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Dialogic Science and Democracy: the Case of Nanotechnology

BY PADRAIG MURPHY

INTRODUCTION

Nanotechnology, we are told, is an area of great promise for society (Forfás, 2010; European Commission , 2005). At this time of crisis in Ireland and Europe, however, all promissory tales told by governments and institutions need to be placed under scrutiny. In this chapter, I look at an emerging system of interdisciplinary research and development in Ireland that has evolved under the 'smart economy' and 'innovation' banners, an area of connected technological approaches collectively called 'nanotechnology'. Nanotechnology has wide political support globally (Hullman, 2006), and in these challenging times, is increasingly linked in developed economies to national recovery and global technology strategies (Forfas, 2012). It has been called an emerging, disruptive technology (ibid.) However, while opposition is not evident in Ireland (Murphy 2010), NGOs and policymakers internationally urge caution against what some see as hype or misplaced promise at best, and potential health, environmental and ethical implications at worst (Friends of the Earth, 2010). While the inclusion of NGOs in discussions about any technology is increasingly seen as a more dialogic way of developing technology (Felt *et al*, 2007) – particularly with local and international protests over emerging technologies such as genetically –modified foods, energy technologies, and many others- civic society organisations are not necessarily the gatekeepers of public opinion. It is for this reason that this chapter argues for broadening inclusivity to include diverse publics, including the marginalised voices in society, to explore the true democratic potential of a potentially pervasive emerging technology and its associated nanoscience research .

How do we mean 'democratic' and 'dialogic' when referring to something supposedly universal such as science? This chapter will look at nanotechnology in an Irish context drawing from current thinking in science communication and science studies, particularly ideas concerning public engagement and public participation in science governance. The specific approach used here extends the concept of engagement to include how publics might interact and potentially shape the discourses, and indeed even the 'products', of emerging science. I will address two key areas: first, a separation between a strategic science and a constructed 'public' where public participation might happen, on the one hand operating as a one-way communication process but now increasingly dialogic, yet on the other hand also increasingly the context for strategic vision for Ireland in a global economy. We are in the era of *technoscience*, application-driven science with extraordinary epistemological position of legitimacy and public resonance (Nowotny *et al*, 2001). 'The public' here is often constructed as 'disadvantaged' in the sense of having a knowledge deficit, requiring education and more scientific literacy. Second, I ask why and where public participation should occur for something as abstract and technical as the nanosciences among communities that are truly disadvantaged in a social and economical sense, removed as they are from hi-tech policy discourses. However, there has, in recent

decades, been greater emphasises in science communication theory and practice on public engagement (Wynne, 2005; Dalgado, 2010). I will focus on the citizen jury as one potentially strong, public -oriented model, drawing from an Environmental Protection Agency project on which I worked (Murphy, 2010). The chapter concludes with a description of how a sub-political dialogue, contributing to social action beneath mainstream politics, can best be achieved in an Irish context and how policy could realistically change in response to public response to nanotechnology.

Nanotechnology is a curious area, fractured into several areas of discourse. It became a talking point globally in the mid-2000s. Yet the talking was arguably of an elite nature. A UK report by the Royal Society and the Royal Academy of Engineering (2004) was the first major scientific policy document in this part of the world that recommended social, ethical and environmental considerations when pursuing nanoscale research and development. There is a broad definition often presented . The terms 'nanoscience' and 'nanotechnology' describe a range of converging technological processes expected to impact greatly on our future lives. The terms are commonly grouped singularly as nanotechnology. In this field, the standard definition goes, atoms and molecules are manipulated at scales below 100 nanometres, about 1/50,000th the width of a human hair. Because of the difference in properties of all matter at this scale 'the 'nanocale' - technologists theorise that matter can be exploited, creating new types of processes and objects. Structures can be created in the lab that are unimaginably small, and durable. Discourse around this can be quite futuristic, but there are current applications such as nanosensors used as medical devices in the body and nanomaterials for the electronics or microchip market and in textiles, cosmetics and sporting equipment, where materials called nanoparticles are often used. Nanowires and carbon nanotubes are future applications expected in the construction of materials with vastly superior strength and electrical properties than currently exist in nature. But such social disruption, however positive, also brings risk. There are also many policy initiatives globally which suggest something else about nanotechnology besides promise. For example, the National Science Foundation in the US has invested 5% of its 2012 budget to what is termed 'ELSI', ethical, legal and social issues (National Science Foundation, 2012). The OECD has published guidelines for member countries on how to engage publics about nanotechnology (OECD Directorate for Science, Technology and Industry Committee for Science and Technological Policy. 2008). There is, without question, a ground-breaking aspect to this technology. If this technology is likely to be all-pervasive, then it needs to be the subject of public discussion.

