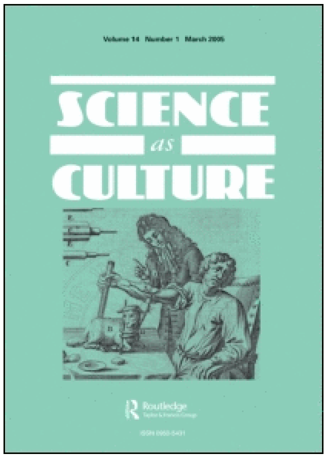

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Introduction: (Re)Imagining Nanotechnology

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Introduction: (Re)Imagining Nanotechnology

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For its proponents nanotechnology offers so much—unlimited and clean energy, targeted pharmaceuticals, intelligent textiles and self-organizing molecular machines. Bottom-up or top-down, the *promises* of nanotechnology are revolutionary and other-worldly. Similarly reports in the popular press have begun to grapple with the complicated implications of a nano-enabled world and inevitable concerns about safety. In public policy, debate centres on how to regulate nano-products and nanoscience research whilst negotiating the complex practices of scientific innovation. These social, cultural, moral, political and economic visions of promise, threat and governance have shaped and are shaping—in uneven and complicated ways—the research trajectories that will determine the eventual form of nanotechnologies. This special issue critically engages with the real-time social and political constitution of nanotechnology and together the papers contribute to an emerging analysis of the 'upstream' shaping of nanotechnology research agendas. The special issue calls for the formation of a reflexive social science of nanotechnology in which critical social science scholarship re-imagines what is at stake—politically, culturally and socially—in the development of nanotechnology.

Why Nanotechnology?

Nanotechnologies represent an imaginative challenge. Indeed, the nanoscale—a billionth of a metre—is near impossible to imagine, or comprehend. In an attempt to communicate what Nordmann (2005) terms the '*incredible* tininess of nano', the UK Royal Society and Royal Academy of Engineers (2004) recently published a graphical illustration which compared the nanoscale with more commonplace scalar dimensions (p. 4). In this graphic, the nanoscale—and the scale of future nanotechnologies between 100 nm and 1 nm—is described as smaller than a common virus and yet bigger than most atoms and simple molecules. One might ask, though, how big is a human virus exactly? Does this comparison assist in comprehending—or even *imagining*—the tininess of the nanoscale?

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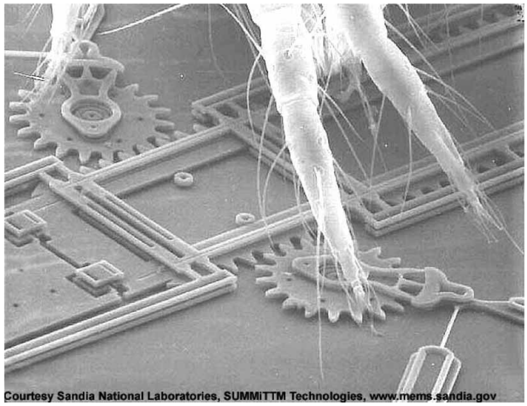

Figure 1. Spider mite with legs on a mirror drive assembly, illustrating the tininess of nanotechnology. *Credit*: Sandia National Laboratories, SUMMiTTM Technologies, http://mems.sandia.gov/scripts/images.asp

In addition to being beyond the limit of direct human perception the nanoscale is also beyond the capacities of most forms of technical and machinic sensitivity. Current visualizations of the nanoscale are something of a misnomer. For example, Scanning Tunnelling Microscopy which has been used to produce 'images' of the nanoscale—and has been heralded as providing the basic technological capacity necessary for nanotechnology—should more properly be termed techniques of 'characterization'. Rather than visualizing the nanoscale, such techniques produce visual representations through direct physical manipulation of material surfaces. In describing the imaginative terrain of nanotechnology, Nordmann (2005) suggests that nanoscale technologies constitute a form of 'noumenal technology' in which:

> The link between representation and control is broken, that is, when we successfully create artefacts and perhaps a technical agency whose presence and action are inscrutable to us and, in effect, indistinguishable from the presence and action of the natural processes that serve as an unconsidered background and framework of our lives (Nordmann, 2005, p. 7).

