See-Through SCIENCE

Why public engagement needs to move upstream.

continued ▸

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THE STAGE IS SET

On 29 July 2004, a mile down the road from London's West End, the curtain rose on a unique theatrical experiment. Its theme was nanotechnology, the science of small things. The venue was the Royal Society, the headquarters of Britain's scientific elite. The immediate audience was a group of journalists, but the performance was then relayed to a larger public: policymakers, scientists, business leaders and campaigners, all eagerly waiting to interpret its meaning.

We live in a political culture that is steeped in science. When faced with dilemmas over food safety or phone masts, climate change or child vaccination, the first response of politicians and regulators is to seek refuge in 'sound science' and the advisors who produce it. These experts and the panels and committees they inhabit are vital to the smooth running of our political system. But how do they make their advice credible to a sceptical public? What techniques of legitimacy do they use?

One answer is that they act. According to the sociologist Stephen Hilgartner, expert advice is a form of drama. Hilgartner uses the metaphor of performance to explain how scientific advisors speak with authority on the public stage. Describing a series of reports on diet and health issued by the US National Academy of Sciences in the 1980s, he draws our attention to the theatrical dynamics at work in the production, unveiling and dissemination of expert opinion. 'Reports and recommendations are performances; advisors are performers who display their work before audiences.'[1] Before a performance starts, there are months of rehearsal and negotiation between actors. Once it is underway, a division is maintained

between the back-stage, where scaffolding, costumes and props are hidden from view, and the front-stage, which is open to public scrutiny.

The Royal Society's production on 29 July surprised the critics. Its year-long inquiry into the health, environmental, ethical and social implications of nanotechnology had resulted in a report of unusual quality.[2] A few predictable voices remained unconvinced, but the majority agreed that it was a sparkling performance. Several aspects were striking:

» **IT RELIED ON AN ENSEMBLE CAST.** On the Royal Society's working group, alongside the usual principals — eminent professors of physics, medicine, chemistry and engineering, the head of a Cambridge college and a senior industrialist — were some unexpected supporting players — an environmentalist, a social scientist and a consumer champion. For inquiries of this nature, such voices are often called to give evidence, but for them to sit as equals alongside 'real' scientists is rare.

» **IT WAS IMAGINATIVELY STAGED.** In any performance, the stage management determines which elements are visible to the audience and which remain invisible. Typically, the work of scientific advisors takes place out of sight. Debates rage and arguments are resolved in private, long before the public is presented with a consensus view. This inquiry tried hard to be more open. Aspects of its performance were still carefully rehearsed, but there was also room for improvisation. It consulted widely, ran workshops with stakeholders, and published evidence on its website.

» **IT WAS DELIBERATELY AVANT-GARDE.** Anyone familiar with the Royal Society's oeuvre could spot instantly that here the style had changed. The tone was unusually precautionary. Social and ethical issues received prominent billing. Uncertainty and dialogue were recurring motifs. One actor was particularly well placed to observe these changes. Professor Nick Pidgeon sat on the nanotechnology working group, but also played a leading role in

an earlier Royal Society production: its 1992 report on risk.[3] Then, the mere suggestion that risk is socially constructed — a heretical notion to many natural scientists — led to the report being downgraded and released without the society's full endorsement. Twelve years on, the mood was very different. "A new understanding of science and society is spreading through the work of the Royal Society," observes Pidgeon. "These perspectives are finally being mainstreamed."[4]

The nanotechnology report represents a change in the scientific community's approach to the risks, uncertainties and wider social implications of new and emerging technologies. In many ways, it redefines the genre. But to fully appreciate its significance, we need to locate it in the wider context of relations between science and society.

THREE PHASES OF PUBLIC ENGAGEMENT

Historically, the authority and legitimacy of science as a public good rested on a perceived division of labour between academia, commerce and politics. Academic scientists carried out basic research in laboratories, motivated purely by the spirit of inquiry. The results of their endeavours were then applied as technology, but clear dividing lines separated the worlds of science and business. Politics only entered the fray in order to regulate the market, manage risks or set standards.

Such divisions never existed in these straightforward terms, but they have now entirely broken down. Discrete categories of basic and applied research no longer hold in a world where the production and uses of science are intertwined and embedded in dense relationships with business and politics. This blurring of boundaries has contributed to a climate where science no longer has an automatic claim to authority and

respect. As the controversies over BSE, genetically-modified (GM) crops and foods, and now nanotechnology illustrate, people are questioning scientists more and trusting them less. There is particular wariness towards scientists working in industry and government, and a suspicion of private ownership of scientific knowledge. Drawing on extensive polling data, Ben Page of MORI sums up the current state of public opinion: "Blind faith in the men in white coats has gone and isn't coming back." [5]

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This is not a surprise. As we move towards knowledge societies that rely on innovation to drive economic growth, science and technology are likely to become increasingly contested sites of public debate. As Sheila Jasanoff notes, such "far-reaching alterations in the nature and distribution of resources and the roles of science, industry and the state could hardly occur without wrenching political conflicts." [6] Nanotechnology is only one of several areas where the pace of innovation is accelerating. Others such as genomics, neuroscience, pervasive computing and artificial intelligence are giving rise to distinct sets of ethical and social dilemmas.

The response of the science establishment to these fluctuating and unpredictable cycles of public and media response has been to reach out and experiment with new forms of public engagement. For the past twenty years, in response to a perceived 'crisis of trust', scientists have been slowly inching their way towards involving the public in their work. They looked

first to education as the answer, and more recently to processes of dialogue and participation. But these efforts, while admirable, have not yet proved sufficient. Our argument is that we are on the cusp of a new phase, in which public engagement moves upstream.

