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Moving forwards or in circles? Science communication and scientific governance in an age of innovation

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Just how complicated can science communication be? Surely all it requires is that we choose the relevant facts, select the right audience (sometimes eager, sometimes more difficult to entice) and put the information across as persuasively as possible? And we hardly need to justify science communication in a world where technical change is taking place all around us. As the Royal Society (the UK's elite scientific organization) expressed it back in 1985:

> . . . better public understanding of science can be a major element in promoting national prosperity, in raising the quality of public and private decision-making and in enriching the life of the individual. . . . Improving the public understanding of science is an investment in the future, not a luxury to be indulged in if and when resources allow.
>
> Royal Society (1985, p. 9)

Partly inspired by the Royal Society report (but drawing also on deeper roots), many practical initiatives, academic courses and conferences have taken place promoting what in the late 1980s and 1990s became known as the 'public understanding of science'. Writing at a time when nanotechnology, stem cell research and energy policy are all matters of political as well as scientific concern, it is hard to resist the blunt argument that the more science communication takes place the better. As J. B. S. Haldane, one of the great science communicators of the 1930s and 1940s, put it:

> I am convinced that it is the duty of those scientists who have a gift for writing to make their subject intelligible to the ordinary man and woman. Without a much broader knowledge of science, democracy cannot be effective in an age when science affects all our lives continually.
>
> Haldane (1939, p. 8)

Of course, science communication now extends beyond Haldane's imaginative newspaper articles on such topics as 'Why bananas have no pips' and into any number of televisual, multimedia and information and communication technology (ICT)-connected conduits. However, the basic argument remains the same. Science is central to the modern world. Public knowledge of science is a democratic, personal and cultural asset. Enhanced science communication is therefore vital. Occasional controversies over nanotechnology, nuclear power and genetic research only increase the importance of science communication. What more is there to say?

This chapter is written in the belief that actually there is an awful lot more to be said about the theory and practice of science communication. In part, this reflects the substantial experience in science communication that has built up since the 1980s—and especially the experience of trying to 'engage' with the wider publics about science-related issues. Whether this experience suggests that science communication has moved forward or in circles is a question we will consider later. Certainly, a frustration has developed—especially among policy-makers and practitioners—that one-way communication may not be enough but that two-way communication is much more challenging than it might at first appear. It should also be stressed from the start that the point of considering science communication more deeply is not simply to make life complicated—or turn a lively endeavour into a dusty academic exercise—but rather to understand how scientific and social communications can be *improved*. As I hope to suggest, the intellectual and practical challenges of communicating science are profoundly interlinked.

Mad cows and cognitive deficits (and zombies too)

Perhaps the best way of opening up these issues is through a quick journey back in time—a journey which will take special account of British experience but without forgetting that these are international issues and concerns. We can start with one of the most-discussed episodes in UK science–public relations: the case of BSE (bovine spongiform encephalopathy—or 'mad cow disease' as it was generally known).

At the beginning of the 1990s, BSE was seen as an animal problem with an uncertain connection to human health and illness (Irwin 1995). No specific infectious agent had then been identified (talk of prions was to come later), but equally the existence of such a mechanism could not be ruled out. However, and as should have been clear at the time, 'absence of evidence' and 'evidence of absence' are certainly not synonymous. In demonstration of that point, by the end of the 1990s, a growing number of human deaths—in the specific form of new variant Creutzfeldt–Jakob disease (nvCJD)—were being linked to BSE. Over 4 million cattle were slaughtered as a precaution. Sales of British beef plummeted both nationally and internationally. The government department responsible found itself under great public and political pressure with many arguing that the dual roles of industry promoter and risk regulator were fundamentally incompatible. This pressure eventually led to the department being split apart. Reflecting widespread criticism of the government's handling of the whole episode, an influential report was later to declare: 'Confidence in government pronouncements about risk was a further casualty of BSE' (Lord Phillips *et al.* 2000, Vol. 1, Section 1)

As can already be gathered, communicating science in such a situation presents considerable challenges. What form should 'the science' to be communicated take when 'the facts' do not simply speak for themselves? When there are many different, albeit overlapping, publics (consumers, activists, farming communities, elected representatives, households, audiences at home and abroad), which are the publics with whom one should be communicating and in what way? One question would prove especially important within this case: *what assumptions about uncertainty should be built into public communications*? Is it better to acknowledge doubt (and risk appearing ignorant and out of control) or to attempt reassurance (and risk appearing at best complacent and at worst deceitful)? On that basis, the handling of the BSE crisis in the UK is generally viewed as a classic example of how science communication (and science governance) can go badly wrong.