TECHNOSCIENCE STRATEGY AND PUBLIC ENGAGEMENT

Epistemologies, Ontologies and Institutions of Science

Science, in a traditional understanding of it, strives to be global, objective, consistent non-contextual. It is presented as the ultimate objectivity, removed from public intervention. Increasingly, in the West, it provides ontological security; in Ireland, science has emerged from Catholic dogma, perhaps leaving less room for other worldviews. In short, we believe, as a society, in science and its applications in society. The theme of the Martin McEvoy seminar series to which this chapter contributes is the current democratic deficit that appears to be a central criticism of the European crisis. And the European Research Area wants more science, more innovation, more translation from knowledge processes in higher education into product and jobs. Against this backdrop, science is surely a common good? Of course, we do need more science and in this year, Dublin being the ESOF City of Science, we celebrate Irish science and our world class research (Forfas, 2012).

However, all should now be put before public consideration, across Europe. Dialogue has been one of the key objectives for Dublin City of Science. Dialogue requires greater discussion between institutions of science and the rest of society. The time of accepting universally the unlimited progress

of science is gone. The condition of late modernity in the 21st century presents challenges to the linear progression of science, a dominant model, one version of the history of science. The evidence for why this is not the case anymore lies in the myriad of epidemics, genomics, climate change HIV, diffusion of politics and knowledge, mixed together. Also, in the knotted history of technological development,(Bucchi, 2004) there have been innovations that have been morally and socially destructive (science –based eugenics, the Manhattan project, environmental degradation since the Industrial Revolution) as well progressive (healthcare generally in the 20th century, environmental cleaning technologies, space and geological exploration). This is not to say that nanotechnology is another Manhattan project [footnote?]. But there have been concerns internationally (RS/RAE, 2005) , rarely discussed in Ireland (Murphy, 2010). 'Science' becomes ring-fenced from other discourses, particularly discourses of risk, as we shall see, and a discourse of scientific literacy prevails. In this sense, science then is a hegemony. But the counter-argument against concerns about hegemonic control are the very real, rationalist fears about the rise of so-called pseudoscience (eg any science-sounding descriptions of alternative medicines or nutrition), or responses like faith -based resistance to stem cells or evolution and concerns over climate denialism.