This special issue addresses the imaginative challenge of nanotechnology from the perspective of its social, political and moral constitution. Nanotechnology is also currently being imagined by powerful actors as a paradigmatic reorganization of research techniques and abilities at the nanoscale with potential for wide-ranging and transformative social, economic and political implications (Roco and Bainbridge, 2002). The papers that comprise this special issue critically engage with this social and political construction by *re*-imagining nanotechnology as social and politically constituted. This special issue addresses the more enduring imaginative challenge posed by nanotechnology—to properly conceptualize its societal and political relations in real-time. This involves understanding the ways in which social, cultural, moral, political and economic visions have shaped and are shaping—in uneven and complicated ways—the research trajectories that will determine the eventual form of nanotechnologies (Guston and Sarewitz, 2002).

In an introduction to a recently published special issue of the journal *Science Communication* (2005), Bruce Lewenstein asks:

> *Why should we begin examining* 'nanotechnology and the public'? One could argue that nanotechnology is simply the latest scientific fad (or 'research area' if you prefer), following on space exploration, the war on cancer, nuclear power, genetic engineering, biotechnology, genetically modified organisms (GMOs), stem cells, and so on, and so on (Lewenstein, 2005, p. 169).

Here the same question applies. Why should a special issue of *Science as Culture* focus specifically on nanotechnology? What is unique about nanotechnology such that it warrants special 'social science' attention? Or, as Lewenstein implies, is nanotechnology of interest precisely because it shares generic social, economic and political dynamics with a range of cognate scientific and technical fields?

This special issue has been assembled out of various attempts to cast light on such questions. All the papers engage with the distinctive dynamics of emerging nanotechnologies, but located in specific contemporary social and cultural contexts. They thus contribute to what may be regarded as an embryonic social science of nanotechnology. However, in contributing towards such an encounter the papers that comprise this issue all subtly reinterpret what such a social science may look like.

A consensus across the papers lies in the examination and interpretation of nanoscience and nanotechnology, not simply as an emerging field of scientific research and experimentation, but as also constituted through the deployment of a range of discursive repertoires of promise and expectation. The uniqueness of nanotechnology in this special issue is not defined by the technical novelty of the field. Rather, the papers engage with the ways in which the technology is socially constituted in real world circumstances—especially the ways in which developments in nanoscience and nanotechnology are embedded in and contribute to societal discourses of expectation, hope and threat (Grove-White *et al.*, 2000).

A Sociology of Promises

Such social promises are reflected spectacularly in the avowedly 'future' oriented focus of much nanotechnology rhetoric. For example, there are numerous commentaries that take the form of speculative lists of possible applications of nanotechnology, ranging from the trivial to the revolutionary. At the more radical end of the spectrum lies the 2002 National Science Foundation report on 'Converging Technologies for Improved Performance'. In this report, Mihail Roco and William Bainbridge, two of the main architects of US nano-policy, suggest a list of almost limitless possibilities enabled by advances at the nanoscale and its convergence with modern biology, the digital revolution and the cognitive sciences.

- The human body will be more durable, healthier, more energetic, easier to repair, and more resistant to many kinds of stress, biological threats, and aging processes.
- National security will be greatly strengthened by lightweight, information-rich war fighting systems, capable uninhabited combat vehicles, adaptable smart materials, invulnerable data networks, superior intelligence-gathering systems, and effective measures against biological, chemical, radiological, and nuclear attacks.

