

I have absolutely no basis for making the next comment I am going to make, but I think that British politics of science and technology produces more dramatic pictures than America's, and more of British politics happens, as a result, in the visual domain. Maybe it's the nation's commitment to theatrical performance, and the impact of the monarchy, maybe it's the absence of as many formal procedures as we have in the US, so that people need to resort to theatre to prove a point. I do know that over many years of comparative political study on science and technology I have discovered that some of the best pictures that show what's going on in the public domain are produced here. This was the case in a Greenpeace-inspired destruction of a research site. This is resistance at its most basic, the destruction of a research plot planted with genetically modified crops. When I talked to the people who were organising these campaigns they said it's incredibly effective to have a bobby in the background. So, this was a carefully staged piece of theatre, a rhetoric of resistance, that substituted for public reasoning.

A somewhat different sort of resistance which actually worked very well happened around the “terminator gene,” which was the popular name given to a Monsanto project. In this case, the company had not yet even embarked on a full-blown research and development strategy that was going to insert a gene into various grains that would shut down fertility in the next generation. This technology would prevent farmers from hoarding or saving their seed from one year to the next. The unveiling of this project produced a really serious public outcry. In effect, you can look at the case as a case of global popular technology assessment. People said, “Sorry, we just don’t want this technology,” And indigenous groups and Third World farmers were able to form a coalition with powerful actors such as the Rockefeller Foundation. Ultimately it was that coalition that brought pressure to bear on Monsanto, and the company retreated, at least for a time, away from that particular technological trajectory.

Let us move to symbolic politics. You see here the transparent Norman Foster dome of the Reichstag in Berlin. Starting with the WTO protests in Seattle, there have been lots and lots of street protests in which people have used symbols to build up a kind of public movement, a non-verbal discourse of opposition against globalisation and biotechnology. Then, here is another case which I think is worth stopping and thinking about. It involves the work of Chicago based American artist Eduardo Kac, who in 2000 participated in creating (or said he had) Alba, the world’s first “green fluorescent protein (GFP) bunny.” This rabbit was genetically modified with jellyfish genes so that it glows when you expose it to ultraviolet light. I still remember that when the news of Alba’s birth, unlike the news of Dolly’s, was first announced, scientist colleagues of mine said that this was an absolute ethical disaster. People shouldn’t be doing this sort of thing; it was an irresponsible, an unethical experiment. One of my colleagues, then a leader of the Science, Technology, and Public Policy Program at the Kennedy School, said this new animal had absolutely no utility for people and hence should not have been made. But since that time, in the context of my current thoughts about experimentation, deliberation, and the right to speak about innovation, I have been reconsidering whether we might not read this artistic experiment in somewhat different ways. Alba, after all, accomplished a certain number of things that Dolly did not. I think that for those of us who like the comparative method, it’s worth putting Alba, the glowing bunny, next to Dolly, the cloned sheep, and ask what Alba performed that Dolly did not.

First, there is the issue of visibility and invisibility. Dolly looked the same as any other sheep, whereas Alba, at least when put under the right kind of light, revealed herself as a new kind of thing. Her images call attention to ontological overflowing: the fact that biotech is constantly producing for us new kinds of things, kinds that we haven’t dealt with before. Because Alba is a plaything, created as an obvious fetish (the creator wanted to bring the animal into his house as a pet, but supposedly he had to do the research in France for ethical reasons, and the American import authorities, the border authorities, wouldn’t allow him to bring the animal back to Chicago) she makes visible the constructedness of the ethical judgments that we make with biotechnology. Her creation places on the table a set of questions about the purposes of genetic manipulation, why we’re doing it, and to what ends. This is a question that people in BIOS, and people in Demos who are also present in this audience, have been asking a lot in connection with novel technologies. Important to me, too, the “GFP bunny” puts on the table the question of the meaning of new technologies for us, and says that anybody can speak about that meaning. When you move a technology out of science and into art you suddenly allow a lot more talk about what is going on when we intervene in nature, and that is no bad thing.