Phase 1: Public Understanding of Science (PUS)

The initial response of scientists to growing levels of public detachment and mistrust was to embark on a mission to inform. Attempts to gauge levels of public understanding date back to the early 1970s, when annual surveys carried out by the US National Science Foundation regularly uncovered gaps in people's knowledge of scientific facts (for example, whether the earth goes round the sun or vice versa.)[7] Walter Bodmer's 1985 report for the Royal Society placed PUS firmly on the UK policy agenda, and proclaimed "It is clearly a part of each scientist's professional responsibility to promote the public understanding of science." [8]

Phase 2: From deficit to dialogue

For more than a decade, the language and methods of PUS oozed across the face of science policy. But instead of lubricating understanding, scientists gradually discovered that PUS was clogging the cracks and pores that might have allowed genuine dialogue to breathe. Implicit within PUS was a set of questionable assumptions about science, the public and the nature of understanding. It relied on a 'deficit model' of the public as ignorant and science as unchanging and universally comprehensible. Partly as a result of PUS's failings, relations between science and society festered throughout the 1990s, and an occasional rash of blisters erupted (the BSE crisis, GM crops, mobile phones, MMR). In the UK, it wasn't until 2000 that PUS was washed away, when an influential House of Lords report detected "a new mood for dialogue".[9] Out went PUS, which even

the government's Chief Scientific Adviser now acknowledged was "a rather backward-looking vision".[10] In came the new language of "science and society" and a fresh impetus towards dialogue and engagement.

Phase 3: Moving engagement upstream

The House of Lords report detected "a new humility on the part of science in the face of public attitudes, and a new assertiveness on the part of the public."[11] And in the four years since it was published, there has been a perceptible change. Consultation papers, focus groups, stakeholder dialogues and citizens' juries have been grafted on to the ailing body of British science, in the hope that they will give it a new lease of life. Ever so often, a few drops of PUS still dribble out from a Lewis Wolpert or a Lord Taverne,[12] but these voices are now a dwindling force. The science community has embraced dialogue and engagement, if not always with enthusiasm, then at least out of a recognition that BSE, GM and other controversies have made it a non-negotiable clause of their 'licence to operate'.

Yet despite this progress, the link from public engagement back to the choices, priorities and everyday practices of science remains fuzzy and unclear. Processes of engagement tend to be restricted to particular questions, posed at particular stages in the cycle of research, development and exploitation. Possible risks are endlessly debated, while deeper questions about the values, visions, and vested interests that motivate scientific endeavour often remain unasked or unanswered. And as the GM case demonstrates, when these larger issues force themselves onto the table, the public may discover that it is too late to alter the developmental trajectories of a technology. Political, economic and organisational commitments may already be in place, narrowing the space for meaningful debate.

But now, a new term has entered the lexicon of public engagement. Scientists and science policymakers are increasingly recognising the limitations of existing approaches, and there has been a surge of interest in moving engagement 'upstream'.

For example, the Royal Society's nanotechnology report acknowledges that "Most developments in nanotechnologies, as viewed in 2004, are clearly 'upstream' in nature"[13] and calls for "a constructive and proactive debate about the future of nanotechnologies [to] be undertaken now — at a stage when it can inform key decisions about their development and before deeply entrenched or polarised positions appear."[14]

Similarly, the UK government's new 10-year strategy for science and innovation includes a commitment "to enable [public] debate to take place 'upstream in the scientific and technological development process, and not 'downstream' where technologies are waiting to be exploited but may be held back by public scepticism brought about through poor engagement and dialogue on issues of concern."[15]

A FEW LESSONS LEARNED

What has triggered this sudden enthusiasm for upstream engagement? There are a variety of factors and motivations at work. Most immediately, policymakers and the science community are desperate to avoid nanotechnology becoming "the next GM". The wounds of that battle are still raw, and there is little appetite for a rerun. One of the criticisms levelled at the 2003 'GM Nation?' debate is that it took place too late to influence the direction of GM research, or to alter the institutional and economic commitments of key players.

Second, this desire to learn from what has gone before extends beyond GM across the wider realm of biotechnology and the life sciences. It is widely felt that processes of public debate and engagement around human embryology and genetics, from

the pioneering work of the Warnock Committee in the 1980s through to the activities of the Human Fertilisation and Embryology Authority and the Human Genetics Commission today, have 'worked' in a way that similar processes around GM have 'failed'.[16] Interesting assumptions lie behind such framings of 'success' and 'failure', but there are instructive contrasts to be drawn.

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This connects to a third set of motivations for policymakers to embrace upstream engagement. Across the OECD, government are placing ever greater emphasis on science and innovation as central pillars of their economic strategies. In the UK, an extra £1 billion has been allocated to science over the period of the next Spending Review — a real-terms increase of 5.8 per cent each year until 2008. But a big question remains unanswered: Will all of this extra cash and the innovation it aims to unleash improve or worsen relations between science and society? Tony Blair was explicit about this danger in his May 2002 speech to the Royal Society: "When I was in Bangalore in January, I met a group of academics who were also in business in the biotech field. They said to me bluntly: 'Europe has gone soft on science; we are going to leapfrog you and you will miss out.'"[17]

So, in debates over science and society, a small but significant shift is underway. The sudden vogue for upstream engagement may prove ephemeral, or may develop into something more promising. Yet it is also important not to overstate the novelty of moves in this direction. Sheila Jasanoff describes how in the early years of biotechnology, upstream efforts to identify risks and explore ethical dilemmas were led by the science community itself. In 1973, the US National Academy of Science established a committee under the chairmanship of Paul Berg to explore the potential risks of recombinant DNA research. As Jasanoff notes, "Thirty years and several social upheavals later, the Berg committee's composition looks astonishingly narrow: eleven male scientists of stellar credentials, all already active in rDNA experimentation."[18] Nonetheless, the committee's conclusions were precautionary: it called for a voluntary moratorium on certain types of research until more was known about their risks.