But for nanotechnology, faith and fiction are ambiguously tied to the science as scientists and science communicators struggle to separate the 'fact' from the 'fiction'. Nanotechnology has been described as being somewhat alien, making it difficult for a non-expert to visualise as well as define (Hayles, 2004). This visual, epistemological issue with nanotechnology is a challenge for the real world. Science sociologist Steve Fuller notes how, in contrast to data coming from physics, the 'convergences sciences' (bio-, cogno-, info- and nanotechnologies) are organised around an epistemology of predictable, reconstructable matter with an aim to lead to human enhancement and other ethical minefields (Fuller, 2011). But at least by portraying the nanoscale in terms of real objects we can - goes the theory - understand it better. In classroom discussions with senior level students, described briefly below as part of my EPA-funded public engagement project, when discussing nanodevices used for medical procedures within the body, the first thing that students tended to ask was: 'How can we get it out again? (Murphy, 2010). From this point, the element of risk is introduced. But more tellingly, the question was never fully resolved – does it mean nanobots? Is it invisible? What actually *is* nanotechnology, they may persistently ask, even at the end of a detailed class on the subject. The standard process descriptions are therefore rendered meaningless, when it is expected to be part of so many future products in healthcare, electronics, cars, sportsgear, clothes, even our food packaging, as nanotechnologists tell us will occur. This is part of the challenge for scientists and media when communicating nanotechnology (Murphy, 2009). When we narrowly define what nanotechnology is, there is a danger of reducing other meanings, including the idea of risk (Murphy, 2010). And there are risks associated with nanotechnology, both health and environmental – the extent of which nanotoxicology studies continue to determine (Anderson *et al*, 2009; Donaldson *et al* , 2004)) but also the three Es of the ethical, and what might be call issues of equity and the existential. In the early 2000s, social scientists and natural scientists associated with the National Nanotechnology Institute in the US identified a need to engage with a sceptical public , mindful also of resistance to GMO foods, which have threatened whole industries (Roco, 2003; Roco and Bainbridge, 2001). And while the young people in our classroom discussions were unaware of, and felt far away from, the discourses that have emerged about nanotechnology, the less-than-real pictures of future nanotechnology painted by Roco *et al* have used utopian and dytopian colours. Consider space

elevators and 'grey goo' scenarios of Ray Kurzweil (2012), or engines of creation of futurist Eric Drexler (1986), tiny replicator robots taking over the world. Neither seem likely to our current common sense.

This makes nanotechnology an interesting test case for all other emerging technologies in this late modern environment, where institutions, according to Ulrich Beck (1994) and Anthony Giddens (1994), have more 'reflexivity', introducing various perspectives on risk. 'Institutional reflexivity' is the phrase used by social theorists such as Beck and Giddens to describe the response by institutions, such as science centres, but also other mega-institutions of science itself, to the identification, construction and control of risks in late modernity. Lash describes this best as *self-confrontation* of institutions (Lash, 1994). Contemporary risk theorists such as Wynne (2005) and Sandman (Sandman and Lanard, 2005) also point out that the subjective and affective are integrated into opinion-forming and decision-making in the rationalist discourse of scientific , technical risk assessment. This point, in many ways, is controversial; are we to treat each perspective on nanotechnology as valid? This attention to competing perspectives in a place where science establishes *fact* may be what postmodernist agendas have helped shape within science studies; however it is not that diffuse or relativist – we need to ensure varying viewpoints are heading towards workable (if not always consensus-based) solutions, and processes, even products, or perhaps challenging common and long-held assumptions. These ways of visualising science as part of a wider culture is the domain of science studies, just as we , as a society , often have a corpuscular view of the world, engaging with the 'nanoscale' as cultural theorists Katherine Hayles (2004)and Colin Milburn (2004)would say, more than an epistemology but also an ontology of reduction.

However, in the European Research Area, a conglomerate of policy bodies, higher education institutions, industry and research centres, a new theme within European science policy is the idea of 'responsible innovation'. Responsible innovation demands ethics, taken to account, transparency. This does not always mean better public engagement however, although implicit in the terminology, as we shall see, as there is a certain scientific hegemony within society. Society, in the main, trusts scientists regarding knowledge, as much as it trusts most technology.

Where does Public Participation Happen? Constructing the Public in the Context of Irish Science, Technology and Innovation

Strategic science communication, traditionally, was a one-way affair, science disseminated from an expert, without distortion to 'the public' via media (Hilgartner, 1990). This dissemination model requires little feedback, and practically no critique. In some ways, this models still persists in Ireland. In late 90s, early 2000s Ireland , with the emergence of the Celtic Tiger, there was an Irish 'turn to science'(Trench, 2009) , starting with the Tierney Report (Ireland, Science, Technology and Innovation Advisory Council, 1995)and the White Paper on STI White Paper (Ireland, Department of Commerce, Science, and Technology, 1996) of the 1990s, a policy report that leading to the setting up of Irish Council of Science Technology and Innovation (ICSTI, now ACSTI) .There then followed a ramping up of investment , not just of nanotechnologies, but of ICT and biosciences through the Programme for Research in Third Level Institutions (PRTLI). As this model was embedded in an educational-knowledge economy-policy nexus, the 'education and outreach' allocation of funding was invested in increasing scientific awareness among second level students in particular in often quite