There are many possible ways of telling the story of BSE. It could be recounted as a sombre tale of experts failing to identify (or at least to identify with sufficient alacrity) a causal link between an animal health problem and human morbidity/mortality. Equally, it could be told as a heroic account of a small group of scientists fighting to convince sceptical civil servants and politicians about the underlying threat. The story could also be presented as a manifestation of the commercial pressures which often surround (and indeed permeate) apparently 'technical' issues. Certainly, the British beef industry was very concerned in the early 1990s about the impact on sales of yet another food and health scare (for this was not the first). International politics also entered the picture, as British officials attempted to prevent their European counterparts from imposing a ban on beef exports (with much muttering in the British corridors of power about the Continental cousins imposing unfair barriers to trade).

All of these versions of the 'mad cow' crisis could be offered. However, two very significant quotations, separated by 10 years of bitter experience with BSE, suggest the most common lesson to be drawn from this case:

> As the Chief Medical Officer has confirmed, British beef can continue to be eaten safely by everyone, adults and children.
>
> John Gummer, Minister of Agriculture, Fisheries and Food, May 1990

> The Government did not lie to the public about BSE. It believed that the risks posed by BSE to humans were remote. The Government was preoccupied with preventing an alarmist overreaction to BSE because it believed that the risk was remote. It is now clear that this campaign of reassurance was a mistake. When on 20 March 1996 the Government announced that BSE had probably been transmitted to humans, the public felt that they had been betrayed.
>
> Lord Phillips *et al.* (2000, Vol. 1, Section 1)

The story that emerges here is of a closed group of civil servants and advisors convincing one another that the risks were low and, having done that, embarking on a campaign of public reassurance which played down any element of doubt. In these circumstances, spokespeople tended to dismiss other, more critical, viewpoints as uninformed and irrational. As my own experience at the time suggested, attempts to engage the Ministry in dialogue about issues of risk and public communication were met with a defensiveness which often employed science as a rhetorical weapon aimed at closing down discussion (Did I have better expertise in the subject than the government's scientists? Was I aware of specific empirical evidence that had not been located by the Ministry?). Of course, this

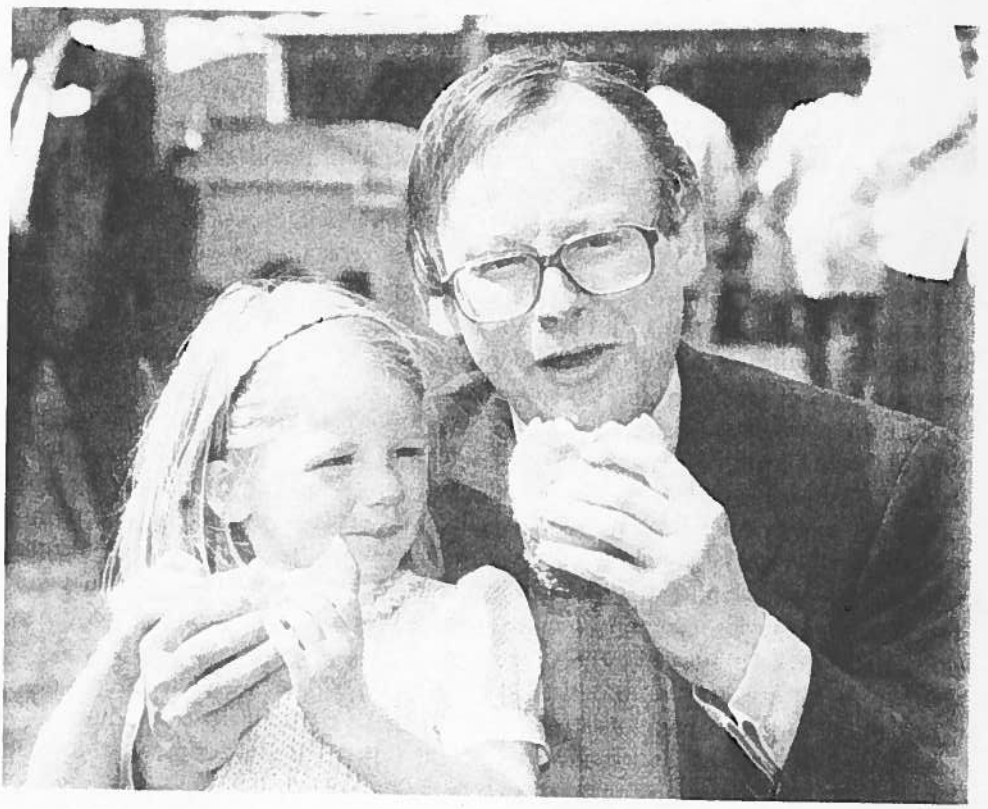

Figure 1 The then Secretary of State for Agriculture, Fisheries and Food, John Selwyn Gummer, and his daughter, Cordelia, eating beefburgers. (First broadcast on BBC2, *Newsnight*, 16 May 1990. Picture from Empics.com.)

in itself represents a form of science communication—although hardly what the Royal Society (1985) and Haldane (1939) had in mind.

