

Nanobiotechnology and Ethics: Converging Civil Society Discourses

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Abstract Nanobiotechnology as a “converged” technological platform (CT = Converging Technologies) is discussed in relation to discourse within civil society. The conflicts and ethical debates surrounding nanobiotechnology can be intuited from these larger discursive frames of reference. Complimenting Glimell and Fogelberg’s (2003) research documenting an emergent epistemic culture amongst scientists researching and working on nanotechnologies, and more recent research on the multiple meanings of nanotechnology in the political economy (Wullweber, 2007), this paper traces an emergent ethnography of engaged actors within civil society as they develop discursive and mobilization repertoires. Whilst on occasion ambivalent about the combination of specific promises and risks in relation to nanobiotechnology, in general a broad critique of the politics of technology is emerging as a counter epistemology or “Master Frame” (Snow & Benford, 1992) amongst certain predisposed UK civil society groups. Converging Technologies provide the issue around which this broad critique is solidifying. Thus whilst many of the specific risks raised by nanobiotechnology (and other CT) are definitively new, many of the potential risks and grievances, have been raised before in relation to other issues of scientific and environmental controversy, often by the same actor groups. Thus convergence is a useful metaphor for appreciating that broader frame of reference from within which the emerging conflicts and ethical debates about nanobiotechnology are being situated.

If you go ten, fifteen years in the future, you're not going to be able to distinguish between what's nano technology, what's bio technology, what's information technology or what's genetic engineering. They're all going to be the same kind of technologies . . . just employed in different ways and different places. (“Mike”, technology watchdog campaigner, in interview January 2004)

Keywords Nanotechnology, biotechnology, converging technologies, civil society, risk discourse, social movements

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Introduction

Nanobiotechnology is the convergence of existing and new biotechnology with the ability to manipulate matter at or near the molecular level.¹ This ability to manipulate matter on a scale of 100 nanometers (nm) or less is what constitutes the nanotechnology revolution occurring today, the potentially vast economic and social implications of which are yet to be fully understood (Royal Society, 2004). The most immediate way to understand the implications of nanobiotechnology for ethics is to consider the real life concerns of communities that are mobilizing within civil society. The conflicts and ethical debates surrounding nanotechnology will, almost by definition, emerge on the fault lines between different civil society actors, researchers and financial interests associated with nanobiotechnology, as well as (potentially) government regulators. These fault lines are all reflected within the concerns (as expressed discursively) of the communities mobilizing. This chapter will explore converging discourses regarding converging technologies.

Converging Technologies (CT) are already a familiar theme in the next generation of biotechnology, nanotechnology, pharmacogenomics and proteomics research and development. Nanobiotechnology² means that previously separate disciplines (IT, physics, chemistry, and biology) are merging and converging to create new applications and even new life forms through converged technological platforms. Schummer (2004), and Glimell and Fogelberg (2003, p. 43), note the predominance of interdisciplinarity as a core theme of nano-discourse. This technological and domain convergence is now so familiar a concept as to be given acronyms like GRAIN (Genetics, Robotics, Artificial Intelligence and Nanotech) and NBIC (Nano, Bio, Info, Cogno).³ Convergence and its implications are becoming standard regulatory and policy concepts and strategies, especially within the EU⁴ (Nordmann, 2004). For example:

The rapidly mounting level of interdisciplinary activity in nanostructuring is truly exciting. The intersections between the various disciplines are where much of the novel activity resides, and this activity is growing in importance. (WTEC Panel, 1998, p. 5)

Current social science in this emergent arena has mostly focused on analysing core discourses of those involved in producing the science, such as Glimell and Fogelberg's (2003) report on scientific framings of nanotech, which seeks to define an "epistemic

¹This definition is consistent with more general definitions of nanotechnologies (Royal Society, 2004, p. 5).

²Nanobiotechnology is used in this chapter as the prime example of CT; however it should be noted that the actors identified in case study work tend to talk about CT and nanotechnology more broadly, rather than specifically focussing on nanobiotechnology.

³"We talk about BANG and that's Bits Atoms Neurons Genes..." ("Mike", technology watchdog campaigner in interview January 2004).