More fundamental questions around ownership, control and the social ends to which the technology would be directed were ignored.

At around the same time, the US Office of Technology Assessment was established to provide Congress with "early indications of the probable beneficial and adverse impacts of the applications of technology."[19] And in the Netherlands, theorists such as Arie Rip spent much of the 1980s and 1990s developing methods of 'constructive technology assessment' (CTA) for use by the Dutch government, in an effort to embed social values in the design stages of innovation.[20]

Britain was slower to adopt these new techniques, but in 1994, inspired by Dutch models of CTA and Danish use of consensus conferences, the Science Museum and the Biotechnology and Biological Sciences Research Council (BBSRC) organised a consensus conference on plant biotechnology. This event, held over three days at Regent's College in London, is often cited as the first British attempt at upstream public engagement. In front of an audience of over 300 people, a panel of ordinary citizens took evidence and cross-examined a range of expert witnesses, before coming to their conclusions.[21]

We are unlikely to reach the mythical end-point of consensus, the middle ground of prudent progress behind which everyone can rally.

What makes the current talk of upstream engagement any different from what has gone before? Clearly, any new efforts will be informed by and build on these past experiences and methodologies. But if we review these earlier approaches, they appear lacking in several respects. First, they relied primarily on narrow forms of expert knowledge and analysis. More diverse and plural forms of public knowledge were either marginalized (in the case of the Berg Committee or the US Office of Technology Assessment), or implicitly given lower priority (as in the design of the BBSRC's consensus conference, with its reliance on expert witnesses). Second, the framing of debates and the range of issues up for discussion was restricted primarily to questions of risk in the application of new technologies. More fundamental questions around ownership, control and the social ends to which the technology would be directed were ignored.

Most importantly, these initiatives usually took place in a vacuum — with no explicit link back to the research choices and innovation priorities of scientists or industry, or to the decisions of policymakers. CTA stands out as an exception, as its results flowed into the work of the Dutch government. Elsewhere, the connections with policy were absent from the start, or quickly broken. In the US, the cautious warnings of the Berg Committee were soon lost in the cloud of optimism and hubris that enveloped biotechnology, and in 1995, the Office of Technology Assessment was closed down. In Britain, there was no clear mechanism through which the conclusions of the BBSRC's consensus conference could influence the political and public debate that followed. One commentator describes it as "an admirable initiative that took place in a political cul-de-sac."[22]

So as we embark on a fresh attempt to head upstream, there are lessons to be learnt and mistakes to be avoided. No matter how well we handle one new development, controversy is not about to disappear. We are unlikely to reach the mythical end-point of consensus, the middle ground of prudent progress behind which everyone can rally. The challenge is to recognise that we rely on this constant questioning and the innovation that drives it. Instead of shrinking from scientific and technological endeavour for fear of the uncertainty that accompanies it, we should work to create the conditions for science and technology to thrive. But the simultaneous challenge is to generate new approaches to the governance of science that can learn from past mistakes, cope more readily with social complexity, and harness the drivers of technological change for the common good.

To return to the idea of science as performance, the task of upstream engagement is to remove some of the structures that divide the back-stage from the front-stage. It seeks to make visible the invisible, to expose to public scrutiny the values, visions and assumptions that usually lie hidden. In the theatre of science and technology, the time has come to dismantle the proscenium arch and begin performing in the round.

SCIENCE AND THE SOCIAL IMAGINATION

> Reports that say that something hasn't happened are always interesting to me, because as we know, there are known knowns; there are things we know we know.
>
> We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know.
>
> – Donald Rumsfeld [23]

Chris Patten came a close runner up with his observation that "Having committed political suicide, the Conservative party is now living to regret it." But the 2003 award for most absurd remark by a public figure went to that guru of obfuscation, Donald Rumsfeld. The US defence secretary won the Plain English Campaign's 'Foot In Mouth' trophy for his 62-word attempt to clarify a point at a NATO press briefing. His intention was to defend Washington's view that the US could not wait for "absolute proof" before taking action against groups and states suspected of acquiring weapons of mass destruction, but his remark left NATO allies and journalists completely baffled. "We think we know what he means", said John Lister, a spokesman for the Plain English campaign, "but we don't know if we really know".[24]

Yet, for once, Donald Rumsfeld is onto something. Political processes, when confronted with advances in science and technology, are generally incapable of dealing with anything beyond *known* uncertainties. They can only address questions that they already know how to ask. Conversations are framed in a way that denies or edits out unpredictable consequences. This is despite a growing body of evidence that it is these same areas of ignorance and ambiguity that are of greatest public concern.[25][23]

Research by Lancaster University which compared public attitudes towards GM and information technology found that controversies arise in areas where there is sensed to be no

knowledge, but which are then misleadingly represented in terms of reductionist scientific uncertainty. In such situations, the research team identified a "deep cultural dislocation" between the way that policymakers and the public frame relevant questions. "Whilst the former tend to ask simply 'What are the risks?', the latter ask in addition, 'What might be the unanticipated effects? Who will be in charge of, and will take responsibility for, the responses to such surprises? And can we trust them?'"[26] Many public engagement processes, however well-intentioned, get caught in this trap. Questions of risk — the known uncertainties — can easily dominate proceedings and squeeze out broader discussion of unknown or unanticipated consequences.