In this climate, even the most gentle of inquiries was robustly dismissed as mischievous and politically motivated. Meanwhile, government statements on BSE risk adopted a categorical and confident tone which jarred badly with the scientific uncertainties. This was typified (and captured for all time) by the Minister's feeding of a beefburger to his young daughter before a cluster of eager photographers (Figure 1). As the minister in question subsequently explained it, this was intended as a sincere demonstration of confidence in the safety of British beef. Subsequent commentators have tended to be less generous of what they saw as an attempted exploitation of both the media and (even worse) the minister's own offspring.

It is unsurprising in these circumstances that the official report on the government's handling of BSE was so deeply critical. Terms such as 'unwarranted reassurance' (Lord Phillips *et al.* 2000, paragraph 1150) and 'culture of secrecy' (ibid., paragraph 1258) recur throughout the Phillips report. Indeed, this goes so far as to suggest that the main object

of MAFF's communication strategy was 'sedation' of the public (ibid., paragraph 1179). The report focuses especially on the perceived need by civil servants and others to counteract what they saw as potentially alarmist public and media reactions to the existence of risk: 'the approach to communication of risk was shaped by a consuming fear of provoking an irrational public scare' (ibid., paragraph 1294). More broadly, the official report stressed several points that, in the wake of BSE, have become central to science communication and scientific governance more generally:

- Trust can only be generated by openness.
- Openness requires recognition of uncertainty, where it exists.
- The public should be trusted to respond rationally to openness.
- Scientific investigation of risk should be open and transparent.
- The advice and reasoning of advisory committees should be made public.

Before we go on to discuss this new mantra of openness, transparency, trust and dialogue (and, especially, what it means for science communication), it is worth pausing to consider some of the wider lessons from the BSE case. The governmental handling of the issue can certainly be presented as a textbook example of what has become known as the 'deficit' approach to science communication. This is usually defined as the assumption on the part of institutions and their science communicators that the public is ignorant about science—but that it (for this is a singular presentation of 'the public') would accept science readily if it only knew more (with 'science' similarly being singular rather than plural or heterogeneous). The deficit perspective suggests one-way communication with a passive audience soaking up 'the facts'. It also suggests that one approved model of 'science' should be central to the communication rather than (in this case) information about why usually herbivorous animals were being fed on meat and bone meal, what farmers and abattoir workers had to say about the attempted controls or else what minority views existed within the scientific community.

This model of the public as operating within a cognitive deficit is usually contrasted with the approach offered by the Phillips report which emphasizes a more open and two-way relationship between what we can term (rather awkwardly) 'the sciences' and 'the publics'. Going further, the alternative 'contextual' model of science communication emphasizes that lay people can also be informed and knowledgeable within the conditions of everyday life and, indeed, that science might have as much to learn as to communicate when it comes to understanding the social realities of farming, abattoir operation and feeding a family (Irwin and Wynne 1996).

This is not to say that a farmer's understanding of structural biology is likely to be as good as a qualified scientist's. But it is to suggest that scientists (and scientific communicators) must, on the one hand, be careful about generalizing outside the closed conditions of the laboratory and, on the other, appreciate that issues such as BSE are not solely scientific in character but incorporate wider questions of government competence and credibility, economic and political priorities, ethical concerns and understandings built on direct experience (including that of farmers and those responsible for domestic food preparation). Once we move away from a crude deficit model, science communication becomes rather more complicated—and certainly it involves listening as well as speaking. It also becomes

more interesting as we start to consider the role of science within particular social contexts —and also the limits as well as the strengths of scientific analysis.

Now despite all of the post-BSE talk about the 'death of the deficit model', it has to be said that 'deficit talk' still possesses a zombie-like longevity, refusing to lie down in its grave but instead lurking within many attempts at science communication. Just when we all agree that the model of science communication employed in the early 1990s during the BSE crisis has no place in modern science communication, then it can again be spotted within the statements of government and other organizations (including environmental and campaigning groups). Science communication often takes the form of imploring (or shaming) us to be more rational about 'the facts', explaining to us what we evidently have not understood (or else why would we disagree with the communicator?), and persuading us that science and technology have the answers to our (usually unformulated and unasked) questions. On such occasions, we can feel that—far from making progress in science communication—we are actually just circling the same old issues of how to overcome what is presented as societal resistance to technical change.