But are all these informal mechanisms adequate for the kind of intense global deliberation that I think should accompany a revolutionary suite of technologies, based on path-breaking scientific discoveries, in the contemporary life sciences? I think the answer is clearly no. Very simply, all of these responses, strategies, reactions that I have talked about are constrained by the following factors. First of all, they are reactive, that is, they happen after somebody has already done something novel in science or technology. Very often, the nature of the debate is constrained by how the initial experiment was framed, so when people plant their symbols in front of the Reichstag, they are in the form of corn cobs because corn cobs are the thing that got manipulated. In that sense even when people are engaging in symbolic politics, they have to be speaking back to something that has already happened—been framed in a particular way. I couldn't think of a good phrase to describe this phenomenon. I call it "ontological enclosure." What I mean is that people are not very often given a chance to debate seriously the kinds of things that are being brought into existence. Bt-corn has been accepted as something that we *ought* to have in the world, but of course even the juxtaposition of reactions in the United States and Mexico suggests that Mexicans are less tolerant of the idea of Bt-corn than are people in the United States—or at least growers in the United States. Yet once the reality of Bt-corn is out there in the fields, out of its experimental borders, once it has become something that 300 million Americans are already eating, then everyone else in the world is already sort of closed in by the ontological settlements that have been made elsewhere, and that they had no part in crafting.

Hand in hand with all of this goes the fact that even if protest is successful it usually results in a rejection of the disputed technology. The terminator case is interesting from that point of view. Monsanto was forced to abandon, not redesign, it. Maybe this was the ethically appropriate outcome in this case. If, however, we believe that some biotechnologies *are* important, that human creativity ought to probe into the unknown, as the US Supreme Court suggested in *Diamond v. Chakrabarty*, then we should concern ourselves with deliberative procedures that allow for redesign, not just rejection. "Just say no" may be a good slogan for teenagers tempted by drugs, but it's not a good slogan for biotechnology as a whole. But to secure a better global politics of biotechnology, we need appropriate forums for deliberation. Today, the audiences reached by all the informal modes of debate and deliberation that I outlined are highly selective and partial. After all, who is actually going to pass by the Reichstag on a given day and see that field of sad-looking corn cobs? And how will they convey their feelings and reactions to policymakers in government and industry? The ties of symbolic and informal politics to power and policy are even weaker than is the case for the bioethics commissions that I have already described. Managing biotechnology on global scales will require, it seems, a reinvention of democracy.

So where do we go from here? As usual it's easier to look at what is, and say something halfway sensible about what is working and what is not working. It's much harder to talk about how to redesign institutions that have been carefully developed over many years, many centuries even, to preclude just the kinds of deliberation that I'm talking about. Yet it will be essential to bring society back into these debates, I'd argue, because experiments without borders are already occurring, and are implicating society from the very beginning.

Some of you may know of an extraordinarily influential book by the political scientist Benedict Anderson in which he represented nations as *imagined communities*, communities that imagine themselves as hanging together—sometimes for no better reason than that they all hang out the flag of St George from their windows for the same couple of weeks in the same every-4th-year World Cup ritual. Anderson saw print technologies as almost coercing

nationhood, forcing citizens to think of themselves as part of the same imagined community. With regard to governing biotechnology, though, I think we almost have to turn around that notion of the imagined community. That is, I think we have to consider technologies as systems or spaces of potentiality in which imagined futures can get crafted, as projections of nationhood or of other cultural collectivities. National or cultural communities can constitute, and even reconstitute, themselves in part by collectively constructing their technological imaginaries, and by injecting into them distinctive ways of managing the future. The question for democracy is who gets to participate, and to what extent, in those acts of imagining.