- The vast promise of outer space will finally be realized by means of efficient launch vehicles, robotic construction of extraterrestrial bases, and profitable exploitation of the resources of the Moon, Mars, or near-Earth approaching asteroids.
- Agriculture and the food industry will greatly increase yields and reduce spoilage through networks of cheap, smart sensors that constantly monitor the condition and needs of plants, animals, and farm products.
- Transportation will be safe, cheap, and fast, due to ubiquitous real-time information systems, extremely high-efficiency vehicle designs, and the use of synthetic materials and machines fabricated from the nanoscale for optimum performance (Roco and Bainbridge, 2002, p. 5).

Such lists of possible applications of nanotechnology appear so broad as to construct nanotechnology as a cure for more or less all human ills, and as the sustainer of future growth, prosperity and human happiness. What, therefore, do such accounts demonstrate about the tenor of expectation associated with nanotechnologies? In particular, such narratives are premised on a set of hopes or promises of what future social life should comprise, how the human body should be envisaged, how new transportation systems and infrastructures should be developed, how future warfare should be conducted, and how technological innovation determines particular social outcomes. Such visions demonstrate the social-embeddedness of current nanoscience. Brown *et al.* (2000) define the role of social science inquiry in such 'prospective techno-futures':

> The purpose of this analysis is not the future *per se*, but the 'real time' activities of actors utilising a range of differing resources with which to create 'direction' or convince others of 'what the future will bring'. As such, our purpose is to shift the discussion from *looking into* the future to *looking at* how the future as a temporal abstraction is constructed and managed, by whom and under what conditions (p. 4).

All the papers in this special issue adopt a similar reversal of perspective. Rather than 'looking into' nanotechnology futures, in the manner of futurology or prediction, the papers 'look at' nanotechnology as a set of practices that are embedded within contested discourses about the future. In different ways these papers examine the way that 'the future'—and in an analogous way 'the past'—are mobilized in the development of technology and its governance. As such the various accounts of nanotechnology are seen as deeply and irrevocably social, political and philosophical.

The contested narratives of nanotechnology, structured around an emerging set of visions and discourses, define the field's scientific, social and economic significance. Following Marcus (1995), the paper by Kearnes *et al.* (this issue) defines such visions as 'technoscientific imaginaries'. Similarly Rip (this issue) analyses the 'folk theories' of nanotechnology—the un-tested and tacit assumptions that shape the unfolding development of the field. These imaginaries and folk theories are not simply *imaginary* in a fictional sense but rather define the discursive resources through which the field comes to be defined.

Nano-visions

What, therefore, are the key visions and imaginaries associated with the development of nanotechnology? We now trace the key visions underpinning nanoscience and nanotechnology rhetoric and practice as providing important historical resources for the subsequent discussions. For many, nanoscience and nanotechnology are typically cast as the natural extension of developments within Scanning Tunnelling Microscopy (STM). Invented in 1981 by Gerd Binnig and Heinrich Rohrer at IBM's Zurich Lab, the Scanning Tunnelling Microscope spawned a family of microscopy techniques that enabled the visualization of regions of high electron density and hence the position of individual atoms (Baird and Shew, 2004). STM technology is regarded as one of the direct forebears of nanotechnology because it enables researchers to 'see' atomic patterns and shapes through the direct physical manipulation of atomic surfaces enabling the movement of individual atoms (Baird, 2004; Baird and Shew, 2004; Mody, 2004).

The vision of nanotechnology as both enabled by and an extension of STM has helped shape societal and technological expectations of what is at stake in nanoscience. The timing of the development of the STM in the 1980s was also significant, not long after the coining of the word nanotechnology by Norio Taniguchi in 1974 and coinciding with K. Eric Drexler's well-known account of nanotechnology *Engines of Creation* (1986). Nanoscience also began, in this period, to be organized in large scale national research funding mechanisms premised both on the scientific merit of nanoscience and the potential social and economic impact of future nanotechnologies. In the UK, for example, a National Initiative on Nanotechnology (NION) was launched in 1986 followed by the LINK programme in nanotechnology in 1988 (House of Commons Science and Technology Committee, 2004). However Mody (2004) suggests that the emergence of nanotechnology research from developments in STM was also motivated by an institutional re-organization of the fields of physics and material science in the context of the wide commercialization of basic and university research.