Partly this is a structural and institutional problem: it can be hard for 'scientific' organizations to be 'two-way and contextual' in areas which they see as firmly within their professional competence. Partly also, it reflects the widespread emphasis within modern societies on science as *the* form of knowledge and understanding. However, the point must also be acknowledged that 'deficits' are inevitably and unavoidably embedded in our attempts at communication (Why else write this chapter? Why else read it?) and are not always to be avoided. In that spirit, I am willing to declare my cognitive deficit concerning large areas of mathematics, many world languages, the operation of numerous forms of domestic technology and (especially) the music of Barbra Streisand. 'Deficits' are not necessarily a bad thing—and are not necessarily to be avoided or denied. Taking that point further, it appears an inevitable characteristic of everyday life that we make choices (not always explicitly) about the kinds of knowledge and information we wish to acquire. Equally, and as those working with medical patients are often aware, so-called 'ignorance' of a topic may not simply represent the absence of information but a deliberate decision not to engage ('I don't know, and I don't want to know'). As one resident living close to a hazardous industrial installation put it to me: 'I could have a PhD in chemistry, but I'd still be living here'.

In challenging the 'deficit' approach to science communication, the point is not to deny the existence of knowledge deficits, but instead to be sensitive to underlying assumptions about science–public relations (especially what is being communicated and to whom), to consider alternative forms of knowledge and understanding and to take full account of the communication setting. It is not deficits themselves that are the problem but rather how we construct, respond to and make sense of these within specific contexts. One crucial element within this will be how we communicate scientific and social uncertainty in situations where there may be many understandings in operation. Very importantly also, the case of BSE suggests the dangers of using deficit talk as a means of avoiding institutional self-analysis and the active pursuit of alternative understandings and perspectives. Viewing 'the public' as the problem—and better communication as the answer—can be very comforting for an organization under scrutiny (at least in the short term). It can also mean that the all-important 'what if we are wrong?' question never gets asked.

Trust as the new deficit?

So what then of the new approach to openness and trust-building signalled by the UK Phillips report? Certainly, Phillips has not been alone in advocating a fresh perspective on science–public relations. Thus, 2000 saw publication not only of the Phillips inquiry's findings on BSE but also of an influential report from the House of Lords Select Committee on Science and Technology. *Science and Society* identified a 'crisis of trust' and argued boldly for a much greater degree of public engagement and dialogue around science. As the Lords report began:

> Society's relationship with science is in a critical phase. . . . On the one hand, there has never been a time when the issues involving science were more exciting, the public more interested, or the opportunities more apparent. On the other hand, public confidence in scientific advice to Government has been rocked by a series of events, culminating in the BSE fiasco . . . public unease, mistrust and occasional outright hostility are breeding a climate of deep anxiety among scientists themselves.
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> House of Lords (2000, p. 11)

At the core of the Lords' report was the question of how to improve public confidence in science and technology. For the Select Committee, this issue is central to any future strategy for science and innovation; how can the UK (or any other nation) be successful in science and technology unless the wider publics are broadly supportive? In particular, the governmental agenda of innovation, economic competitiveness and strategic investment has the potential to be in conflict with citizen assessments of science, technology and the direction of change. As the then UK Prime Minister Tony Blair put the same point (in decidedly loaded terms):

> I want Britain and Europe to be at the forefront of scientific advance. But its [*sic*] no exaggeration to say that in some areas we're at a crossroads. We could choose a path of timidity in the face of the unknown.
>
> Or we could choose to be a nation at ease with radical knowledge, not fearful of the future, a culture that values a pragmatic, evidence-based approach to new opportunities. The choice is clear. We should make it confidently.
>
> Blair (2002)

For the Lords Committee, the means of putting the nation 'at ease with radical knowledge' was enhanced *dialogue* around science and technology. This 'direct dialogue' should not simply be an 'optional add-on' to science-based policy-making and to the activities of research organizations but should instead be a 'normal and integral part of the process.' (House of Lords 2000, paragraph 5.48) Similar talk can be heard at the European level. Thus, the European Commissioner for Research called in the EC's Action Plan for Science and Society for a pooling of 'efforts at European level to develop stronger and more harmonious relations between science and society' (Busquin 2002, p. 3). As the EC Action Plan puts this:

> The relationship between science, technology and innovation, on the one hand, and society, on the other, must be reconsidered. Science activities need to centre around the needs and aspirations of Europe's citizens to a greater degree than at present . . . A true dialogue must therefore be instituted between science and society.
>
> CEC (2002, pp. 7, 14)