promotional activities, allied with an economic argument for emerging technologies, with the aspiration to also recruit future engineers. This aspiration still exists, as interest in science , technology, engineering and maths (STEM) secondary and higher education subjects, as well as literacy levels, decreases in this part of the world (Shiel, *et al*, 2010). The objective of the investments made by the education-economy-policy nexus with EU support- would seem to have failed. Still, there have been many relatively large scale institutions and events created in the education and outreach arena which fulfil a valuable civic, as well as technological and economic, role, such as NanoNet Ireland, the Science Foundation Ireland-funded Centres for Science , Engineering and Technology (CSETs), and the Nano, Science and Engineers' Week events, all culminating in this year's ESOF Dublin City of Science 2012. But it could be argued that this continued emphasis on young people creates a kind of dialogue barrier, as topics such as nanotechnology become pedagogic rather than dialogic, an explanation of concepts in a top-down model. The City of Science emphasis on dialogue could be more accurately conceived as the start of a new conversation between science and society given the types of programmes organised - theatre, workshops and arts installations - a dialogue between traditions, not necessarily diverse publics. Another barrier for dialogue is the reduced risk discourse in media for science, technology and society generally, and specifically for nanotechnology. The stories of promise tend to be the only occurrence of nanotechnology in media coverage in Ireland (Murphy, 2010), as it also tends to be abroad (Anderson *et al*,.2009).

The conditions for a reduced type of reflexivity in the institutions of science set up this non-dialogic, non conflicting view of science in the public arena. The 'public' then is often in Irish policy-political culture – but also in global science communication strategy - constructed as a homogenously disinterested one, with young people in particular needing persuasion that science, maths and engineering is the way forward. Irish disposition toward science can be crudely characterised in attitudinal surveys, albeit with useful patterns (European Commission, 2006) .

But why should scientists and policymakers be concerned with public opinion? As already alluded to, one reason is to ensure no repeat of what could be said to be 'the nuclear issue', which could also include GM scenarios, stalling industrial development. Genetically modified organisms have been the site of constant resistance against strategic science in Europe particularly, where there are accusations of PR softening up their market (refs). Education and outreach would then be seen as a pre-emptive strike to remove public concerns and ignorance. In the US, National Science Foundation allocate6% of funding to ethical, legal and social implications (ELSI) . Another reason is: communication strategists are concerned about the general lack of engagement in science in Ireland. And this is a strong argument. For a nation that has had brilliant scientists – William Rowan Hamilton, Robert Boyle, Jocelyn Bell Burnell to name a few - and have embraced science both politically (politics with capital 'P', in that there is Government investment and promotion) and ontologically (we accept what we see and read about discoveries and phenomena) , we do not, paradoxically, have a scientific culture. Boyle, in particular, was a dialogic scientist – not that he may have known it as described here – but he performed his science, out in the open, to his public, to convince and persuade that his empirical work was a description of scientific phenomena (Schaffer and Shapin, 1989) (animals died

during his vacuum pump demonstrations, so it is safe to assume we will not be repeating that level of intensity of public engagement today!) .

