

# Compiling the Ethical, Legal and Social Implications of Nanotechnology

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## Abstract

This paper maintains that although there is much interest at the moment in exploring the Ethical, Legal and Social Implications (ELSI) of nanotechnology, the ability to do so in a critical and reflective way, in part, depends on how nanotechnology's future is envisioned. It is argued that, at present, this vision is articulated through the *novum*, a narrative device borrowed from the science fiction (SF) genre. The paper concludes by arguing that the widely shared narratives about nanotechnology's future, structured by the *novum*, not only limit the types of ELSI questions that can be addressed but also lead to a polarized debate. It is also suggested that the device of the *novum* also obscures the heterogeneous nature of nanotechnology itself.

## Introduction

At present social scientists, amongst others, are being asked to help "compile" the ethical, legal and social implications (ELSI) of developments in nanotechnology. This task is more difficult than might appear because, in part, the nanotechnology program is emerging in a discursive space that limits the types of questions that can be posed. This space draws on narrative forms from the science fiction (SF) genre to visualize nanotechnology's future.

To invoke the presence of SF elements is not to deny impressive developments in the field of nanotechnology. However, as commentators have noted the nanotechnology era is both present and absent. Inasmuch as there have been

important developments in the ability to work at the nanoscale with precision, the nanotech era is present; but inasmuch as significant technical advances are still required to open up the nanotech "frontier", it is not<sup>1</sup> This creates the necessity of projecting nanotechnology into a future. In what follows, I shall describe how narrative devices from SF are used for this purpose and discuss the consequences this has for analyses of ELSI.

## Nanotechnology and Science Fiction

Nanotechnology as a research and industrial program is leveraged by exorbitant promissory notes regarding the creation of wealth and productivity. Hype is not uncommon in science and technology discourse.<sup>2</sup> However, a significant number of nanotechnology advocates not only extrapolate highly beneficial outcomes from existing and predicted technologies, they also use the technologies to imagine radically different futures.<sup>3</sup>

For instance, Eric Drexler, in his book *Engines of Creation*, envisions a future where nanomachines or assemblers will make possible molecular manufacturing processes that fuel both engines of abundance and health.<sup>4</sup> Along the way to the "positive-sum society" intelligent machines shall be produced, societies will develop expert systems to manage their development, and aging will become just another treatable disease. These assemblers have yet to be produced but Drexler's writing narrates their coming as unavoidable.



If one leaves aside the technical argument regarding the viability of molecular assemblers<sup>5</sup>, there are a number of narrative elements in his book that make nanomachines both credible and inevitable. He begins by arguing that throughout history it has been the arrangement of atoms, which has distinguished the cheap from the cherished and the diseased from the healthy. He goes on to write: “Our ability to arrange atoms lies at the foundation of technology. We have come far in our atom arranging, from chipping flint for arrowheads to machining aluminium for spaceships”.<sup>6</sup> In a similar vein, he writes: “The ill, the old and the injured all suffer from mis-arranged patterns of atoms, whether mis-arranged by invading viruses, passing time or swerving cars. Devices able to rearrange atoms will be able to set them right”.<sup>7</sup>

What Drexler’s text achieves, unwittingly or not, is a narrative that re-ontologizes the past, present and future. If it is the case that making and doing things has always really been about re-arranging atoms, no matter how crudely, then the development of technology and human culture can be told as a teleological narrative where “bulk technology” is the starting point and “molecular technology” the goal. If being and suffering in the world has ultimately been about configurations of atoms, then we have always already depended on nanomachines. Indeed, for Drexler, a decisive plank in his argument for the viability of nanomachines is that they already exist in the form of the ribosomes that assemble proteins in our cells. Thus the future is already present.

The narrative process whereby a single element (e.g. molecular assembly) is used as the axis around which a future alternative world is spun is a key discursive element of SF. Though there are significant scholarly disputes about what constitutes SF as a genre,<sup>8</sup> there is some consensus on the centrality of the device of the *novum*:

A *novum* is a deliberately introduced change made to the world as experienced by author and reader, but a change based on scientific or other logic; it is such a significant part of SF that the *novum* frequently determines the subsequent narrative.<sup>9</sup>

The *novum* is a variation of the “what if...” question which assembles a fictive world by drawing out the potential ramifications of the interruption to reality contained in the question. The assembled world, then, derives its coherence not from the logic or validity of the *novum* itself, but from the way all its’ dimensions have been processed by the machinery of the *novum*. This is precisely the narrative structure used to project nanotechnology into the future in Drexler’s text.