Here we have an approach to the theory and practice of science communication which explicitly attempts to learn lessons from BSE and other such cases. Whereas the 'old' perspective on science communication presented knowledge and information as the barriers to public acceptance of science, the 'newer' approach (bearing in mind that such 'old/new' formulations are always open to challenge) puts trust at the core of science–public interactions and presents openness, dialogue and mutual engagement as the means of (re)building this. The treatment of socio-technical uncertainty looms large within this change of perspective. Uncertainties should be acknowledged not denied. Rather than being feared by experts and civil servants (as seemed apparent during the BSE crisis), the publics should be trusted to deal with uncertainties in an appropriate fashion. Characteristically, also, the 'new' perspective on science communication involves an acknowledgement that matters of scientific and technological change are not about science and technology alone but involve social, political and (especially) ethical questions which must be opened up to public scrutiny and debate. Rather than treating the publics as wallowing in a miasma of misunderstanding, the challenge instead is to engage and consult over matters of scientific and societal concern.

There are a number of possible responses to this new emphasis within the language of science communication and science governance. One commonly held position is to view all this as merely lip service—a rhetorical move to silence critics without actually changing very much. Is 'dialogue' around controversial topics such as nuclear power, genetically modified food and nanotechnology to be taken seriously when so many economic and commercial forces are so firmly in their favour? Is 'engagement' at all compatible with the demands of international competitiveness, substantial levels of corporate investment (accompanied by the need for an economic return), commercial secrecy and intellectual property protection?

A more pragmatic form of this criticism would question the practicality of dialogue as a 'normal and integral part of the process' when it comes to the many decisions (large and small) which need to be made about science-based policy (from standard-setting in consumer products to the allocation of research council funds). However, if engagement is not to be 'normal and integral' then who should decide (and how) about which issues to open up to discussion and review? While exhortations about dialogue, openness and transparency seem worthy in themselves, there are many questions to be asked about putting these into practice within administrative systems designed according to very different principles. Of course, these questions only become more challenging when we consider the operation of dialogue at a level beyond the nation-state (would a 'European' citizen dialogue over stem cell research or animal experimentation have any real meaning?).

As we will see, these practical challenges inevitably take us into broader questions about the relationship between science communication and the *direction and governance of science and technology* (and of scientific and technological *institutions*). Once again, we find that—although science communication can appear to be a benignly simple process of 'getting the message' across—it is unavoidably implicated in wider issues of the relationship between science and society. Turning this statement around, we also begin to see that 'communicating science' lies at the core of science–society interactions.

If we start with matters of *practice*, then a number of questions emerge about how the broad rhetoric about dialogue and engagement can translate (and has been translated)

into specific initiatives. This will inevitably involve some discussion concerning the form and timing of dialogue exercises. Is it better to engage 'upstream' (i.e. early in the innovation process) when the socio-technical options are still open or to wait 'downstream' until the options are clear? In what (and whose) terms should dialogue be framed? Particular criticism has surrounded 'toothless' exercises where public views do not seem to have 'made a difference' in terms of practical outcomes. It has often been claimed that dialogue can help create social consensus and agreement—the apparent assumption being that 'consensus' is both possible and desirable (a notion that appears profoundly open to challenge in this area). Practical experience meanwhile suggests that dialogue has often led to calls for more dialogue—and that 'democratic' initiatives in consultation have generated angry charges that the activity was insufficiently democratic.

Engaging with GM—and anticipating nanotechnology

One important example of 'putting dialogue into practice' concerns the British *GM Nation?* debate over the commercialization of genetically modified (GM) crops (for a comparison with the equivalent Dutch debate see Hagendijk and Irwin 2006). Taking place in the summer of 2003, the debate was designed to be 'innovative, effective and deliberative' but also 'framed by the public'. Reflecting a generally cautious response, the final report on the debate characterized public opinion over the growth of GM crops in Britain as 'not yet—if ever' (*GM Nation?* 2003).

Here then we have what was, in terms of UK practice, a very well-developed exercise in 'public dialogue' around science and technology (Irwin 2006a). The steering group conducting the exercise received some 37,000 feedback forms from members of the public. There were 2.9 million hits on the debate's website, and over 600 local, regional and 'top tier' (i.e. centrally organized) meetings. Despite this, the exercise was roundly criticized for its limitations. Discussion after the event suggested both that the exercise had been 'hijacked' by activist groups and that it was far too restricted in participation, depth and coverage (House of Commons, Environment, Food, and Rural Affairs Committee, 2003). What we can especially identify in this case is a tendency for 'public communication and dialogue' to be seen as a discrete phase within the policy process: an activity to be fed into decision-making at the appropriate time, alongside other forms of evidence, before business as usual can return. Such an approach imposes fundamental constraints on public dialogue with science. To offer three examples of these constraints:

1. The 'public' strand of the debate ran in parallel with a separate review of the available science and an economic assessment of the costs and benefits of GM crops. It would appear that the construction of public debate, economic and scientific reviews as three separate strands inhibited the possibility of transparent public engagement in 'technical' analysis or of public discussion openly reflecting upon the issues raised by the other streams (Irwin 2006b).