Today however, this 'ELSI' strategy fits into an emerging discourse of public engagement in what can be broadly called sociotechnical issues meaning the social and cultural implications and dependencies of technologies (Schot and Rip, 1997). But this strategy often follows what is often called a 'deficit model' (Miller and Gregory, 1998), assuming a knowledge gap to be filled only, revealing an outmoded idea of 'knowledge', and a perceived 'public' that is non-expert, with a negative relationship with knowledge. Although concerned with public attitudes, Chris Toumey (2011), demonstrates this traditional 'poling' view of public opinion in recent ongoing concerns about public opinion . But behind this, although 'knowledge' is the key construction it is seen as a deficit, although the intentions may be noble. This construction of the public too easily separates science from politics. And this is the common mistake – the assumption that such a separation is possible . Many scholars such as Brian Wynne and Alan Irwin, as well as high level science policy reports (Felt *et al*, 2007) – and more radically, Michel Callon (1986) and Bruno Latour (2004) – have demonstrated how that intuitive separation of 'science' and 'politics' or 'knowledge' from 'opinion' is doomed to failure. In this separation, it becomes easy to construct a public in terms of a range of 'knowledge' and 'attitudes', somewhat outside the reflexive system, rather than social phenomena created by institutional systems themselves (even political polling has its issues in this regard). When publics (we therefore refer to 'publics' not 'public) are constructed in this way, it is seen that for general issues of science and society (including nanotechnology) there is a lack of engagement, a removal from discourse.

TECHNOSCIENCE AND THE LOCAL

Technology, Local Opinion and Politics

To bring matters closer to home, let us examine how nanotechnology can be a matter of concern to a local community, even where the word may have little currency. We have already mentioned the low occurrence of 'risk talk' in media for science, technology and society also found for nanotechnology (Anderson et al. 2009). In environmental issues, local activism – where science reaches a zenith as a matter of concern – is unfairly characterised as NIMBY-ism. Again, the sociotechnical nature of science/politics can be described by Beck (1992) and Giddens (1991) in their descriptions of sub-politics, action beneath the surface level, at a remove from media preoccupation with 'capital P' politics. There is a growing backlash fuelled by economic and political disillusionment and driven by civil society in Ireland. Examples include the Occupy movements, Claiming Our Future, Galway 2040, Social Justice Ireland, and for environmental issues, Shell to Sea, Cork Harbour Alliance for a Safe Environment (CHASE) and, more recently, Good Energies Alliance Ireland, a collaborative of campaigning against shale gas hydraulic fracturing, or fracking, the latest sociotechnical controversy in Ireland. As Brian Wynne skilfully demonstrated in his study of 'lay knowledge', the subjective of jobs and livelihoods versus fears of corporatist bullying versus scientific rationality are all part of a web of opinion in various local public arenas where there are sociotechnical disputes. While dcience as knowledge, politics as "mere" opinion, Wynne challenges us to look to new definitions. For nanotechnology, while the risk discourse is practically absence (due to lack of current knowledge) ,

particular questions about technology and industry in the real world need to be addressed in post-troika Ireland. Can there be real jobs in a nano-economy? What are the ideas of nanotechnology within society and local culture? These are the kind of questions the more community-engaged dialogue models discussed in the next section raise.

Community Engagement with Science: An Irish Citizen Jury for Nanotechnology

As already discussed, research and development in nanotechnologies and other convergent future and emerging technologies increased substantially in developed economies - and so-called BRIC and Asian countries - at the same as an increase in emphasis in dialogic potential in science communication fields, at least notionally. I say notionally, as public engagement exercises such as the *GM Nation* initiative in the UK during Gordon Brown's Labour Government was accused of using deliberative methodologies such as focus groups to gather social intelligence rather than address real public concerns (Gaskell et al, 2003). The EPA project reported in this chapter attempted to investigate this 'new breed' of science dialogue in an Irish context. The types of public engagement activity used in this study included secondary school visits, an installation in the Science Gallery with supporting online forum, the Alchemist Café - a *café scientifique* with an Irish flavour - and focus groups (newly created, open invitation and pre-existing groups) (see Murphy, 2010 for the full research).

The four categories used as evaluation criteria in the research, based on guidelines developed by the OECD on nanotechnology public engagement (Gavelin *et al*, 2007; OECD Directorate for Science,Technology and Industry Committee for Science and Technological Policy, 2008), were:

- Emphasis on dialogue
- Range of participation
- Depth of issue or topic engagement
- Impact

In the evaluation, each public dialogue model had different 'scores' across the criteria. For example, the open invitation focus groups were high on depth of scientific/ issue engagement, but lower on range of participation, owing to low numbers. The Science Gallery installation had many visitors, so was high in range of participation and also potential impact due to large numbers, but lower on issue depth.