THE TYRANNY OF RISK ASSESSMENT

Why is it that whenever a new development in science or technology sparks debate, the key elements of that debate are then framed by scientists and policymakers as "risk issues"? Michael Power argues that there is now an overwhelming tendency in political and organisational life to reach for "the risk management of everything".[27] In a recent Demos pamphlet, he describes how risk management, once an obscure and technical practice within the private sector, has become a dominant discourse within public service delivery and at "the heart of government itself".[28]

In the "risk society", perhaps the biggest risk is that we never get around to talking about anything else.[29] Brian Wynne describes how the past five years have seen a huge flowering of practical and analytical work aimed at nurturing dialogue and mutual understanding between science and society. Yet the "radical apparent potential" of these activities "is compromised by deeper, less manifest cultural assumptions and commitments…[which] have yet to be identified, confronted and changed."[30]

Wynne pinpoints two factors that contribute to this problem. The first is that most forms of public participation are focused on downstream risks or impacts, "reflecting the false assumption that public concerns are only about instrumental consequences, and not also crucially about what human purposes are driving science and innovation in the first place." The second is an assumption that the task of defining what the salient issues are within processes of public engagement automatically falls to experts, leaving citizens with "no capability nor proper role in autonomously creating and negotiating…more diverse public meanings."[31]

Debates are too often framed in terms of "Is it safe?", with the implication that the likelihood of certain outcomes is susceptible to rational calculation.

It is not that involving the public in risk assessment is a bad idea. Quite the opposite: any process of evaluating risk and designing responses to it is likely to be greatly enriched by public involvement. Yet when we are faced with potentially disruptive innovations, the danger is that risk assessment — however participatory — merely digs us deeper into the hole that we are trying to escape from. It avoids our real predicament, which is one of ignorance and ambiguity. Debates are too often framed in terms of "Is it safe?", with the implication that the likelihood of certain outcomes is susceptible to rational calculation. More challenging questions that flow from ignorance about the long-term social consequences of a technology's development are never asked, let alone answered.

This concentration on risk is an entirely understandable way of rationalising an otherwise open and daunting set of questions. It reflects what Zygmunt Bauman memorably describes as modernity's "gardening instinct".[32] Yet this desire to tidy the borders and prune the

hedges of our democracy means that many public engagement processes are stripped of any meaningful content. Sheila Jasanoff recalls how this process played out in the development of GM technology:

> Within barely a decade, environmental consequences that were once considered speculative and impossible to assess came to be regarded within policy circles as amenable to rational, scientific evaluation. By 1990, it appeared that, for genetically modified crops, apocalyptic visions and the rhetoric of science fiction could be set aside in favour of objective expert discourses and routine bureaucratic approvals.[33]

Brian Wynne goes so far as to argue that "virtually all of the mushrooming commitment to public citizen engagement in 'science policy'…is something of a mirage".[34] One deficit model has gone, only to be replaced by another — a misunderstanding of what is at stake and what is the basis of public concern. Recently, in the context of international development, the relentless drive for participation has been dubbed "the new tyranny".[35] Here, the process of taking questions that are essentially political and reducing them to issues of risk management has a tyrannical aspect of its own.[36]

Downstream, the flow of innovation has absorbed numerous engagement processes. Yet few of these have any real connection to the upstream questions that motivate public concern: *Why this technology? Why not another? Who needs it? Who is controlling it? Who benefits from it? Can they be trusted? What will it mean for me and my family? Will it improve the environment? What will it mean for people in the developing world?* The challenge — and opportunity — for upstream public engagement is to force some of these questions back onto the negotiating table, and to do so at a point when they are still able to influence the trajectories of scientific and technological development.

WHO NEEDS IT?

Ten years ago, the consultancy SustainAbility published a report called "Who Needs It?", which sought to introduce a new set of questions into the corporate sustainability arena.[37] It argued that simply adding a dash of eco-efficiency or a drop of social responsibility to the existing mix of products and services was no longer sufficient. The markets of the future would be shaped by human values and needs that until now have been unarticulated and unserved. Key characteristics of this impending values shift would include a new focus on inter-generational equity, and a desire to meet the basic needs of people in the developing world. This would be good news for certain sectors, whose offerings would adjust well to the new social climate, but bad news for others, who would eventually discover that they no longer chimed with the expectations of consumers. To help determine the winners and losers in this brave new world, the report proposed a 'Needs Test' that companies should carry out every time they proposed a new product or service.

With new technologies, the question "Who needs it?" is very rarely asked. Means have an awkward habit of becoming ends.

Surveying the business landscape in 2004, the values shift predicted by SustainAbility still looks to be some distance away. But their report alerts us to some important questions that are highly relevant to our analysis. With new technologies, the question "Who needs it?" is very rarely asked. Means have an awkward habit of becoming ends. There is often a circularity in the arguments used to support new developments — just because a new technology is possible, it is therefore seen as desirable. Before a proper conversation can get underway

about the priorities and ends to which the technology should be directed, policymakers have already skipped on to the next layer of questions about how to deal with the risks, benefits and consequences of its exploitation. Policy and regulatory debates tend to assume that the debate about ends has already occurred — that the economic and social benefits of innovation are obvious and agreed. But of course, this is rarely the case.