2. The UK government's eventual decision to proceed with GM technology on an 'individual case by case basis' fitted more easily with the economics and science strands

than it did with the public debate. Whilst the economics and science strands appeared to feed directly into the government's decision, the 'public' strand was presented as a viewpoint for government to bear in mind rather than a body of evidence and opinion on which it must act.

3. It was also very apparent in the debate that members of the public typically 'framed' the underlying issues much more broadly than governmental and industrial officials. Whilst for the concerned civil servants this was a matter of deciding about a particular technical and administrative issue, for many members of the public the debate was connected to a much larger set of questions about the power of transnational companies, globalization, the future of UK agriculture and the benefits of current GM technologies to British consumers. Whilst policy-makers tended to frame the issue as a matter of 'risk' (to humans and the environment) this by no means captured the full spectrum of public assessments (a point made more generally by Wynne 2002).

None of the above represents a fundamental critique of the *GM Nation?* exercise. However, it does draw attention to the practical challenges involved in achieving 'dialogue' around science and technology. Openness, transparency and engagement are beguiling concepts but they also provoke (or rather *should* provoke) profound questions about their meaning, formulation and practice (especially when applied to specific contexts and situations). The point should also be made that this particular form of dialogue represents a very 'top down' (i.e. government-led) approach to what is often seen as the 'bottom up' expression of citizen views and concerns. This also makes us aware that dialogue initiatives often draw on consultation methods (citizen juries, people's panels, consensus conferences) which are still relatively unfamiliar and need to be 'learnt' (reminding us too that all such methods represent a specific 'framing' of the scientific citizen; Irwin 2001).

One particular criticism of the 2003 GM debate was that it came too late in the development process—when technologies were already close to market and international economic pressures high. Might these issues of dialogue and communication become easier if they were tackled earlier? In 2004, two of the UK's leading scientific organizations—the Royal Society (RS) and the Royal Academy of Engineering (RAE)—produced a report on the nanosciences and nanotechnologies which considered this very point.

On the one hand, the 2004 report was certainly in sympathy with 'the new mood for dialogue' (as the 2000 Lords report put it)—recommending in particular that:

> . . . the government communicate with, and involve as far as possible, the public in the decision-making process in the area of nanotechnologies.
>
> RS/RAE (2004, p. 62)

On the other, the report's authors found themselves confronted with a difficult set of issues. How to establish dialogue when less than a third of the population even recognized the term 'nanotechnology'? How to decide who might be involved in any dialogue over these issues? How to specify the precise form of dialogue when the objectives and terms of discussion are likely to evolve as the issues themselves evolve?

The RS/RAE report presents the nanotechnologies as an 'upstream' issue in terms of the development decisions yet to be made, the social and ethical impacts yet to be envisioned, and the public acceptance (or otherwise) yet to be formulated. Noting that the precise

form of dialogue will be 'no simple matter' (RS/RAE, p. 64), the report advocated early dialogue and communication:

> The upstream nature of most nanotechnologies means that there is an opportunity to generate a constructive and proactive debate about the future of the technology now, before deeply entrenched or polarised positions appear.
>
> RS/RAE (2004, p. 67)

Although there is much sense in this proposal, 'upstream' dialogue should not be seen as a solution in itself but rather as one element in a continuing process of engagement and communication. It is also the case that engaging earlier does not automatically ensure that engagement will be better—instead all the questions about the form and content of communication presented here still apply. Equally, upstream engagement should not be considered primarily as a means of predicting (and subsequently managing) public responses (Wynne 2006). Instead, the potential for early engagement is precisely that it can shape patterns of technological development in a fashion which takes account of public concerns, aspirations and preferences—and can put the assumptions of the developers of technology into dialogue with those of the wider publics (Wynne 2006).

Far from making science communication an easier task, upstream dialogue needs to consider that even the definition of the 'nanosciences and nanotechnologies' is as yet unstable and unfixed, that expectations of science and technology cannot be separated from social and personal expectations of the future, and that societal responses are likely to be negative as well as positive. Certainly, 'dialogue' undertaken with the aim of 'winning over' the publics to the technological and economic potential of the nanotechnologies is not dialogue at all but simply a more sophisticated form of the old (and zombie-like) deficit model.

Inventing the futures

Our discussion seems to have taken us a long way from the 1985 Royal Society report with which we began. Since that time, there have been many practical initiatives in science communication and many analyses of the relationship between 'the sciences' and 'the publics'. Of course, this flurry of activity partly reflects the inherent fascination and challenge of communicating science and technology in an age where the issues appear so pressing and so many channels are now open and available (in the case of the GM debate, from 'village hall' discussions to on-line consultation, but the possibilities are clearly much greater). It is also not hard to identify beneath all of the positive talk about dialogue and open communication an institutional anxiety that public scepticism about science and technology might lead to societal resistance and lost possibilities for innovation.

