## Chapter 5

# The Slippery Nature of Nano-Enthusiasm

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This chapter identifies and analyses competing and contradictory claims made by supporters of nanotechnology. Enthusiasts for nanotechnology make one set of claims when they want to advertise and promote this technology and another, often directly opposed, set of claims when sceptics about the technology question their enthusiasm. Working out which of the very different claims made about nanotechnology are true is essential if democratic societies are to be able to make informed decisions about it.[1]

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*Nano Meets Macro - Social Perspectives on Nanoscale Sciences and Technologies*
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## 1. Introduction

As a philosopher who writes about the ethics of new technologies, I am often invited to conferences on nanotechnology. At these events, I have usually found myself placed in the position of a critic of nanotechnology, despite the fact that I have no particular concerns about nanotechnology that are not reflections of more general reservations about the pace and direction of technological "progress" (Sparrow 2009). However, what I *have* become concerned about is the way in which public discussion of nanotechnology is being framed. Enthusiasts for nanotechnology make one set of claims when they want to advertise and promote this technology and another, often directly opposed, set of claims when sceptics about the technology question their enthusiasm. As a consequence, the terms of the debate about nanotechnology shift so as to hamper substantial critical engagement about the future of this technology.

It may be that nanotechnology raises no distinctive, ethical, political, or environmental issues. However, it is hard to tell when the debate is plagued by constant equivocation between very different claims by those in favour of nanotechnology. What follows, then, is an examination of the slippery nature of nano-enthusiasm. My hope is that drawing attention to the different and diametrically opposed claims often made about nanotechnology may help those who want to think critically about nanotechnology—and the social decisions we face about it—do so in a clear and sober fashion.

## 2. Nanotechnology or No Technology?

When researchers and industry spokespeople wish to advertise their products and/or lobby the government for funding, they wax lyrical about the wonders of nanotechnology. Scarcely a week goes by that we do not hear something reported about the promise of nanotechnology. Nanotechnology will make possible marvelous new consumer goods that



will improve our lives (Drexler *et al.* 1993; Roco & Bainbridge 2001). Nanotechnology will heal the sick and allow us all to live longer (Roco & Bainbridge 2002). Nanotechnology will be worth so many billions of dollars over the next decade (De Franscesco 2003; Roco 2005; Roco *et al.* 1999).

However, the moment criticism of nanotechnology develops researchers and industry spokespeople often beat a hasty retreat to the position that there is no such thing as nanotechnology: there are only nanotechnolog*ies*—diverse technologies and techniques for manipulating matter at the nanoscale, which have been developed in the fields of chemistry, physics, engineering, and materials science. Any concerns about "nanotechnology" are therefore misplaced.

I would have more sympathy with this demand for terminological precision if it weren't usually made in conference streams on the ethical, legal, and social impacts of nanotechnology, at conferences with nanotechnology in the title, and/or by people who have "nanotechnology" on their business cards. It wasn't, after all, critics of nanotechnology who invented the term, which was coined by a scientist and taken up by other scientists in order to attract attention to their work (Interagency Working Group on Nanoscience, Engineering and Technology 2000; Stix 2001; Taniguchi 1974). Moreover, the effect of shifting the topic of discussion to the question of terminology is usually to divert attention from the original criticism into a tedious and remarkably fruitless debate about the appropriate way of referring to nanotechnology (or nanotechnologies!), which is then repeated at the next forum on nanotechnology.

Regardless of how we choose to refer to them, those technologies that engineer matter at the nanoscale do potentially raise new hazards as well as hold out new promise. The role played by surface chemistry and

quantum effects at the nanoscale means that the products of these technologies can have properties that are not possessed by the same materials manufactured at larger scales. The importance of size at the nanoscale arguably justifies grouping these technologies together for the purpose of further developing and investigating the technologies necessary to manipulate matter at this scale. However, it also justifies grouping them together for more critical purposes.

### 3. Revolutionary or Familiar?

Perhaps the most common claim made in public discussion of nanotechnology is that it represents a "technological revolution". Nanotechnology will, we are told, change the world (Atkinson 2003; Berne 2004; Berube 2006; Interagency Working Group on Nanoscience, Engineering and Technology 2000; Smalley 1999; Roco & Bainbridge 2001). It will make consumer electronics cheap and widely available. It will eliminate pollution and repair damage to the environment. It will even allow "the blind to see and the deaf to hear" (Bond 2007). Indeed, if the writings of some nano-enthusiasts are to be believed, there is little that nanotechnology will not do (Crandall 1997; Drexler *et al.* 1993; McCarthy 2003). Describing nanotechnology as revolutionary draws attention to the novelty and/or power of the technology and consequently assists in attracting funding.