We will focus here on the citizens' jury activity, give its potential for high emphasis on dialogue and issue depth , and reflect on what impact it could have, specifically for science policy. Citizen juries are a type of public participation process whereby members of the public, up to 25 in number, are invited to make informed decisions as part of a 'jury' on an issue – in this case future and emerging technologies - based on key expert presentations, or 'witnesses.' The jury participants are offered the opportunity to listen, cross-examine and deliberate. The process has a 'charge', much like a debate motion, in which the facilitator/ judge and the jury must decide for or against the issue, but in contrast to a criminal trial, the verdict can contain more nuanced steps toward resolution, rather than a straightforward 'guilty' or innocent'. The citizen jury model has been successful in the Netherlands and Denmark but also in other Western countries, most successfully resolving issues or developing ideas as solutions where solutions can exist for particular community issues, such as

criminality or anti-social behavior. A citizens' jury on this latter issue was carried out in 2003 (Breeze, 2003).

For nanotechnology, there are some precedents, most notably Nanojury UK organised by Tom Wakeford and colleagues at, PEALS, Newcastle University (Nanojury, 2005).This was an intriguing process, as it contained parallel tracks – a 'top down' approach where the organisers – university researchers, but also included Greenpeace - set the terms for debate on nanotechnology with a corresponding 'bottom-up' track where the participants were asked to organise their own community-based topic. However, Singh (2005) who was on the facilitator team, urges us to be cautious, stating that the main reasons that the UK Nanojury was less than successful was 1) more time was required to deepen the bottom-up process rather than closing off discourse with the top-down process and 2) the issue of balancing participant expectations with real policy change. This of course means increased investment of time and money. Nonetheless, with these challenges, it was decided to run a small-scale Irish version as part of an EPA-funded pilot in DCU on May 16th 2009, with north side Dublin partnership contributors as jurors. The jury numbered six in total, with not all being able to remain for the almost full-day event. This is one challenge with such dialogue model, requiring significant commitments from over-stretched community workers. A healthcare ethicist, a principal investigator in nanoscience research and a social democracy expert were the 'witnesses', all from DCU, and facilitated by a DCU science communication team. The charge was: 'Does small science pose big problems for public policy?'

The short verdict returned by the jurors was 'yes'; however, as with citizen jury convention, there was a more detailed response to the charge. The verdict read that societal issues may not be significantly different for nanotechnology than they were for other big technologies to which society has adapted in the past. The charge outlined questions that nanotechnology raises for society:

- *Policy:* Will policymakers and publics acknowledge the local/global issues regarding the regulation, control and consumption of nanotechnologies? What is the Government position on nanotechnology? Who are the stakeholders? Are there community-based stakeholders? Does policy drive innovation or vice versa?
- *Risk:* Nanotechnology may bring profound changes, but society will adapt. While there was no consensus (and we need not expect consensus in these type of deliberative models), the majority felt that new pervasive technologies always have risks and benefits. Social and ethical risks were seen to be the more visible risks, rather than health or environmental ones.
- *Ethics/ inequity of knowledge domains:* Nanotechnology knowledge might never reach the disenfranchised, or those in disadvantaged areas, or their involvement - in research and development - would be minimal. There was a feeling that publics may be largely unaware of nanotechnology developments.
- *Trust:* It was felt by the jury that citizens will always raise the issue of trust – who is telling me this technological information? And what do expert governance structures know that we (non-experts) need to know?