The relationship between science and SF has been much debated and cannot be dealt with here. Suffice it to say that some futurists see SF as a useful tool for foresight.<sup>10</sup> Be that as it may, I want to argue that narratives about the future of nanotechnology, structured by the SF convention of the *novum*, significantly narrow the exploration of ELSI.

Before doing so, however, I think it is important to establish that Drexler’s narrative is not an anomaly. For instance, as Milburn has argued, in more

detail than is possible here, although some members of the nanotechnology community have attempted to differentiate their own vision of the future from Drexler’s by mobilizing the science fiction/fact distinction, they have had to draw on a SF narrative in order to do so. Moreover, Milburn also traces key ideas from Richard Feynman’s talk, “There’s Plenty of Room at the Bottom”, which is invoked by the nanotechnology community as a source of scientific authority for the nanotechnology program, to the Robert Heinlein SF novella *Waldo*.<sup>11</sup>

That it would be wrong to locate the re-ontologization of the past, present and future through the science fictional device of the *novum* at the periphery of the nanotechnology community is demonstrated by the recent text edited by Mihail C. Roco and William Sims Bainbridge. It collects papers from a conference sponsored by the National Science Foundation (NSF) and the Department of Commerce.<sup>12</sup> Roco and Bainbridge both work for the NSF and have been key players in the public championing of the US National Nanotechnology Initiative.

In their book the *novum* is not molecular assembly but how the nanoscale makes possible the convergence of three tech-

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nologies (nano, bio and information technology) and cognitive science (NBIC). The re-ontologization that the NBIC *novum* makes possible allows the editors and contributors to make claims that not only parallel those of Drexler and other nanotech radicals, but in other respects go far beyond them. The recruitment of cognitive science into the nano-ranks, through a projected mapping of the “Human Cognome”, makes the social as malleable as the material world. It then becomes possible to envision nothing less than “Changing the societal ‘fabric’ towards a new structure”.<sup>13</sup> All of “Being” (social and material) is re-ontologized as an engineering problem for which NBIC will be able to optimize a solution; thus, the narrative structure that weaves through the book locates the NBIC convergence as the necessary transformative mechanism towards which all of the past has flowed and through which the future will be defined. NBIC convergence represents a further increment to human performance on a continuum whose origin is the emergence of the cell, body and brain, running through tool making and the industrial revolution and leading to NBIC based societal and business reorganization, and perhaps even “evolution transcending human cell, body, and brain[.]”<sup>14</sup>

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## The Novum and ELSI

The fundamental shortcoming associated with deploying the *novum* as a device for framing ELSI discussions of nanotechnology is that the speculative future generated in the process is held too tightly in place by the discursive glue of the *novum*. This is because all the components of the imagined world are refracted through the geometry of the *novum* (e.g. molecular assemblers, convergence of NBIC); everything in the projected future can be traced back to the *novum*, which is its seed. As a result the fictional social world already contains beneficent social implications with only minor ethical complications. However the credibility of the beneficent social implications and the lack of serious ethical questions are secured by the narrative structure of the *novum* and not through critical analysis of social outcomes or serious ethical or normative discussion.

The social implications are knowable and the negative ethical dimensions negligible because given the way that the narrative re-ontologizes the past, present and future (e.g. technology has always been about manipulating atoms and molecular assemblers already exist or NBIC makes possible the increases in productivity and human performance that have always been the motive force of human evolution) no other future is desirable or even conceivable. In this context what would be unethical, or what would qualify as a negative social outcome, would be the failure to proceed forward.

Accordingly, the role for the social sciences would then be to analyze and manage the social processes necessary to arrive at the proposed future. Social scientists would study public opinion and overcome public resistance through the effective communication of nano-benefits and promises: i.e. by including the public in the political economy of desire and hope generated by the *novum*. Social scientists would also aid nano-development by analyzing the mechanisms and procedures that would make nano-innovation effective.<sup>15</sup> In all these contexts, social scientists are not invited to test the

assumptions that underpin the social futures or critically evaluate their outcomes.