⁴See also "Converging Technologies for a Diverse Europe" report of the "Foresighting the new technology wave" expert group (2004); dissemination conference programme available at http://216.239.59.104/search?q=cache:THyA8mWIwAQJ:europa.eu.int/comm/research/conferences/2004/ntw/pdf/programme_en.pdf++DG+EU+converging+technologies+of+the+knowledge+society&hl=en

culture of technology” (Glimell & Fogelberg, 2003, p. 82) amongst scientific producers. More recently, a discourse analysis of nanotechnology within market and governance settings notes the broad meaning of the word nanotechnology makes it a useful label to particular “interests and strategies aiming at the reconstruction of industrialised states” (Wullweber, 2007). Nanotechnology is not a particular technology, but rather, it is an industrial strategy.⁵ Nanotechnology is associated with the consolidation of the competition state within the knowledge economy (Wullweber, 2007). We can generalize from these studies to the more particular case of nanobiotechnology. However, to appreciate the conflicts and ethical debates emerging around nanobiotechnology, the types of conversations happening within civil society also need to be examined.

This chapter seeks to compliment previous research by identifying emergent patterns of engagement with CT by specific network clusters of (UK) civil society actors. Based on case study work, this chapter focuses primarily on networks comprised of genetic technology watchdogs, environmental and anti-globalization activists (including, as discussed below, New Luddites and New Chartists), feminists, and Disability Rights campaigners. Although the networks considered here are predominantly UK-based, there are important globalized trends; activists are networking across Europe and beyond. To use Glimell and Fogelberg’s term, these actors are also developing an epistemic culture, in that they tend to be *predominantly* critical, and raise a variety of concerns about the implications of nanobiotechnology and other converged technologies. It might be possible to identify an emergent master frame (Snow & Benford, 1992) of the politics of technology. This master frame incorporates a broad range of issues—other frames—such as commodification, control and identity. These frames have as yet only been broadly traced through the more visible engagement of NGOs such as ETC group and GeneWatch with the policy process (Wood et al., 2004; Grove-White et al., 2000). Presumably these discourses are still in a relative state of latency and emergence (Melucci, 1996) amongst these predisposed actors (Evans et al., 2007; Welsh et al., 2007).

Whilst some potential risks relating to nanobiotechnology are of course completely new, such as a specific type of health or environmental risk, many broad themes are familiar territory. Tellingly, in relation to CT/nanobiotechnology, many of these same critical or oppositional frames are being raised by the same networks of actor groups, and social movements who previously mobilized over precursive single issues such as nuclear power and agricultural GM (Welsh, 2000; Nelkin, 1995; Purdue, 2000; Plows, 2004b; Welsh et al., 2007). Thus convergence is not only an important techno-scientific reality; it is also a useful metaphor for appreciating the ways in which core critical frames articulated by civil society have been raised before in relation to other issues of scientific controversy, and often by the same actor networks – this is what Nelkin (1995) terms discursive linkage (see also Bauer, 1995). Nanobiotechnology, as a key example of converging technology

⁵This point was originally made to us in a conversation with Jim Thomas, ETC campaigner.

(CT), is thus a site in which, for example, established (academic, activist) discourses on public engagement with science (Irwin & Michael, 2003; Wynne, 1996; CorporateWatch, 2005a; Fischer, 2000) and likewise established discourses on the impact of market forces upon science (Glasner & Rothman, 2004; CorporateWatch, 2005b, 2007) are once again becoming linked.

Thus, triggered by new technological developments, converging civil society discourses are producing an emergent⁶ master frame (Snow & Benford, 1992) or epistemic culture (Glimell & Fogelberg, 2003). A critical perspective on the politics of technology is developing which incorporates questions about the relationship between science and society, i.e. in what type of society do we want to live, and by what norms and values should it be driven? This broader framing of specific single issues (for example, the development and potential use of nanobiotechnology) was a core feature of much qualitative data collated in the UK between 2003 and 2006.

Bigger questions around technology [are] playing on the sidelines, as they have in the nuclear energy debate, in the toxic chemicals debate...whereas talking about converging technologies... if you can find a way of opening that up then you are talking about the politics of technology. ... ("Mike", technology watchdog campaigner in interview January 2004)

In 2003, an international event of prime movers expressing a range of concerns over medical bioscience asked the question:

*How much do we focus on the technologies themselves, and how much on the social justice and global equity values that motivate our concerns?*⁷

A very significant issue thus raised by this emergent master frame, is whether it is socio-political relations more generally, or the specific (environmental, health, social, ethical) risks/implications of these new technologies, which should be the core grievance frame, and whether it is possible, or indeed even useful, to separate out the two, given that such multiple framings arising from a single issue are the norm in these milieu (see Table 2). This issue is also a case of chicken and egg, as campaigners argue that the technology both (re)produces, and is itself a product of, existing social inequalities and power structures. This conceptual problem has policy implications in terms of the ways public engagement around issues of medical bioscience (generally, as well as nanobiotech specifically) is sought and framed (Welsh et al., 2007).