A subtly different set of expectations, also emerging in the late 1970s and 1980s, rooted nanotechnology in developments of micro-electronics and advances in data-storage. Nanotechnology is here positioned as the 'natural' inheritor of the drive toward miniaturization, and as providing the technique to overcome the physical limitations of silicon in maintaining trends towards smaller and smaller electronic circuits and data storage (Roco and Bainbridge, 2002). As such, nanotechnology development is guided by the economic and technological imperative to maintain Moore's law—the prediction that the complexity and hence capacity of the integrated circuit will double every 18 months. Moore's law operates as both a prediction of what *will* happen and a road-map with an in-built imperative within the semi-conductor industry to maintain innovation and technological development. The law works as a way of coordinating both actors and action in the development of new forms of ever denser data storage and smaller circuitry. In this way the vision of 'Moore's Law' is underpinned by a set of practices that has so far served to reinforce the apparent prescience of the prediction. Nanotechnology is now positioned as the new hope for maintaining momentum on this road-map, and therefore for maintaining the inbuilt relations of economic, political and social expectation and dependence that Moore's Law entails (Roco and Bainbridge, 2002).

A further 'imaginary' lies in the definition of nanotechnology as a form of 'control over the structure of matter'. In his now famous speech to the Caltech Institute, Richard Feynman—often referred to as the 'father' of nanotechnology—wondered 'Why cannot we write the entire twenty-four volumes of the Encyclopaedia Britannica on the head of a pin?' (Feynman, 1960). In this he signalled that there was no logical or physical reason barring the technological exploitation of the nanoscale and the direct manipulation of atoms and molecules. The Feynmanian vision has become particularly associated with the work of Eric Drexler—particularly in concepts such as molecular manufacture and universal assemblers, which require the direct and precise control and manipulation of nanoscale particles. Though Drexler's radical vision for 'molecular machinery' has been thoroughly criticized and critiqued (see, for example, Smalley, 2001, 2003a, 2003b), the definition of nanotechnology as control over the structure of matter has emerged as a programmatic vision that maps many of the goals of nanoscience (Kearnes, 2006).

The rhetorical force of the vision of nanotechnology as a form of control over the structure of matter is clear. For example, the title of an early brochure of the National Science and Technology Council (NSTC) Committee on Technology and The Interagency Working Group on Nanoscience, Engineering and Technology (IWGN) was *Nanotechnology: Shaping the World Atom by Atom* (1999). Similarly, in the testimony on the societal implications of nanotechnology to the Committee on Science of the US House of Representatives, the futurist Ray Kurzweil stated:

> The golden age of nanotechnology is, therefore, a couple of decades away. This era will bring us the ability to essentially convert software, i.e. information, directly into physical products. We will be able to produce virtually any product for pennies per pound. Computers will have greater computational capacity than the human brain, and we will be completing the reverse engineering of the human brain to reveal the software design of human intelligence. We are already placing devices with narrow intelligence in our bodies for diagnostic and therapeutic purposes. With the advent of nanotechnology, we will be able to keep our bodies and brains in a healthy, optimal state indefinitely (Kurzweil, 2003, p. 3).

This vision is deeply social in its imagination. The ability to operate at the nanoscale—atom-by-atom—symbolizes an expression or ambition of power. It represents the material world subordinated to human will with unprecedented degrees of precision and control. More pragmatically, the suggestion is that *once* such control over the structure of matter is achieved *then* the radical possibilities of nanotechnology will be realized (Nordmann, 2004).

Similarly, the social and economic impact of nanotechnology is imagined in revolutionary terms. The potential impact of nanotechnology is typically predicted to be huge. A report by the US National Science and Technology Council and Interagency Working Group on Nanoscience, Engineering and Technology in 2000, entitled *National Nanotechnology Initiative: Leading to the Next Industrial Revolution*, stated that:

> The emerging fields of nanoscience and nanoengineering—the ability to precisely move matter—are leading to unprecedented understanding and control over the fundamental building blocks of all physical things. These developments are likely to change the way almost everything—from vaccines to computers to automobile tyres to objects not yet imagined—is designed and made (NSTC and IWGN, 2000, p. 11).