Similarly, in all the excitement that surrounds new technologies, it is easy to neglect the untapped potential of the technologies we already have at our disposal. Our list of unasked questions grows longer: "What are the outcomes that this technology seeks to generate? Could we get there in another, more sustainable and cost-effective way?" We should never underestimate the power that the techno fix exerts over the political imagination. But as governments everywhere are learning through bitter experience, environmental problems will not be solved by technological innovation alone. It is easy to throw money at the technological end of the problem. But this must be accompanied by social and political innovation that alters the frameworks within which choices are made. Charles Leadbeater makes this point well in the context of transport:

> New, more sustainable forms of car transport will require scientific and technological innovation, such as new fuel sources for cars. But the true potential will not be realised without social innovation to create new patterns of car use, and even ways for consumers to share and own cars through leasing schemes. It will require regulatory innovations such as road pricing, which may well only be possible if we have political innovations to give cities more powers to control their own transport taxation. We need to imagine not just new technologies, but whole new social systems for transport.[38]

Similar stories could be told about energy, waste, water policy or agriculture. In each of these areas, technology is part of the solution, but it is no panacea. No-one has made this argument better than Fritz Schumacher, in his classic text *Small is Beautiful*. Schumacher describes how the "forward stampede" who advocate new technologies "burst into the newspaper headlines every day with the message, 'a breakthrough a

day keeps the crisis at bay'".[39] This constant focus on "breakthroughs" distracts attention from the real, though not very technological, problems that we face — not to mention the real, though not very technological, solutions that lie within our grasp. Schumacher recognised this only too well. As he wrote "it takes a certain flair of real insight to make things simple again."[40]

THE POLITICS OF SMALL THINGS

As we have seen, two impulses within existing models of public engagement threaten to undermine their radical potential. The first is for policymakers and other experts to restrict the space for debate to a technocratic discourse around risk. The second is for deeper questions about human needs and ends to be squeezed off the agenda. Both of these tendencies were evident during the GM controversy. But will the same apply to emerging debates over nanotechnology?

The Royal Society's nanotechnology report is a good place to start in considering this question. Here we find several encouraging signs of a new approach. A whole chapter is devoted to social and ethical issues, and another to public dialogue. The latter even includes the language of upstream debate. Yet viewed in its entirety, the body language of the report still signals that questions of risk take priority. Much of its analysis is devoted to these, along with a large share of the recommendations. And although the report acknowledges that social concerns are likely to focus on two questions — "Who controls use of nanotechnologies?" and "Who benefits?" — little attempt is made to follow through and answer these, beyond a call for more research.[41] There is little sense that these questions are up for serious negotiation within the terms of reference of the inquiry.

This is perhaps understandable. As a recent paper from Lancaster University and Demos argues, when faced with new situations, policymakers generally turn to the tools and frames of reference that lie close at hand. Just as early policy discussions around GM were shaped by risk assessment models that were originally developed within the nuclear industry, so discussions around nanotechnologies are likely to inherit models that were devised for GM. The way such patterns repeat themselves highlights the need for a more searching analysis of the distinctive character and properties of nanotechnologies before regulatory commitments are made. "It cannot be assumed that the conceptualisations and analytical categories currently available will be able to capture what may prove to be most distinctive about nanotechnology. In other words, be very careful to ensure we don't set ourselves up to fight the last war."[42]

In the same way, the visions of nanoscientists need to be surfaced and opened up to wider debate. One doesn't have to delve far into the scientific and policy literature around nanotechnology to find enormous claims being made about its transformative potential. Bottom-up or top-down, the promises of nanotechnology are revolutionary. For its growing band of cheerleaders in government, academia and industry, nanotechnology offers unlimited energy, targeted pharmaceuticals and intelligent materials. It is increasingly talked about with the same breathless enthusiasm that surrounded biotechnology and information technology in the mid-1990s.[43]

NANOVISIONS

For most people, nanotechnology is still an unknown quantity. But swirling around behind the science are many different views of its social implications and transformative potential. These fall into at least three categories:[44]

» **NANO-RADICALS** see nanotechnology as profoundly disruptive of economies and societies. In his 1986 book *Engines of Creation*, Eric Drexler, the so-called 'father of nanotechnology', predicted a world in which nanoscale machines – 'molecular assemblers' — would be capable of arranging atoms to build almost anything from the bottom up. Because it would take millions of these assemblers to build anything, Drexler argued that assemblers would also need to be capable of replicating themselves, hence his famous — and now disowned — scenario of self-replicating nanobots smothering the world in 'grey goo'.

» **NANO-REALISTS** emphasise the incremental innovations and commercial returns that the technology will provide in sectors such as manufacturing, IT and healthcare. They aren't interested in the hypothetical possibilities of bottom-up molecular manufacture. Theirs is a venture-capitalised, research-council approved version of nanotechnology, focused on practical applications and economic returns. It is this vision that has excited policymakers and unleashed a cascade of government funding across the industrialised world.

» **NANO-SCEPTICS** count Prince Charles and Michael Crichton amongst their number, but their most active and articulate representatives are the ETC Group, a small Canadian NGO. It's not grey goo that worries them, so much as the immediate risks posed by nanoparticles to human health and the environment. They also have some pretty serious questions about who is controlling the technology and whose interests it will ultimately serve.

Such categorisations inevitably simplify a complex range of perspectives, but they are useful in understanding how public perceptions of nanotechnology could evolve over time. The GM saga shows what can happen when the underlying social visions of key players (such as Monsanto) are not surfaced and opened to public deliberation. The challenge now facing those involved in nanotechnology research is to approach things differently: to articulate the visions, promises and expectations of the technology at an earlier stage, and make them the focal point of upstream public engagement.