Moreover, the totalizing utopian vision produced through the device of the *novum* really only leaves room for similarly constructed counter-visions. The latter follow the logic of the *novum* with as much rigour as the former, they differ only in the maleficence that they attribute to the *novum*.<sup>16</sup> Thus the generation of dystopian futures linked to nanotechnology may have much less to do with lack of adequate knowledge, fear-mongering or technophobia than with the fact that the pro-nanotechnology futures are so tightly woven by the *novum* and impenetrable to critique, so that the only way to criticize them is to introduce a dystopian virus into their core and use their *novum* to assemble a dystopian future.

For social scientists it is difficult to engage in a discursive space where the seed of a future full of abundance and promise is so tightly tied to the unfolding of a technology or a



putative family of technologies. As Bruno Latour has suggested, technologies “[f]ar from primarily fulfilling a purpose...start by exploring heterogeneous universes that nothing, up to that point, could have foreseen and behind which trail new functions.”<sup>17</sup> The range of tools, techniques, algorithms, machines, procedures, materials and processes which are included under the rubric of nanotechnology are unlikely to develop in unison and will more likely than not produce varied social, legal and ethical implications. Would it make sense to group all of our macro-technologies in the same way? Perhaps the most important question that social scientists can tackle in the context of nanotechnology, at present, is the ethical, legal and social implications of a configuration of science and technology which needs to claim such clairvoyance and promise so much in order to function.

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- 1 Colin Milburn, “Nanotechnology in the Age of Posthuman Engineering: Science Fiction as Science” (2002) 10 *Configurations* 261 at 272.
- 2 See e.g. Helga Nowotny, Peter Scott & Michael Gibbons, *Re-thinking Science* (Cambridge: Polity, 2001); Nik Brown, “Hope – Against Hype – Accountability in Biopasts, Presents and Futures” (2003) 16:2 *Science Studies* 3; Bryn Williams-Jones & Oonagh P. Corrigan, “Rhetoric and Hype: Where’s the Ethics in Pharmacogenomics?” (2003) 3:6 *American Journal of Pharmacogenomics* 375.
- 3 For a recent review, see Stephen Wood, Richard Jones & Alison Geldart, *The Social and Economic Challenges of Nanotechnology*, online: UK Economic and Social Research Council <<http://www.esrc.ac.uk/esrccontent/DownloadDocs/Nanotechnology.pdf>>.
- 4 K. Eric Drexler, *Engines of Creation* (New York: Anchor Books, 1987).
- 5 For a critique from within the nanotechnology community see Richard E. Smalley, “Of Chemistry, Love and Nanobots” *Scientific American* 285:3 (September 2001) 76.
- 6 Drexler, *supra* note 4 at 3.
- 7 *Ibid.* at 99.
- 8 See e.g. Edward James, *Science Fiction in the 20<sup>th</sup> Century* (Oxford: Oxford University Press, 1994).
- 9 *Ibid.* at 108.
- 10 Dominic Idier, “Science Fiction and Technology Scenarios: Comparing Asimov’s Robots and

Gibson’s *Cyberspace*” (2000) 22 *Technology in Society* 255.

- 11 Milburn, *supra* note 1 at 284.
- 12 Mihail C. Roco & Williams Sims Bainbridge, eds., *Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science* (Dordrecht/Boston/London: Kluwer Academic Publishers, 2003), online: World Technology Evaluation Center <[http://wtec.org/ConvergingTechnologies/Report/NBIC\\_report.pdf](http://wtec.org/ConvergingTechnologies/Report/NBIC_report.pdf)>.
- 13 *Ibid.* at vii.
- 14 *Ibid.* at 23.
- 15 See e.g. *ibid.*; Mihail C. Roco & William Sims Bainbridge, eds., *Societal Implications of Nanoscience and Nanotechnology*, online: World Technology Evaluation Centre <<http://www.wtec.org/loyola/nano/societalimpact/nanosi.pdf>>.
- 16 See e.g. Bill Joy, “Why the future doesn’t need us”, online: *Wired* <<http://www.wired.com/wired/archive/8.04/joy.html>>.
- 17 Bruno Latour, “Morality and Technology: The Ends of the Means” (2002) 19:5/6 *Theory Culture & Society* 247 at 250.