A term that has gained enormous popularity on this side of the Atlantic in this context is “upstreaming”—specifically, upstreaming public engagement in technological innovation. We are not really using that concept in America, but we too are talking about procedures like “real time technology assessment,” which incorporate some of those same objectives. What these terms imply is that post hoc reactions to technology via the marketplace no longer seem quite good enough from the standpoint of democratic participation. Instead, we are beginning to think how to inject serious public critique and opinion much earlier in the process of design. I’m arguing further that this has to be done not just so that people can express their values, like for instance the so-called “yuk reaction” against reproductive cloning. Expressing visceral reactions is not the point of public engagement. I’m suggesting instead that novel technologies should engage us in a continuous process of experimentation. If this is the objective, then the design of all those experiments without borders—the underlying theories, conceptual structures, premises, hypotheses, outcomes, how we evaluate them, and how we serve the demands of ethics—all of that has to be on the line for democratic questioning. Mine is very much a plea for rational debate about our technological imaginaries, for more explicit and effective forms of public reasoning, not an argument about letting people express some deeply held values, so they can go home happy that they were heard, but without real opportunities to change anything.

Most experiments with public engagement that have been done to date have been extremely ad hoc, often conceived as a silver bullet for an already intransigent problem: a citizen jury, a referendum, a consensus conference, a public inquiry. But if experimentation itself is an ongoing process as I believe, whenever new technologies go out into the world, then public engagement has to be much more continuously conceived as well. Most of the forums we have in which such debating occurs—think of *GM Nation?* in this country, for example—take place in national forums, organised, constituted, and procedurally devised in accordance with the rules of particular nation states. We have to think harder about how to design *forums without borders* in which to deliberate more fruitfully about *experiments without borders*. The debates are happening at the present time in an extremely patchy and inadequate way.

Lastly, I want to leave with a question. Many of the examples that I’ve talked about—examples of resistance and examples of reimagining—come from agricultural biotechnology, that is, from green rather than red biotechnology. And yet, when all is said and done, most of us probably care more about how current biological experiments will affect human nature 50 years from now or 100 years from now. In our societies, you see very minor perturbations around all of those issues, as when people talk about genetic testing of foetuses or about how sex selection based on those tests may be skewing male-female ratios in some parts of the world. But these are examples of people getting worried about a very small subset of what may amount to a wholesale reimagining of human nature now in progress. To me, it is an

interesting question why it is around green biotechnology that there has been so much more creative mobilisation, and so many more attempts by publics to insert themselves into the imaginaries produced by science and industry. Why has there been in some ways a less developed political discourse around experimentation with human nature? Could it be that formal ethical discourse has been too quick and too successful in colonising the kind of deliberation that I would hope to see around these biotechnological experiments? If so, I think we very much need to open up the whole notion of bioethics to permit a more inclusive, and in some ways more contentious, debate than we've promoted on many of these issues thus far. So let me stop with that, and invite your reactions.

[APPLAUSE]

Professor Rose

I would like to thank Sheila very much for a very wide ranging and incisive account of the problems that we face and some provocative solutions. I also share the view that much of the debate around these things has become rather defensive and the possibilities of reimagining in a positive way of what human nature might be are often constrained. We have about 20 minutes for questions. I was going to begin with the observation that some on this side of the pond might wonder a little bit about the interpretation of the results of that experiment on 300 million Americans and just question whether or not there had been any adverse effects on the American population as a result of them eating GM food but that would be a cheap remark! So I'll hand over to you for questions.

Question 1

Before the discussion opens in view of the great depth of your presentation and the absence of an audience appropriate to hear it may I ask when there is any intention to publish this lecture on the LSE website?

Professor Rose

We would seek permission for that. I very much hope we'll be able to or find somewhere at least of making it available to a wider audience.

Question 2

Would the speaker believe that experimentation with mitochondria might lengthen life and have any comments on the ethical repercussions of lengthened life?

Professor Jasanoff

Well, lengthened life by itself is not considered a good by many people. Many of us increasingly are seeing greatly lengthened life on the part of our parents and grandparents, and thus far many of the other attributes that one would want along with long life, like long health and long mobility and so on, are not coming into being. I'm not sure of the spirit in which you ask the question. I remember that about 30 years ago Robert Sinsheimer, a very famous American biologist, created a huge stir in the biological community by saying that he thought that there ought to be some experiments, certain lines of research actually, that shouldn't be conducted. One of them, he said, was ageing and of course this was before the formation of the political groups around ageing, like the Grey panthers, that coalesced later on in America. But it's clear that the example you are raising is exactly the sort of thing that I'm talking about. Prolongation of life in sheer biological terms, the number of years you are adding to a person's life, happens inside a very complex social context. It's happening while many other changes are affecting the family, and many other changes are affecting people's