Science Policy: Public Response and Emerging Technologies as Political Action

The citizen jury verdict also stated that policy-makers were the key people in terms of setting the agenda for science in industry and the education system. There were concerns for implications for students in disadvantaged areas regarding access to nanotechnology knowledge for the future. It was

clear to the jury that nanotechnology, as with many other so-called 'disruptive technologies,' has many interconnecting implications for science policy in Ireland which goes beyond science and technology. Policy-makers, stakeholders and publics, the jurors stated, may tend to 'exist in bubbles' regarding these issues, but is it clear that nanotechnology has both local and global implications. It was important then to have policy-makers represented at the next jury event, it was said. The key is to have science policy change as an intended outcome of the process. In this community-based approach, it was also informative to witness how local practical problems of education, jobs training or 'up-skilling' were integrated with ethereal and abstract debates in nanoscience discourses, public contribution and policy buy-in.

There are other examples where nanoscale research and related technologies contain more flattedn democratic process. The 'science shop" movement beginning to have an elevated status in University College Cork, Dublin Institute of Technology and Dublin City University. In the science shop model, the research question emerges from the local community, rather than the technoscientific community of higher education institutions (a example in which DCU ins currently involved is the PERARES project, where networks co communities across Europe debate online about potential nano futures, through the organising frames of energy or cancer treatment (Living Knowledge, 2012)). Going further, there are also participatory design concepts, in the sense of common public and expert involvement, perhaps with different purposes (Guston and Sarewitz, 2002). The vision is for community engagement with publics having direct ownership to how a technology develops, such as smart meters or photovoltaics, while also responding to the debates about nanotechnology and energy in the outside world.

CONCLUSION

Nanotechnology is part of a discourse of technoscience from which we cannot escape nor do we necessarily need to. But it is a multi-pathway area of discourse where dialogical action already happens, between disciplines, institutions and various media. So why is the dialogue not more equitable? Ireland has a lack of engagement with socio-technical issues, elite discourse that rarely allows dissent. There is an absence of 'risk talk' in public discourse about science, technology and society, whatever about debates within science itself about theories or processes. There are many global debates about science governance, ethics and funding. Citizens juries or panels are one solution for community-based fora where representations and overlap between democratic principles and effective science communication, while avoiding the 'Phantom Public' temptation (Lippman, 1993/1927), that is, constructing a homogenous public that does not exist, while at the same time paying attention only to scientific literacy. We must, of course, be careful. Foreign models have been applied to an Irish situation many times in the past, not always unsuccessfully. We cannot push engagement, and we must see if Irish people really connect with the narrative of Ireland as a world class scientific island. And we have still way to go. Despite the dialogue planned for the City of Science Nobody was asked to be critical of science, at its most fundamental. Paradoxically, the abstract was dealt with through film, art and theatre, the epistemological questions were addressed, but not the everyday practice.

The collapse of the Irish economy within the continuing European financial, and political, crisis has prompted many to cry out for a new republic , where power structures are called to account or, if

necessary, built anew. The banking and wider economic systems are included in this but as previously described, the governance of science is just such a power structure. Our current Government insists that there are plans for citizens' assemblies. I would argue such a new imagining of a republic would place more emphasis on a democratic, responsible governance of science. What would 'responsible governance' mean? It would mean knowledge equity and social sustainability are framed equally within economic rationale and the technological development of a process or product. The dialogic element for a public emerging technology, in the case of nanotechnology, is a concentrated effort to employ various methodologies that allow publics to have a conversation with those who control the technologies, on an equal footing, not as a means just to 'learn from the experts'. There would be a middle ground of action, pockets of practice, where beliefs are not necessarily the issue – for example, dealing with immediate energy issues, photovoltaics , contributing to local or global problems as actors, with ownership of an issue, removing an immediate threat. In a modest way, even reporting here, in this book chapter, and subsequent policy reports there is some dissemination to stakeholders. These represent small steps to impact on science policy, connecting with the emergence of responsible innovation narrative (ref, Murphy, 2010))

Nanotechnology does promise much. But for Irish society, we are seeing many different futures presented before us, and the future we choose must be more inclusive than has gone before. The lack of real public engagement in science has not been given the same level of attention as in other domains, but for emerging science and technologies and science governance, this inclusivity and flattening of power is just as important.

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