Tellingly, the 'crossroads' speech by Tony Blair (2002) quoted above was prompted by the former PM's experience not in London or Brussels but Bangalore. As Blair told the story, he was challenged there by a group of academics (who, significantly, were also 'in business') telling him that 'Europe has gone soft on science, we are going to leapfrog you and you will miss out'. This group professed itself to be astonished by the European

debate over GM and saw emotion driving out reason in such discussions. Blair's expressed fear was that the Indian business-academics might be proved right 'if we don't get a better understanding of science and its role' (ibid.). It is hard not to see the hand of the zombie behind such words, reminding us that—despite all the claimed progress in science communication—we may not (or at least not consistently) have moved so far forwards.

Similar statements abound as dialogue and communication are put firmly into the context of the need for successful innovation. As the Independent Expert Group on Research and Development (R&D) and Innovation expressed it in a 2006 European Commission report:

> Europe and its citizens should realise that their way of life is under threat but also that the path to prosperity through research and innovation is open if large scale action is taken now by their leaders *before it is too late*.
>
> CEC (2006, p. vii, emphasis in original)

Meanwhile, official statements about the European Research Area make reference to effective sharing of knowledge between 'public research and industry, as well as with the public at large' but do so firmly in the service of developing European economic competitiveness and especially a leading edge in knowledge and innovation (CEC 2007). The Commission might use the strapline of 'inventing our future together' but institutional expectations of that future are already firmly in place and the scope for expressing other inventions (and other futures) appears limited.

At this point it is very clear that the governance of science (including its direction, sponsorship and control) and the communication of science are not separate activities but instead tightly bound up with one another. Discussion of scientific communication cannot therefore stand apart from discussion of research investment, economic development and the agenda for scientific and industrial change. The challenge for science communication now is whether it should simply serve to (to put it crudely) soften up public opinion in the face of pending innovation or else provoke richer and more meaningful discussions over the alternative futures for science, innovation and society. Put differently, should science communication continue to circle the notion that the wider publics are a problem for change—or should it instead view public expressions, cultural understandings and expectations of the future as a valuable resource (see also Stilgoe *et al.* 2006)?

We can conclude this discussion of deficits and dialogues, and moving forwards and in circles (not to mention the occasional zombie), with a final look at the nanosciences and nanotechnologies. Certainly, communication in this area can easily trade in the language of public ignorance and emotion, of potential resistance and fear of the unknown. The alternative approach of dialogue and engagement offers no easy route and raises as many questions as answers. Equally, science communication cannot assume that knowledge and information are readily detachable from the institutions that provide such evidence—which must themselves be open to external scrutiny. The challenges of science communication around the nanosciences are considerable. Science communication alone may not have all the answers to the questions being raised. But without the practice of vigorous, critical, imaginative, multi-level and provocative science communication, our socio-technical futures will be severely constrained.

REFERENCES

Blair, T. (10 April 2002). *Science Matters*. Available at **http://www.number-10.gov.uk/output/Page1715.asp**.

Busquin, P. (2002). Foreword. In: Commission of the European Communities (CEC) *Science and Society: Action Plan*. European Communities, Luxembourg, p. 3.

CEC (Commission of the European Communities) (2002). *Science and Society: Action Plan*. European Communities, Luxembourg.

CEC (Commission of the European Communities) (2006). *Creating an Innovative Europe: Report of the Independent Expert Group on R&D and Innovation appointed following the Hampton Court Summit and chaired by Mr. Esko Aho*, EUR 22005. European Communities, Luxembourg.

CEC (Commission of the European Communities)/Directorate-General for Research (April 2007). *The European Research Area: New Perspectives*, EUR 22840 EN. European Communities, Luxembourg.

GM Nation? (24 September 2003). *The Findings of the Public Debate*. Previously available online at: **http://www.gmpublicdebate.org.uk/ut_09_9_6.htm#summary**.

Hagendijk, R. and Irwin, A. (2006). Public deliberation and governance: engaging with science and technology in contemporary Europe. *Minerva*, **44**(2), 167–84.

Haldane, J.B.S. (1939, reprinted 1943). *Science and Everyday Life*. Pelican, Harmondsworth.

House of Commons, Environment, Food and Rural Affairs Committee (2003). *Conduct of the GM Public Debate*, Eighteenth Report of Session 2002–2003. HMSO, London.

House of Lords, Select Committee on Science and Technology (2000). *Science and Society*, Third Report. HMSO, London.