ability to work. So for instance in America we don't have a retirement age. In most of Europe you do have a retirement age, so that prolonging life might mean that people that are routinely living to 120 and yet the retirement age is at 65. What are the implications of this for all kinds of things including Treasury, not least of all? To imagine that one could simply do research on ageing or prolonging life without taking any of these other concerns on board, and without finding out what people want, would be a mistake. I mean, supposing people think that amount of research money ought to be expended instead on other things such as maybe malaria or maybe arthritis. I don't know. We don't tend to have those discussions about relative priorities in research policy, nor do we have a forum for them. Our peer review mechanisms around grant getting and grant awarding don't line up different research trajectories side by side and say do this, don't do that.

Professor Rose

I believe life expectancy of a woman born in North America, white woman born in North America is probably about 85 at birth but I believe that life expectancy in Malawi is 39.

Question 3

I would be very interested to hear your view on where exactly the boundaries should be set between what the public should know and what should be held away from the public. Of course it would be very democratic and very well for most of the information to be open to everybody but on the other side if we open everything that scientists do in research or trying to find out of course there will be more competition in the field even more. Of course something's that really probably shouldn't be opened to everybody will emerge and probably science will go a lot further than we might want it to. So where really should be this boundary?

Professor Jasanoff

Well I think it maybe useful to begin by observing that these kinds of questions never have either/or sorts of answers, but if we look at any system of open information what you find is that there are competing rules that are in place. So, for instance, universities are among the most open societies that we know. We all believe that knowledge should be transparent and totally available and so on and so forth. But when a decision is being made to give somebody a permanent post, what we call tenure decisions in America, the letters written for or against the candidate may be held in the strictest confidence for a variety of reasons and are not made public. So I think that if you look into any models of open information systems you will find that it's never a blanket transparency. There are always tacit rules or sometimes explicit rules for what things will be made available and what not. My view is two-fold: first, there should be open debate on what these rules are, so that people are actually aware where the lines are being drawn between openness and not; and, second, to recognize that in some areas the lines are clearly being drawn too much on the side of secrecy. So for instance genuine upstreaming on technological design choices today can't happen because of confidentiality claims by industry, and those confidentiality claims are even permeating universities through privately funded research. That's an area where I think the rules and presumptions badly need to be revisited and possibly revised.

Question 4

You mentioned a number of the constraints of sort of normal experiments but don't appear to be constraining contemporary biotech concepts, geography, ontology politics and so on. One form of constraint you didn't mention was economics and I was wondering if you had any thoughts on whether market constraints, if those sorts of constraints on science have remained

constant or whether economic boundaries have also dissipated or perhaps markets might be playing a more important role in determining what sort of issues are examined by biotech?

Professor Jasanoff

Well yes, I should remember that it's the London School of Economics and Political Science, not Political Science and Economics, and that's a very important point you raise. I think that the economic constraints of course have changed. In most advanced industrial countries the relative funding of science by government as opposed to the private sector is a constantly changing ratio, and in the States in particular private money has been flowing into biotechnology for quite a long time, and that share is increasing as well. What all of that implies is that whether the borders are disappearing or not is highly contingent on where you sit. It's not at all unheard of for a firm, a multinational company in an industrial country, to be able to do its research wherever it pleases, to round up raw materials, including people for clinical trials, and so forth. The reverse is not possible for a poorer nation. So if you even take a semi-industrialised country like India, it is much more likely that Indians will be serving as clinical trial subjects than as the people running clinical trials in America. I have never heard of that reverse case being true, and those kinds of disparities are consequences of economic constraints operating very differently in different geographical regions of the world.