In this we see the confluence of visions of control and precision with the technological imperative to perpetuate innovation. It is predicted that nanotechnology will change 'almost everything' with the implicit warning of the danger of not capitalizing on this revolutionary capability. Current estimates of the potential value of future nanotechnology industries range anywhere from the billions to the trillions (Department of Trade and Industry, 2002, p. 24). Similarly there are a number of web-based initiatives and conferences all aimed at securing first-mover advantage in the predicted nano-markets.[1] The message is clear: the impact of small technology will be big.

Even in the relatively more conservative language of the UK Department of Trade and Industry's Taylor report (2002) the sheer promise of nanotechnology is palpable. In its opening paragraphs, the report states:

> Few industries will escape the influence of nanotechnology. Faster computers, advanced pharmaceuticals, controlled drug delivery, biocompatible materials, nerve and tissue repair, surface coatings, better skin care and protection, catalysts, sensors, telecommunications, magnetic materials and devices—these are just some areas where nanotechnology will have a major impact (Department of Trade and Industry, 2002, p. 6).

A Vision for the Social Sciences?

Significantly, in addition to such expectations of radical social transformation lies an equivalent set of promises for the social sciences. Both social science and public debate are seen as actors that have a important role to play in helping ensure the development of a 'socially robust form' of nanoscience, a development that appears to have become increasingly mainstream from 2002 onwards (see Te Kulve, this issue). There have been repeated calls for the incorporation of social science scholarship into the development of nanotechnology research programmes. For example, the US National Science and Technology Council report, *The National Nanotechnology Initiative*: *Leading to the Next Industrial Revolution* (2000) includes explicit reference to the role that the social sciences might play in the development of nanotechnology:

> Ethical, Legal, Societal Implications and Workforce Education and Training efforts will be undertaken to promote a new generation of skilled workers in the multidisciplinary perspectives necessary for rapid progress in nanotechnology. The impact nanotechnology has on society from legal, ethical, social, economic, and workforce preparation perspectives will be studied. The research will help us identify potential problems and teach us how to intervene efficiently in the future on measures that may need to be taken (NSTC and IWGN, 2000, p. 13).

The establishment of the National Nanotechnology Initiative (NNI) in the US was succeeded by the *21st Century Nanotechnology Research and Development Act*, passed by Congress in 2003 (see Bennett and Sarewitz, this issue). This Act also included calls for the establishment of 'a research program to identify ethical, legal, environmental, and other appropriate societal concerns related to nanotechnology'.

Analogous European strategy documents have called for the incorporation of social science insight and improved science communication into the development of both nanoscience and nanotechnology. For example, the official communication by the European Commission on nanotechnology: *Towards a European Strategy for Nanotechnology* (2004) recognized the need to incorporate social science scholarship, stating:

> Without a serious communication effort, nanotechnology innovations could face an unjust negative public reception. An effective two-way dialogue is indispensable, whereby the general public's views are taken into account and may be seen to influence decisions concerning R&D policy. The public trust and acceptance of nanotechnology will be crucial for its long-term development and allow us to profit from its potential benefits. It is evident that the scientific community will have to improve its communication skills (p. 19).

This call was also thoroughly debated in subsequent public consultations on the European strategy for nanotechnology. Reporting on the outcome, Malsch and Oud (2004) state:

> One participant stressed, however, that a more deliberative process of public dialogue and engagement is better since 'the Communication seems to suggest that wider public concern may be simply managed by the more effective communication of nanotechnology'. In this context, two participants highlight the importance of learning the lessons from the experience with genetic modification. On the subject of realising the potential benefits of nanotechnology, one respondent highlighted that 'in the absence of mechanisms to distinguish between "good developments" and "bad developments" with reference to societal objectives fosters the impression that so long as nanotech develops its commercial potential then it is all good news' (p. 78).