Irwin, A. (1995). *Citizen Science*. Routledge, London.

Irwin, A. (2001). Constructing the scientific citizen: science and democracy in the biosciences. *Public Understanding of Science*, **10**(1), 1–18.

Irwin, A. (2006a). The politics of talk: coming to terms with the 'new' scientific governance. *Social Studies of Science*, **36**(2), 299–320.

Irwin, A. (2006b). The global context for risk governance: national regulatory policy in an international framework. In: *Globalization and Health: Challenges for Health Law and Bioethics* (ed. B. Bennett and G. Tomossy), pp. 71–85. Springer, Amsterdam.

Irwin, A. and Wynne, B. (eds) (1996). *Misunderstanding Science?* Cambridge University Press, Cambridge.

Phillips, Lord, Bridgeman, J. and Ferguson-Smith, M. (2000). *The BSE Inquiry: the Report*. HMSO, London.

Royal Society (1985). *The Public Understanding of Science*. Royal Society, London.

RS/RAE (Royal Society/Royal Academy of Engineering) (July 2004). *Nanoscience and Nanotechnologies: Opportunities and Uncertainties*, Royal Society Policy Document 19/04. Royal Society, London.

Stilgoe, J., Irwin, A. and Jones, K. (2006). *The Received Wisdom: Opening up Expert Advice*. Demos, London. Available online at: **http://www.demos.co.uk/publications/receivedwisdom**.

Wynne, B. (2002). Risk and environment as legitimatory discourses of technology: reflexivity inside out? *Current Sociology*, **50**(3), 459–77.

Wynne, B. (2006). Afterword. In: *Governing at the Nanoscale: People, Policies and Emerging Technologies* (ed. M. Kearnes, P. Macnaghten and J. Wilsdon), pp70–8. Demos, London. Available online at: **http://www.demos.co.uk/publications/governingatthenanoscale**.

FURTHER READING

- Hagendijk, R. and Irwin, A. (2006). Public deliberation and governance: engaging with science and technology in contemporary Europe. *Minerva*, 44(2), 167–84. This article draws upon key findings derived from the results of 26 qualitative case studies conducted in eight EU member states as part of the 'Science, Technology and Governance in Europe' (STAGE) Network. The results are interpreted in the light of theories of deliberative democracy, as well as concerns over the level and quality of public participation in science governance.
- House of Lords, Select Committee on Science and Technology (2000). *Science and Society*, Third Report. HMSO, London. This report represents 'official' recognition of some of the key findings of at least two decades of scholarship in science and technology studies. Essentially this report acknowledges a 'crisis of trust' with science. It argues that this problem should not be simply viewed as a public relations issue, but rather it should be answered by a long-term and routine commitment to dialogue and public engagement with science.
- Jasanoff, S. (2005). *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton University Press, Princeton, NJ. This book addresses the public and political issues arising from biotechnology in Europe and the United States. Situating these issues with the wider context of science–society relations, the author makes a convincing case for a form of scholarly analysis that is theoretically informed and empirically aware.
- Leach, M., Scoones, I. and Wynne, B. (eds) (2005). *Science and Citizens: Globalization and the Challenge of Engagement*. Zed Books, London and New York. This edited collection addresses issues of citizenship and engagement from the perspectives of science and technology and development studies, and in relation to a series of pressing science-based issues, including HIV/AIDS and agricultural biotechnology.
- Royal Society/Royal Academy of Engineering (2004). *Nanoscience and Nanotechnologies: Opportunities and Uncertainties*, Royal Society Policy Document 19/04. Royal Society, London. This report represents a consultation process that is widely considered one of the best examples to date of upstream public engagement in UK science governance. The qualitative workshops revealed some key areas of public concern, including financial implications, societal impacts, efficacy, side-effects and future controllability of the technology. However one of the most interesting results is that only 29% of respondents to the quantitative survey of UK adults had ever heard of nanotechnology. This and other aspects of the consultation exercise have raised questions about how effective such early upstream engagement can be, and whether publics may change their orientation towards a technology as it becomes more widely known.

USEFUL WEB SITES

- **research*eu: http://ec.europa.eu/research/research-eu**. *research*eu* is a European Union magazine aiming to 'broaden the democratic debate between science and society'.
- **The Stem Cell Network: http://www.stamcellenetvaerket.dk/**. The Stem Cell Network is an experiment in 'spatial research communication' which seeks to create dialogue and interaction around the social and political aspects of stem cell research.
- **The 'Science, Technology and Governance in Europe' (STAGE) Network: http://www.stage-research.net/STAGE/index.html**. Papers from the Science, Technology and Governance in Europe (STAGE) Network—a European project covering eight nations.