Question 5

My question actually picks up on what was said in the last question but I really liked your point about the way the debates around the biosciences have been in a sense corralled by ethics and this constraint notion of what ethics is but I do wonder whether the talk of upstreaming, talk of deliberation, talk of democratisation, actually corral's the issues again in terms of politics and a particular conception of politics which is in a sense the traditional bourgeois parliamentary conception of politics as external to economics because in a sense when you think about what these technologies are they are means of production and the earlier gentleman mentioned the market but that's not the only way in which these things are economic. They are also economic in the sense of the relations within the productive process, the labour process, the mode of production, and of course those aspects of production have never been democratic in our society. Democracy sort of, in some ways, ends at the point of production and managerial authority takes over so in that sense I would argue that really democratising these issues about technology and the way we go about producing new life forms, producing new agricultural technologies, that poses a radical challenge to how we conceptualise the limits of democracy itself. So I just wondered what you would say to that?

Professor Jasanoff

You have produced an extremely eloquent argument for continuing to think of democracy as an essentially contested concept, with a meaning that we have to keep asking about all the time. Democratisation can't mean simply creating a bunch of procedures and assume that anyone can walk in off the street and make meaningful comments on the plans we are making and so forth. It turns out that even voting has become a rather bourgeois preoccupation at least in the United States, that voter apathy is growing and growing, and the classes who vote are the ruling classes, the people with the highest income levels, the people with the highest educational levels, and women more than men. The standard instruments of democracy are not performing particularly well at present, and exactly what we mean by democracy isn't... I mean it has become attenuated. A lot of people talk about the hollowing out of democracy in our time, a lot of people talk about a democratic deficit—those critics I think are right, and

that's why I have spent a lot of time talking about extra-formal ways of going about getting public engagement.

I personally think that we need to think much more about the scale at which these debates happen, so about localism in relation to globalism. I think we need to rethink the ways in which global institutions produce rather obvious barriers to democratisation, like the World Trade Organisation. What I feel about this in part is, let's not let the perfect be the enemy of the good. I mean we are never going to get perfect democratisation, however we define it. But there are lots and lots of situations where even the most minimal preconditions that we might all agree on are not being met. So even a highly selective analysis of very powerful institutions, asking very plain-Jane questions about who really gets to see what, would help. How closely held are decisions? How can we encourage debates between partners who aren't usually sitting at the same tables? There are not many forums in American politics where a developing country person can speak directly to a member of the Bush administration and raise questions about means of production. Nor indeed about discrepant ethical standards, discrepant property rights systems, and so on and so forth. So we can think a lot more deeply about institutional reforms that would get us to points that are much better than those we have now; and there would be quite a lot of agreement that what we're trying to achieve is better than what we have now.

Question 6

That was a great lecture, I really appreciated that and I could make the question very short if I just said Tesco but the longer version would be is there a more everyday kind of resistance to the over industrialisation of the food chain and all of its link defects from global warming to child health that does offer a model of a kind of communal reimagining or are you a bit pessimistic about that and I wondered if you could just say a little bit about how that quite widespread movement to express views although everything from agricultural biology to child health has come to be an ordinary part of going to the supermarket.

Professor Jasanoff

Now I would class that as an optimistic observation! I am not sure that I see it as an across the board happening. I mean, I do think that communal reimaginings are happening in selective ways around particular sorts of things, and to some extent it is most alive where new communities are forming around those imaginings. So for instance indigenous people around property rights in genetic products. I mean indigenous people's groups didn't even exist as groups until they felt the threat of their property rights being infringed upon, and now you are seeing a sort of emergence of these groups and a set of quite everyday critical discourses about how Anglo-Saxon conceptions of property rights are not adequate to safeguard what these people would want. Or around climate change, the emergence of something like the small island nations as a political force, which in no other way could they possibly have been unless they had been able to find within the phenomenon of climate change itself the resources to imagine themselves as a community that didn't exist before. So I think this is the kind of thing that Paul Rabinow talks about under the heading of biosociality, that the emergence of new genetic traits has allowed people to imagine themselves as part of new social groupings, with the ability to set agendas and push policy forward in certain directions.