THE RULES OF ENGAGEMENT

The Great Yorkshire Showground in Harrogate, famed for its agricultural shows, is an unlikely setting for an exercise in democracy. But one afternoon last summer, 250 people gathered there to voice their hopes and fears about genetically modified crops and foods. Bruised and weary from its conflicts with the press, public, pressure groups and scientists, the UK Government decided to confront the issue head-on and sponsor the *GM Nation?* debate. This was an innovative attempt at public engagement, and may come to be seen as marking a sea change in the government's approach to science and technology. In agreeing to a debate on GM, ministers were implicitly acknowledging the inadequacies of previous attempts to handle such issues, and signalling their intention to try a new approach.

It can be hard to get these things right first time — and there was certainly plenty of criticism of the GM Nation? process. An independent evaluation uncovered a number of shortcomings, including inadequate resourcing; a failure to engage members of the public who had not previously been involved in GM issues; and a lack of space for genuine deliberation.[45] But perhaps the biggest flaw of the GM Nation? process was its timing — it took place too late to influence the direction of GM research, or to alter the institutional commitments of the bio-technology industry and other key players.

WHY ENGAGE THE PUBLIC?

When commissioning *GM Nation?*, the government were strangely silent on perhaps the most important question — why they decided to run the process, and what they intended to do with its findings. The official reason for the debate was that the government's advisers, the Agriculture and Environment Biotechnology Commission, had asked for it. But it was never

made clear how the findings would be used in future decisions on GM. Would the government accept the verdict of the debate and follow its recommendations? Would they support or oppose the commercialisation of GM crops on the basis of the evidence received? These issues were not at all clear. As the National Consumer Council observed at the time, "The impression created was of consultation without inclusion, raising questions about whether the government genuinely had an open mind."[46]

The goal is to improve social outcomes in a deeper sense than just improving the reputation of the technology, company or government involved.

A clear lesson from *GM Nation?* is that the objectives of any public engagement process should be clear from the start. It might simply be designed to gather information about public opinion — or, at the other end of the spectrum, to determine a policy decision. In disentangling the different reasons for public engagement, a useful distinction can be made between *normative*, *instrumental* and *substantive* motivations.[47]

The normative view states that such processes should take place because they are the right thing to do: dialogue is an important ingredient of a healthy democracy. The instrumental view holds that engagement processes are carried out because they serve particular interests. Companies developing a new technology may want to find out what people think, so that they can present their innovation in the best possible light. Governments may want to engage in order to build trust in science and manage their reputation for competence.

From a substantive perspective, engagement processes aim to improve the quality of decision-making, to create more socially-robust scientific and technological solutions. The goal is to improve social outcomes in a deeper sense than just improving the reputation of the technology, company or government involved. From this view, citizens are seen as subjects, not objects, of the process. They work actively to shape decisions, rather than having their views canvassed by other actors to inform the decision that are then taken.

With hindsight, it seems that the motivation behind *GM Nation?* was partly normative — the government wanted to do the right thing, as recommended by its advisers. It was definitely instrumental — Ministers wanted to be *seen* to be doing the right thing, in order to build trust in their handling of the issue, and perhaps to move towards greater acceptance of the technology. But given that it was never made clear how the results of the debate would be used, it seems unlikely that there was any substantive motivation behind the debate. It was not aimed at making better, more informed decisions about GM. In this respect, it was too little, too late.

As Andy Stirling points out, substantive approaches are particularly important when there are "intractable scientific and technological uncertainties…as a means to consider broader issues, questions, conditions causes or possibilities."[48] Although there is still a role for normative and instrumental approaches, it is clear from the GM debate, and from emerging debates about nanotechnology, that public engagement must be substantive. It must not just inform decisions — it must shape them.

OPENING UP RATHER THAN CLOSING DOWN

Stirling goes on to make a helpful distinction between processes that aim to *open up* a debate, and ones that aim to *close it down*. For engagement to be meaningful, it needs

to open up some of the deeper questions discussed earlier — to look at who frames the visions and purposes of a new technology, and to allow the public to ask the questions that they consider most important.

A more substantive model of engagement would hand over authorship of the recipe to a more plural and diverse set of publics, rather than reducing the public to just another ingredient in the pot.

Stirling reminds us that implicit assumptions lie behind all engagement processes. Supposedly 'objective' reports by 'experts' are actually carefully and subjectively framed according to the outlook of the experts themselves, and the questions they choose to answer. This is where the retreat to a risk discourse occurs — with biotechnologists, for example, choosing to answer the question 'is it safe', rather than 'is it necessary or desirable'. Identical framing assumptions apply to engagement processes. Decisions made about the type of process used, the participants, the questions asked, the information provided, and so on can lead to inadvertent bias or deliberate influence.[49] In other words, you can get the results you want if, consciously or subconsciously, you frame the debate in the right way.

Even engagement processes like citizens' juries or consensus conferences can be used to close things down, in just the same way as risk assessment. The worst outcome would be one in which techniques for engagement are incorporated into the bureaucratic processes of

decision-making without changing the way that decisions are made; in which 'public engagement' is no more than a process box that civil servants and scientists have to tick when drawing up a policy or applying for funding.

By contrast, practiced in a meaningful way, public engagement can lead to better, more robust policy and funding decisions, provided it is used to open up questions, provoke debate, expose differences and interrogate assumptions. From this perspective, it is not up to 'experts' to frame a question and slot in an engagement process to provide the answer. As Brian Wynne has argued, this is simply the deficit model in a new guide. Instead, the public should help to decide the questions and the way in which a particular issue will be approached.