Similarly, in the UK a report by the Royal Society and Royal Academy of Engineering entitled *Nanoscience and Nanotechnologies: Opportunities and Uncertainties* (2004) called for 'upstream' public dialogue in setting the agenda for nanotechnology, stating, 'our research into public attitudes highlighted questions around the governance of nanotechnologies as an appropriate area for early public dialogue' (p. 67).

In all these calls nanotechnology is being cast as an opportunity to build a new type of 'socially robust science' through the integration of social science analysis and public dialogue into the development of the technology itself (Macnaghten *et al*., 2005). Nanotechnology is here presented as an opportunity to avoid some of the mistakes of the past and by building insights from the social sciences and public consultation and engagement programmes into the development of different nanotechnologies. This discourse draws on wider notions of the social robustness of (Mode 2) science, as developed by (amongst others) Nowotny *et al*. (2003) and the institutionalized programmes of ELSI assessment (see Bennett and Sarewitz, this issue).

Informing such calls for the incorporation of social science scholarship and public dialogue into the development of nanotechnology are a number of often contested and contradictory expectations of the role of social science. Variously, social science is conceived as:

1. a form of social learning through which it will be possible to avoid the 'mistakes of the past', through its ability to anticipate and hence help avoid future public controversy;
2. a way of 'picking winners' through helping to shape innovation processes that go with the grain of wider public and consumer attitudes and sensitivities;

3. a conduit for enhancing public communication and dissemination of (nano)science and technology through outreach activities;
4. a mechanism for eliciting public forms of knowledge that are relevant to identifying, assessing and managing risks; and
5. a source of expertise for interpreting and reporting (thus, representing) public concerns and questions, which have not been recognized by policy experts.

However, notwithstanding differences in orientation and approach, the variegated field of nanotechnologies now represents an opportunity to innovate more reflexive relationships between the social sciences, the physical sciences and policy (for an extended commentary, see Kearnes *et al.*, this issue). We now give brief outlines of each of the papers of this special issue regarding the putative role for the social sciences.

The Papers

Typically, calls for social science engagement have tended to rely on an ontological distinction between a particular technology and social science analysis of that technology. It is assumed that once a technology is developed then social science methods may be employed to assist in managing its introduction into society and to measure its impact. For example, a report on the NSF sponsored workshop on the 'Societal Implications of Nanoscience and Nanotechnology' indicated what is expected of such insights, stating: 'research on societal implications will boost the NNI's success and help us to take advantage of the new technology sooner, better and with greater confidence' (Roco and Bainbridge, 2002, p. 2). It is imagined that social science research will identify areas of social concern and of felt need, thus enabling governance actors to ensure that the development of nanotechnology is a publicly acceptable development and therefore avoid future technological controversies.

The papers in this special issue share a critical engagement with the way that social science research is currently being positioned and together contribute to an analysis of the 'upstream' dynamics shaping such research agendas (Macnaghten *et al.*, 2005). Bennett and Sarewitz (this issue) analyse the evolution and framing of research initiatives in the US on the societal implications of nanotechnology from 2001 onwards. They suggest that such initiatives were designed and conceived of in ways that were directly informed by earlier research programmes on the ethical, legal and social implications (ELSI) of the Human Genome Project, and which were largely independent from at least three decades of research on the interactions of science, technology and society. Bennett and Sarewitz's narrative account of the germination of US nanotechnology policy, particularly the institutionalization of 'social implications' research in the development of the *21st Century Nanotechnology Research and Development Act*, is an account of what scholars have dubbed the increasing 'ELSI-fication' of the field (see Leydesdorff and Etzkowitz, 2003; Guston, 2004; Rip, 2005; Williams, this issue). Williams identifies a number of concerns arising from the ways in which the institutionalization of ELSI research is tending to create 'a narrowed scope of enquiry and a linear model of innovation pathways and outcomes'. The papers by both Bennett and Sarewitz, as well as Williams, suggest that dominant institutional approaches are in danger of narrowing the field of social science inquiry. This has the effect of limiting the potential for greater reflexivity within the scientific community to address the ways in which innovation processes could gain added sensitivity to a diverse array of societal needs and sensitivities.