The problem with this rhetoric of revolution is that it also draws attention to the magnitude of the changes nanotechnology promises and to the fact that there are likely to be winners and losers from any such revolution. The rhetoric of revolution also draws attention to the questions of power and democracy involved in technology policy. If there is to be a revolution, it should be a democratic one. Indeed, given that revolutions are dangerous and unsettling, perhaps we don't want a revolution at all (Sparrow 2008)!

When questions about the distribution of benefits of this purported revolution or about who will control it arise, then, enthusiasts for nanotechnology retreat to the contrary claim that nanotechnology is nothing new, that it is in fact entirely familiar (Atkinson 2003; Mody



2006; Royal Society and Royal Academy of Engineering 2004; Schummer 2006). Nanotechnology is merely the latest stage of a continuing process of miniaturisation of technology. Indeed, it is already present in various consumer goods such as paints, sunscreens, and some consumer electronics. Because the technology is familiar, we have nothing to fear from it. We might equally wonder what all the fuss is about and whether the promise of "more of the same" justifies the enormous amount of public money currently being spent on nanotechnology research.

Cynics might note at this point that it is when researchers and corporations want to patent their products that they argue that their products are new and unique. However, when it comes to discussing their possible effects on human health and environment all of a sudden they are moved to argue that these nano-products are nothing new.

The question of whether nanotechnology is revolutionary or familiar is perhaps most important when it comes to evaluating the possible environmental and health impacts of nanoparticles, as the use of engineered nanoparticles for their catalytic or other properties in manufacturing is the nanotechnology which is closest to fruition. In discussions about this topic, it is often pointed out that we are all already regularly exposed to nanoparticles in the form of the exhaust products from diesel combustion engines, soot from forest fires, and salt in sea air (Albrecht *et al.* 2006; Roco 2003; Royal Society and Royal Academy of Engineering 2004; Swiss Re 2004). Exposure to nanoparticles is nothing new and—by implication—nothing to fear. What this observation neglects (besides, bizarrely, the fact that some of these particles are known to be responsible for thousands of deaths each year in modern cities) is that the nanoparticles that have been produced by human activity to this point have been accidental products with large distributions of particle size and shape. Engineered nanoparticles will have been designed to have specific properties by virtue of having particular structures and size distributions. They are therefore likely to behave very differently. It would be extremely foolish indeed to base our assessment of the risks involved in exposure to engineered nanoparticles on our experience with naturally occurring and/or existing anthropogenic nanoparticles (Balbus *et al.* 2005).

## 4. Inevitable or Precarious?

According to many pundits, the nanotechnological revolution is not only going to change the world, it is going to do so regardless of what you or I think about it. Many writers on nanotechnology seem to feel that technological development has its own dynamic which is effectively beyond human control (Mody 2006). As a result, the development of nanotechnology is, we are told, inevitable. The future is coming and we had better get ready for it (Atkinson 2003; Bond 2007; Drexler 1986; Mulhall 2002).

Yet this certainty that the development of nanotechnology is inevitable seems to be matched by hysteria at the possibility that public hostility to this technology, lack of investment, or a hostile regulatory environment, might prevent it (Bond 2007). Indeed, it sometimes seems that the main function of the claim that the development of nanotechnology is inevitable is to support the argument that we must get ready for it. Unless we direct more money into funding this technology, change our intellectual property law, and educate the public about the benefits of nanotechnology, the nanotechnology revolution will not arrive. Of particular note in this context is the frequency with which consumer hostility to Genetically Modified Organisms (GMOs) is mentioned in discussions of nanotechnology as an example of the way in which public concerns about safety and benefit can remove the incentive to develop certain types of product and thus effectively halt the development of a technology (Balbus *et al.* 2005; Court *et al.* 2004; David & Thompson 2008; Hood 2004; Moore 2002; Nature Biotechnology 2003; Royal Society and Royal Academy of Engineering 2004). Those involved with developing and promoting nanotechnology are terribly concerned to avoid any similar public backlash against nanotechnology. Of course, the possibility that the public might reject nanotechnology suggests that the nanotechnological revolution is not inevitable after all.