I guess I am worried about the adequacy of such developments, especially in the light of the previous question. That is, if it is the case that communal reimaginings are happening where communities already have sufficient resources to respond to perceived or actual threats, and form themselves into these kinds of coalitions, what about all those other cases of people who

lack those resources, yet where they are definitely implicated, and *could* think of themselves in communal terms, but various opportunities are missing so that they don't. I think that as, I don't know, counter-examples one could think of rhetorics like environmental justice that have broken through those sorts of barriers of economic and class position to some extent, and the extension of ideas of environmental justice now to domains that are just not environmental. So one could come up with some of those examples, but I don't see as yet how, without a push from law and public policy opportunities, people who are not already well endowed with the capacity to regroup themselves will get into these debates and be able to engage in the imaginings.

Question 7

I was just wondering why you constrained your comments to biotechnology? It seems to me everything you say applies to technology more broadly. So the experiments without borders that you're describing, that applies to every technology that's been introduced, all the major technologies that have been introduced, over the last 100 or 220 years. I mean none of us had any say about whether television would invade our lives. Over the last 30 years we have had no say about whether computers would invade our lives and the parameters that you are concerned about are much more influenced by conventional technology than biotechnology. So for example the gentleman earlier who asked about mitochondrial, the act of mitochondrial technology on life span, the biggest impact on lifespan of the last 100 years has been in hygiene and plumbing. Would you apply such restrictions to those because of the impact they were going to have on us? So I am slightly concerned of how you are going to implement the kind of distinctions that you're drawing in a way that will be meaningful and not actually have an overly great impact on life sciences. You could make a very strong case I think for saying that biotechnology, life sciences generally, are the most regulated aspect of technology already and that actually within the relatively minor impact that they are having they are over regulated and that it's the other technologies that impact on us much more directly and much more quickly I would say that you should be turning your attentions to.

Professor Jasanoff

Those are far too important questions to be dealt with in a short answer but I think first of all you're right, that the argument is not only about the life sciences, although launching a BIOS annual lecture series, one does want to focus in on the particular examples to do with the life sciences. I do think there are some special things to note about the life sciences. On a theoretical level I think that all kinds of technological developments can be thought of in ontology-changing terms, but the concern is more far-fetched for some than in the context especially of human biology, but also agricultural biology. And I think that the reflexive properties of the life sciences, their ability to bear back on ways in which we think about ourselves as a human species, well television doesn't do that with quite the same urgency. Of course, it does to some extent. I mean, if you think of the television as people in science and technology studies do, as almost like a human actor in a network of human relationships, it does of course bring human beings who would not be in your living room into your living room in all kinds of ways. Yes, you could think about it in that way, but this it's a fact about all sameness-difference arguments that we could do the same with different technologies until we are blue in the face. But a more important thing is to realise that some differences may matter more than others. Like if you get two historians together they will always say, oh this is new, oh are you sure that's new, and that other phenomenon is not really new. And yet, over the sweep of history, things do change. So I think there is that kind of possible debate about the particularity of the life sciences.

On the regulation point I want to make clear that I'm not saying there should be more regulation. I'm saying that we have here a profoundly important technology which affects our ability to imagine or reimagine all kinds of aspects of our lives, as societies living together, and I think that the capacity to imagine is too closely held at the moment, with possible risks to humanity. I'm not so much worried about risks in the physical or environmental sense, even though I do think those concerns were under-considered at the time that America released vast quantities of genetically modified crops into the biological environment. But I think the question of technological societies and how they interact with their productions is what's important. I mean, in part, the sponsors of this meeting come from the sociology department, and it has been recognised now for a while that a sociology that doesn't think about technology as being part of society is an impoverished sociology. So how do we rethink society in the light of how we innovate? It doesn't mean necessarily a call for more regulation. I mean, regulation may be far too narrow a response to the wider question of how we repoliticise, rephilosophise, the territory of living with our own technologies.

Question 8

Thank you for a brilliant lecture. You opened with a reference to Asilomar and I just wondered if you had any reflections to offer on the attempt last month to recreate an Asilomar moment when this group of synthetic biologists met in Californian and tried to come up with this framework for self regulation in synthetic biology and I just wondered whether you felt depressed that elements within the scientific community still felt that such gestures of containment, of self regulation, were possible or whether you felt heartened that they were at least trying and I ask the question in a week where this stuff has been in quite high profile here in the UK. We had the *Guardian* newspaper obtaining these different segments of DNA that could be combined into a potentially lethal virus so this stuff is sort of bubbling up. I was just interested whether you felt that the synthetic biology debate was a particularly interesting emerging case study?