There is a hint of this 'mark-2' deficit model in the Royal Society's nanotechnology report. The need for engagement processes is flagged alongside other asks — additional research, risk assessment, lifecycle analysis, and so on. The Royal Society has written a recipe for the public consumption of nanotechnologies, in which one of the ingredients is public involvement — alongside numerous others. A more substantive model of engagement would hand over authorship of the recipe to a more plural and diverse set of publics, rather than reducing the public to just another ingredient in the pot. This more substantive model of engagement would genuinely 'open things up' in Stirling's terms, by uncovering framing assumptions and making citizens the subjects rather than the objects of the process.

HOW TO ENGAGE?

Once the question 'why engage' has been answered, we can then turn to the secondary question of 'how to engage' — what methodologies allow a proper consideration of public views and values? A great deal of energy has been expended on this in recent years, but the short answer is that there is no ideal process, but a menu of different methods and tech-

niques. From focus groups to referenda, citizens' juries to stakeholder dialogue, there are as many processes for engagement as there are issues to debate. Our argument here is that aim should come before method, but it is worth reviewing the different techniques on offer. The box below shows some — though by no means all — of the methods available.

METHODS OF PUBLIC INVOLVEMENT [50]

DELIBERATIVE POLLING

In a deliberative poll, a large, demographically representative group of perhaps several hundred people conducts a debate, usually including the opportunity to cross-examine key players. The group is polled on the issue before and after the debate.

FOCUS GROUPS

A focus group is a qualitative method used widely in commercial market research and increasingly in academic social research. Typically, a group of 8–10 people, broadly representative of the population being studied, is invited to discuss the issue under review, usually guided by a trained facilitator working to a designed protocol. The group is not required to reach any conclusions, but the contents of the discussion are studied for what they may reveal about shared understandings, attitudes and values. Focus groups may also help to identify the factors (which large-scale surveys rarely do) that shape attitudes and responses, including trust or mistrust. They also help in the design and interpretation of quantitative public opinion surveys.

METHODS OF PUBLIC INVOLVEMENT [50]

CITIZENS' JURIES AND PANELS

A citizens' jury (or panel) involves a small group of lay participants (usually 12–20) receiving, questioning and evaluating presentations by experts on a particular issue, often over 3–4 days. At the end, the group is invited to make recommendations. In the UK to date, local authorities, government agencies, policy researchers and consultants have convened over 200 citizens' juries on a wide range of policy issues.

CONSENSUS CONFERENCES

By convention, a group of 16 lay volunteers is selected for a consensus conference according to socio-economic and demographic characteristics. The members meet first in private, to decide the key questions they wish to raise. There is then a public phase, lasting perhaps three days, during which the group hears and interrogates expert witnesses, and draws up a report. The main differences between a consensus conference and a citizens' jury or focus group are the greater opportunity for the participants to become more familiar with the technicalities of the subject; the greater initiative allowed to the panel; the admission of the press and the public; and the higher cost.

STAKEHOLDER DIALOGUES

This is a generic term applied to processes that bring together affected and interested parties (stakeholders) to deliberate and negotiate on a particular issue. Stakeholders can range from individuals and local residents to employees and representatives of interest groups.

METHODS OF PUBLIC INVOLVEMENT [50]

INTERNET DIALOGUES

This term is applied to any form of interactive discussion that takes place through the internet. It may be restricted to selected participants, or open to anyone with internet access. The advantages of internet dialogue include the ability to collect many responses quickly and to analyse them using search engines. Similarly, they can combine the benefits of rapid exchange of ideas (brainstorming) with a complete record. On the other hand, participation may be self-selecting and unrepresentative, and the anonymity of the internet may encourage impulsive rather than considered responses. Anonymity may make it difficult to investigate the provenance of information provided.

DELIBERATIVE MAPPING

This is a process in which expert and citizen assessments are integrated. In a deliberative mapping exercise, citizens panels and specialist panels are convened and interact with each other, allowing interrogation of each others' views and knowledge, and exposing framing assumptions made by both sides. Deliberative mapping seeks to bring together the views of 'experts' and 'public', through face-to-face deliberation between these two groups. The approach was pioneered through a consortium of research institutes in the UK, applied to the specific problem of organ transplant options.[51]

The type of process used will, obviously, depend on what is required. Timing and resource constraints will determine how ambitious or far-reaching a process can be. But there are other issues to take into account. Our analysis of normative, instrumental and substantive motivations gives rise to a number of further questions:

- **DELIBERATIVE OR SNAPSHOT?** Is the process designed to involve people in a process of deliberation, whereby information is processed, and views formed and discussed? Consensus conferences and citizens' juries allow this. Or is the aim merely to get a snapshot of people's views, in order to inform decisions? In this case, a straightforward opinion poll or focus group may be more appropriate.

- **REPRESENTATIVE?** Different methods will be required if the aim is to involve a representative sample or a particular segment of the population. But even smaller, more deliberative processes can be 'representative' in a less formal, statistical way, if participants are selected according to certain criteria — as is routinely the case with focus groups, for example.

- **HIERARCHICAL OR NON-HIERARCHICAL?** One important, though often overlooked, factor is how 'expert' knowledge is treated. In other words, does the method follow the traditional hierarchy whereby experts decide what questions need addressing, and what information should be taken into account? Or does it subvert this, allowing lay participants to frame questions, gather information and question evidence? The citizens' jury is perhaps the best example of a process in which hierarchies are reversed, with jury members free to define the question, call witnesses and seek whatever information they deem relevant or necessary. Such a model makes it easier to open up rather than close down debates, along the lines discussed above.

- **CONSENSUAL OR EXPLORATORY?** Lastly, it is important to consider whether a deliberative process aims to reach a consensus, or simply to explore views. Some processes, like deliberative polling, aim to develop a richer understanding of views. Consensus conferences and stakeholder dialogues often aim to bring about consensus, or even to reach a definitive decision.