## 5. "Nothing to be Afraid of" or "Cause for Alarm"?

The next contradiction I wish to draw attention to does not appear in public discussions of nanotechnology so much as between the rhetoric and the reality of the regulatory authorities that are likely to be responsible for protecting consumers and the environment from any hazards associated with nanotechnology.

One of the 'big questions' in current discussions of nanotechnology is whether the public is adequately protected from possible hazards associated with exposure to nanotechnology (Albrecht *et al.* 2006; Balbus *et al.* 2005; Friends of the Earth 2006; Hood 2004; Nordman & Holman 2005; Sellers *et al.* 2009; Swiss Re 2004). In order to establish the need for extensions to existing regulations, critics and concerned regulators emphasise our current lack of knowledge about the toxicity or safety of matter engineered at the nanoscale and the gaps in our existing regulatory schemas which mean that materials that are "new" only in relation to their size may not be subject to any special scrutiny (Balbus *et al.* 2005; Royal Society and Royal Academy of Engineering 2004). These studies make a convincing case that the public is currently not adequately protected from possible hazards due to nanoparticles. At the very least, our existing regulatory systems need to be strengthened and modified to ensure that nanoscale particles and materials are evaluated for possible health risks and environmental impacts before being released into the environment (Balbus *et al.* 2005; Royal Society and Royal Academy of Engineering 2004). The fact that the properties of nanomaterials—and of engineered nanoparticles in particular—are so sensitive to their size, shape, and molecular structure suggests that this may be more difficult than first appears (Donaldson *et al.* 2004).

However, these discussions of the need for the extension of existing regulatory systems are striking not just because of what they conclude about the unknown risks involved in nanotechnology but because of what they reveal about our regulators' attitudes towards environmental risks more generally. Having learned that the toxicology of nanoparticles is largely unknown (Albrecht *et al.* 2006; Colvin 2003; Hood 2004), that their movement through environmental systems is poorly understood and extremely difficult to model (Mackay & Henry 2009), that some

nanoparticles seem to be able to pass through the skin while others seem to move directly to the brain (Balbus *et al.* 2005), and finally, that cosmetics containing engineered nanoparticles are already on the market (Hood 2004), I naively expect to read expressions of outrage that the public is being exposed to these potentially toxic materials. It seems simple common sense to me that until it can be established that these materials pose no significant threat to human health or to the environment, products containing engineered nanoparticles should not be released on to the market. Instead, it is abundantly clear that many toxicologists, industry figures, and regulators feel that there is nothing untoward in the public being exposed to such risks (Brumfiel 2003; ETC Group 2003). Those involved in regulating chemicals and other possible hazards are well aware that we are all regularly exposed to a myriad of chemicals for which the level of associated risk has never been established; as a result the situation concerning nanotechnology does not —in their minds, at least—cry out for attention.

Existing regulatory systems for environmental protection and health and safety regulation of chemicals turn out to be remarkably unimpressive from the perspective of a concerned citizen. To a large extent, these regulatory systems rely on manufacturers self-regulating and providing data on the chemicals they manufacture and/or import to the relevant regulator. Regulatory agencies are often over-worked, under-staffed, under-funded, and have limited power to investigate and/or punish breaches of the law. It is striking how conservative governments who describe themselves as 'tough on crime' leave corporate individuals to regulate themselves! Hearing that nanotechnology will be regulated in line with existing frameworks therefore does not fill me with confidence.

## 6. Ethical Issues...What Ethical Issues?

Studies of the ethical, legal, and social issues raised by nanotechnology often conclude by suggesting that nanotechnology "raises many ethical issues" (Roco 2003; Lewenstein 2006). This follows naturally from



treating nanotechnology as a revolutionary new technology. It also reflects the tendency in the literature to discuss nanotechnology as though it were a successor to the biotechnology and information revolutions, which clearly have raised many new ethical issues.

My own assessment is that it is in fact difficult to identify any genuinely *new* ethical issues raised by those nanotechnologies that are likely to be developed in the short-to-medium-term future. The most urgent ethical issues associated with nanotechnology concern the relationship between democracy and technology, respect for the environment, risk, privacy, social justice, and the possibility of arms races (Sparrow 2009). All of these issues are already familiar to us as a consequence of existing technologies.

Indeed, the shifting nature of the claims made in the debate about nanotechnology is itself strongly reminiscent of similar phenomena in the debates about the biotechnology and information 'revolutions' (David & Thompson 2008). The history of discussion of these 'revolutions' is also characterised by equivocation about the extent to which they were coherent phenomena, were genuinely new or extensions of what had gone before, and/or were a matter of social choice or historical inevitability. Even the claims made about the implications of this new technology turn out to be old (Edgerton 2006).