Professor Rose

Let's take the two of them and then you can use that for your closing remarks.

Question 9

It is going to be tricky to combine synthetic biology with my question. Sheila, you talked about various informal mechanisms of resistance and you asked the question are these sufficient and your answer was no and I just wondered whether it's a kind of glass half full or half empty because if we think back at least to Europe, in 1998 the moratorium was introduced on GM crops, it stays in existence until 2003/2004 and it's only lifted because the World Trade Organisation rules against Europe. Another consequence of those informal methods of resistance was the introduction of labelling which was rejected by all the industry and most government and regulators as quite unnecessary etc. etc. So I would think, I am not arguing against you on other mechanisms but I think that one should recognise the power of civil society in the public domain to have quite an impact on the course of development, the trajectory of the technology.

Professor Jasanoff

Well just quick comments on those. James, I haven't actually been following the synthetic biology thing. I mean, I have known at the side of my radar screen that it's happening, so I am not yet depressed but on science and self-regulation, I have no problems with any professional or technical group attempting to devise its own ideas of responsibility, but they

should operate with a more reflective sense of what it is they can assume. So what depresses me about Asilomar moments is the continuing mythology that this was the most successful attempt at self-regulation, which of course does not take into account that the moment also successfully framed, especially in the US context, biotechnology as being a very precise molecular biology driven enterprise that had very little to do with society, certainly not much to do with the environment, and also as a technology of precision and knowability. Those were the themes that gained prominence at that time. So my question in looking at synthetic biology would be to ask: did they have a different, external set of participants and critics? I think they didn't very much or certainly not people who recognise these moments as being important framing moments and can therefore bring that sort of critique to bear. And if not, then how can one enlarge that discussion because it surely will need to be enlarged and perhaps reframed as well.

George, on your point, which is also a sort of optimism-pessimism point, half full or half empty—I wouldn't have bothered running through all those informal mechanisms if I didn't think they were important. They obviously *are* important, but maybe here a little bit my bias as a lawyer is also showing through. I mean, I think it's fine to have informal mechanisms in a bubbling-up phase but that eventually you do need some kinds of more formal structures to make the sorts of places at the table that people are asking for, or specific moments of intervention, specific rights even in some cases, to actualise them. It isn't everybody who can participate in those sorts of things. It takes resources and sometimes formal systems are able to decrease or lower the barriers for people have the least amount of resources. So it's not...I mean it's an ongoing sort of evolution. I do think that popular responses by their nature end up being reactive because there has got to be something you actually see that's happening first. The terminator case was maybe one of the best examples of a case where popular resistance got going at the very idea of something that was not already fully in the works, and that's why I ask whether that model is too contingent to be generalised. But we should reflect on those things and think about... You know, supposing it hadn't been Gordon Conway at the head of the Rockefeller Foundation at that moment but somebody more intransigent, suppose it hadn't been Robert Shapiro, at the head of Monsanto, you don't want these sorts of outcomes to depend on individual people who maybe see better or have more sympathy. I mean, that's where law and policy need to come into play. But you know maybe we are having a cultural discussion between me, the American formalist, and you the British scholar who prefers a culture of muddling through!

Professor Rose

Well that's a very appropriate moment to end. Just before asking you to thank Sheila I know there are some people who wanted to ask questions, I apologise for not giving you that opportunity but there is a reception in the senior common room on the 5th floor if you would like to join us for a more informal chat and I would like to also say that we'll do our best to make this lecture available to as wide a possible audience and I will talk with Sheila about that afterwards and just in conclusion, I'll say one thing, among the many things that I forgot to say about Sheila was of course she has trained a whole generation of graduate students whose work is now having a very, very significant affect in addition to her own work across this whole field that we have been discussing and I think tonight we have seen some of the reasons why they are doing such terrific work in their mentor. So thank you so much for a terrific lecture, Sheila.

[APPLAUSE]