In their analysis of the ways in which current political, institutional and regulatory considerations of nanotechnology are set in the context of the divisive controversies of agricultural biotechnology, Kearnes *et al.* highlight the significance of 'technoscientific imaginaries'. Drawing on interview data with individuals responsible for the regulation and governance of GMO plants and crops prior to 1999, the paper points to the ways in which GM crops were justified in terms of positive projective visions, often explicitly utopian, that formed the basis upon which research priorities came to be negotiated and planned. The paper argues that these tacit visions were never openly acknowledged or subjected to public dialogue, and *if* nanotechnology is to learn the lessons from the GMO experience, it is necessary to explore ways of opening up science's hidden presumptions to authentic and inclusive public debate.

Similarly Rip (this issue) examines what he terms 'folk theories about nanotechnology', defined as the commonly held and often taken-for-granted narratives that key actors deploy in making sense of the societal dynamics of emerging nanotechnologies. He analyses how scientists and technologists have developed a set of folk theories about what nanoscience is, how it should be positioned, how public concerns materialize, the lessons to be learnt from the GM controversy, and so on. Rip's argument is that while these folk theories lack systematic empirical support, they nevertheless drive expectation and promise in both policy deliberations and in innovation R&D. Understanding the ways in which folk theories are mobilized by what Rip terms as the 'enactors' of nanotechnology is seen as a key resource for social science in the quest for greater overall reflexivity in the co-evolution of nanoscience and society.

Te Kulve analyses the 'evolving repertories' or representations used in the reporting of nanotechnology in Dutch newspapers. He examines three distinct periods of reporting: 1992–99, in which nanotechnology was widely represented as a 'rising star'; 2000–02, in which deliberations on the social and ethical implications of nanotechnology began to emerge; and 2003–05 when Dutch newspaper coverage of nanotechnology become increasingly polarized between optimistic visions of promise and dystopic projections of risk and threat. Te Kulve concludes his analysis of the reporting of nanotechnology in Dutch newspapers by assessing the ways in which the evolution in such newspaper coverage constitutes a form of informal technology assessment. This analysis adds further weight to the proposition made by both Rip and Kearnes *et al.* (this issue) that visions and projections of nanotechnology are rarely explicitly acknowledged or systematically analysed. Rather, they constitute an informal mechanism or, in Rip's terminology, a folk theory.

The importance of an open and transparent analysis of such sociotechnical imaginaries, projections and cultural repertoires is doubly significant if we consider Frodeman's (this issue) contention that nanotechnology potentially challenges deeply held notions of humanness and naturalness. In a concluding coda to this special issue he addresses the philosophical and ethical dynamics of nanotechnology—particularly the implications of what he calls the new 'material invisibility' at the nanoscale. Frodeman enlarges the scope of reflection by suggesting that 'ethics, values, and the largest philosophic concerns must become part of our conversation from the very conception of new technologies'. The danger, for Frodeman, is that without such an enlarged conversation about the implications, purposes and values of new technologies 'we ensure the continued irrelevance of critical reflection on technoscientific culture'.

To conclude, this special issue aims to contribute towards an enlarged conversation on precisely the kind of 'technoscientific culture' that Frodeman imagines. Inasmuch as the 'incredible tininess' of the nanoscale represents an imaginative challenge, we aim to develop insights on what a reflexive social science of nanotechnology might look like in the pursuit of a critical social science scholarship that helps re-imagine what is at stake—politically, culturally and socially—in the incredibleness of nanotechnology.

Note

[1]For recent examples, see http://www.nanobusiness.org/, http://www.nanotechnology.com/, http://www.nanoeurope.org/, and http://www.nano-tsunami.com.

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