However, my concern here is not with the accuracy of the claim that nanotechnology raises new ethical issues but with the apparent ease with which it sits beside the assumption that we should embrace nanotechnology (Whitman 2007). If those developing nanotechnology really believe that it raises so many ethical issues, one would think that this would at least lead them to adopt attitudes of humility and caution regarding this technology. Yet these attitudes are noticeably absent from most discussions of nanotechnology.

Moreover, the idea that the development of nanotechnology is inevitable sometimes produces a shocking and flagrant disregard for the

possibility that certain applications of nanotechnology might be unethical. If the development of the technology is inevitable, any negative impacts are equally unavoidable. The only question left is who will profit from this state of affairs; the clear implication is that every nation should work to ensure that it gets its share of the spoils. This argument, of course, also works for the production of opium, selling arms to terrorists, and building weapons of mass destruction. The fact that others are doing, or are likely to do, something wrong, is not itself a compelling reason for us to join them.

In the absence of an acknowledgement of a real possibility that we might choose not to develop nanotechnologies, it is easy to suspect that these gestures towards 'ethical issues' are intended mainly as an advertisement that industry and government are appropriately concerned. A genuine concern for ethical issues would, though, result in less haste in pursuing the profits associated with developing a nanotechnology industry and more reflection and debate on how (and whether!) to proceed.

## 7. Conclusion

A proper critical assessment of the impacts, costs, and benefits of the adoption of nanotechnology will not be possible until we can clear away some of the hype around it and adjudicate between the competing claims made on its behalf. If there are only different nanotechnologies, if they are already familiar to us, if we have a choice as to whether to develop them, and if they are adequately regulated by existing institutions or something like them, then there may well be nothing to be afraid of and no significant ethical issues that we need to resolve. If, alternatively, nanotechnology is a revolutionary new technology, the development of which appears to be inevitable, and which raises profound challenges to our regulatory systems as well as new ethical issues, then we would do well to proceed cautiously, if at all. Working out which of the very different claims made about nanotechnology are true is therefore essential if we're to be able to make informed decisions about it. It may turn out that each and every claim made about nanotechnology is true of



some particular nanotechnology in some particular context—although even this observation presumes the validity of an argument about "nanotechnology vs nanotechnologies"!

However, the real problem arising from the existence of the contradictory claims I have highlighted is not so much that it is hard to work out which of them is true but that the combination of them functions to close down the space in which critical engagement with them might take place. Changing stories allows nano-enthusiasts to avoid having to discuss the full implications of their original claims. When advocates for nanotechnology want to drum up interest in it, or funding for it, they talk about nanotechnology and argue that it is revolutionary; when they want to defuse fears, they insist there are only nanotechnologies which are already familiar. When they want the public to accept nanotechnology, they argue it is inevitable; when they want the government to provide more funding, change the laws, or educate the public to be more enthusiastic about it, then they argue it is precarious (Sparrow 2007). They allow that nanotechnology requires regulation but ignore the problems with the institutions that will be doing the regulating. While they routinely acknowledge the importance of ethical issues, they seldom acknowledge the possibility that these might constitute a reason to turn away from developing nanotechnology. This pattern of claims reflects an attempt by advocates for nanotechnology to have the best of both worlds across these areas. It also functions to continually defer sustained ethical discussion of any of them.

As billions of dollars of public money are poured into nanotechnology research and as the products of nanotechnologies start to be introduced to unwitting consumers and to the environment, we can ill afford to defer discussion of the issues raised by nanotechnology any longer. It is time to hold all those involved in debates about nanotechnology to the claims they make and to highlight and challenge equivocations of the sorts I have identified here. If enthusiasts for nanotechnology try to change their stories when critics respond to their original claims, we should recognize this as a sign that they are more concerned about getting the public to embrace nanotechnology than they are about participating in a genuine debate about it. Yet a genuine, open and vigorous debate is precisely what is required if we want to continue

to claim to be a democratic society while pursuing a technology with potentially widespread and profound social and environmental consequences.

**Questions for Reflection:**

1. Does nanotechnology create any genuinely 'new' ethical issues?
2. What is actually required for something to be 'revolutionary'? Do you think nanotechnology has what it takes?
3. Is it problematic that nano-enthusiasts change their stories in al the ways outlined above? To what extent do you think this phenomenon is restricted to enthusiasts?

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