ARE ENGAGEMENT PROCESSES ENOUGH?

So far, we have explored questions of why and how to engage. But true to the spirit of opening up, our answers raise larger questions about the nature of democracy. Where does public engagement fit in the set of relationships between citizen and government?

This may seem far removed from the immediate and practical question of how to handle nanotechnology or GM foods. But the question of how to handle new technologies is not simply a technical or procedural question — it is a question of politics. Decisions about the relationship between technology and society are deeply political. They require forms of mediation between different interests, values and worldviews. The challenge is how to integrate engagement processes into wider patterns political decision-making.

Simply slotting deliberative processes into existing ways of doing things will not result in any real change. Some of the more naïve proponents of public engagement seem to assume that the way to resolve difficult issues is by bringing together the concerned parties, adding a mix of methods and a family pack of post-it notes, and then allowing the facilitators to save the day. But decisions about the way that technology and society interact are deeply political, and engagement processes need some kind of link to the political system. At the end of the day, decisions have to be made, and elected politicians usually have to make them.

TOWARDS A DELIBERATIVE DEMOCRACY

This takes us to the heart of political theory. Advocates of deliberative democracy provide important insights into the relationship between engagement processes and democratic decision-making.[52] They stress, above all, the process by which views are formed. It is often assumed, particularly by politicians and economists, that an individual's political decisions or economic choices are a manifestation of innate beliefs or

preferences. If this is true, then a simple opinion poll — or indeed, a referendum — to assess people's views is the easiest way to understand public attitudes. Everyone, the argument goes, will have a view on a particular technology — GM for example — we just need to find out what it is.

We begin to see the emergence of a two-way, shifting dialogue: the formation of technologies on the one hand, and the formation of views on the other.

By contrast, a deliberative model emphasises that people's views are shaped by the way they encounter or engage with an issue. So people do not have a view on GM unless they are required to have one — which could happen when they read about it in the papers, are asked to buy GM food in a supermarket, are asked by a pressure group to oppose it, or are invited to participate in a *GM Nation?* meeting in their town hall.

This helps us to understand people's reactions to technologies. It is hardly surprising that so many respondents to *GM Nation?* expressed "unease at the perceived power of the multi-national companies which promote GM technology."[53] This is not a criticism of the technology itself, but of the way it was handled. We begin to see the emergence of a two-way, shifting dialogue: the formation of technologies on the one hand, and the formation of views on the other. The mingling of these two processes is what will ultimately determine the direction of a technology — and society's reaction to it. From this analysis, an important lesson emerges. If it is possible to shape the process of view formation through deliberation, then it is possible for people's views, and the technology they are reflecting on, to be shaped simultaneously. It is no longer a case

of developing a technology and finding out what people think about it — the two can, and should, be done in parallel.

In the final analysis, the buck for decisions over science and technology must stop with elected politicians. This is one of the things that we elect them for. But political decision-making should not take place in a vacuum. Rather, it should seek out and take account of diverse forms of social knowledge and intelligence, and use deliberative processes to better inform its decisions.

A final argument in favour of such an approach is that it could help reinvigorate a wider enthusiasm for politics. Critics of engagement processes often point out that political dis-engagement is at an all time high. People are not exactly queuing up to be involved in debates about technology. Many choose not even to vote at a general election.[54] Ironically, though, this rejection of politics could be resulting from too little, rather than too much, engagement. Too many people see politics as separate from their everyday lives. If faith in the institutions of representative democracy is on the wane, now is the right time to start experimenting with new forms of democratic debate.

SEE-THROUGH SCIENCE

> I believe the intellectual life of the whole of western society is increasingly being split into two polar groups...at one pole we have the literary intellectuals...at the other scientists... Between the two a gulf of mutual incomprehension – sometimes (particularly among the young) hostility and dislike, but most of all lack of understanding. They have a curious distorted image of each other.
> – C P Snow[55]

If he had lived to meet him, one wonders what C P Snow would make of Rob Doubleday. Snow, who achieved success as both a scientist and a novelist, is best remembered for his 1959 lecture *The Two Cultures*, in which he lamented the breakdown in communication be-

tween the sciences and the humanities. Doubleday, on the other hand, is a social scientist who recently took a job in the nanoscience laboratory at Cambridge University, providing real-time reflection on the social and ethical aspects of its research. “My role”, explains Doubleday, “is partly to imagine what the social dimensions will be, even though the eventual applications of the science aren’t yet clear.” Communication is a big part of his work: “A lot of what I do is translate and facilitate conversations between nanoscientists and social scientists, but also with NGOs and civil society.”[56]

This is a different sort of experiment in democracy. But it is no less important. Taking public engagement upstream requires us to be creative in the mix of formal and informal methods that are used to infuse science with new forms of public knowledge.

Taken to its logical conclusions, our argument has profound implications for the future of science. At its most ambitious, can upstream engagement reshape not only the way that science relates to public decision-making, but also the very foundations of knowledge on which the scientific enterprise rests?

Running through our analysis is the proposition that different types of intelligence need to be viewed alongside one another, rather than in a hierarchy which places science above the public. Why? Because this will lead to better science. Better in instrumental terms, because if scientists engage as equals in a dialogue with the public at an early stage, there are less likely to be clashes further downstream. But also better in substantive terms: science that embraces these plural and diverse forms of knowledge will be more socially robust science.

As we have seen, the science community has travelled a long way in a short time. In less than twenty years, the style of its conversation with society has changed from the patronising tones of ‘public understanding’ to the warmer banter of dialogue. Now it must change again, to a more honest mode of listening and exchange.

Welcome to see-through science.

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