This chapter will: (a) provide a scientific overview of nanobiotechnology, placing it within the context of Converging Technologies (CT); (b) provide a short ethnographic overview of emergent oppositional and critical UK civil society networks and groups; and (c) demonstrate core converging discourses amongst these

⁶Emergent in the context of engagement with nanobio. To reiterate, a core point in this paper is that such "bigger picture" debates have been expressed in many other settings over decades of environmental and related social movement activity (Plows, 2003, 2004b; Nelkin, 1995; Welsh, 2000).

⁷http://www.genetics-and-society.org/analysis/opposing/2003_berlin_report.html

networks. The conflicts and ethical debates surrounding nanobiotechnology can be seen emerging from these discourses.

Section 1: Scientific Overview: Nanobiotechnology as a Converging Technology

The convergence of different disciplines through nanobiotechnology opens up an uncharted territory of actual, unrealised, and in some cases possibly unrealisable applications and inventions. Utopian and dystopian futures are projected by various actors (Nordmann, 2004; Glimell & Fogelberg, 2003; Wood et al., 2004).⁸ Nanotechnology itself involves changing the nature of elements by breaking them down to the atomic level, where the atomic particles of, for example, gold or steel, possess different qualities and attributes (ETC, 2003; Royal Society, 2004; Corporate Watch, 2005a, b, 2007). This intrinsic change at the atomic level is what invokes both benefit frames in terms of potential applications, and risk frames relating to health and environmental impacts, such as potential toxicity, and the unquantifiable impacts of such potential applications in the “lab without walls” (Szerszynski, 2005).⁹ Research and Development has focused on how to grow these new nano-materials, through the converged technological platforms of IT, nanotech and molecular biology, where the replicatory function of DNA is being harnessed; this is one important aspect of nanobiotechnology.

Nanobiotechnology involves the integration of biological materials with synthetic materials to build new molecular structures or products.... (ETC, 2004)

The use of different disciplines together to create new functions, new elements, new life forms, and the sense in which atomic level manipulation of biological elements can be interpreted from different disciplinary perspectives, is triggering the inter-disciplinarity discourse referred to by Glimmel and Fogelberg (2003) and by Wood et al. (2004).¹⁰

...Biology is the nanotechnology that works. (Tom Knight, Senior research scientist, MIT’s Computer Science and Artificial Intelligence Laboratory¹¹)

“Cut and paste” somatic gene therapy has been referred to as first generation nanotechnology; with claims that faulty genes could now be made to work by altering

⁸The potential futures for these rapidly emerging technologies are difficult enough for those with science and technology backgrounds to understand and predict, and it is certainly beyond the author to do more than identify core principles.

⁹And the “social risks” posed by the development of specific applications.

¹⁰*Cells themselves are very complex and efficient nano-machines, and chemists and biochemists have been working at the nanoscale for some time without using the nano label....* (Wood et al., 2004, p. 21).

¹¹Quoted in ETC (2004) “Green Goo and Red Herrings”.

the molecules which make up the specific proteins, or using computer modelling to design new protein molecules which are then introduced into the patient's body. Efforts to create such self-replicating building blocks out of individual nano atoms are now focusing on harnessing the reproducing mechanisms in DNA:

A nanotechnological dream machine is one that can replicate. (Nadrian C. Seeman¹²)

These have a myriad of potential applications, such as the creation of nano tools and organisms – nanobots – or of new nano particles, for example for drug delivery (Wood et al., 2004; Glimell & Fogelberg, 2003; Roco & Bainbridge, 2002; ETC, 2003). The potential to create nano-organisms specifically designed to clean up environmental problems, such as oil spills, is a frequently cited example. Nano particles are also being used to split open DNA, acting as markers for DNA sequences, further accelerating the rapid advance of mapping genes and proteins and the genomes of entire species. Converging Technology (CT) nano applications are thus either *aiding* biotechnology applications through better genomic/proteomic mapping techniques, or *becoming* biotechnology applications themselves.¹³ The new field of synthetic biology is working to artificially produce organisms from mappings of their genetic code.¹⁴

Section 2: Ethnographic Overview¹⁵

The following is a short overview of “prime movers” (McAdam, 1986) and “early risers” (Tarrow, 1998) amongst a specific civil society network cluster, who are expressing the convergent oppositional frames outlined in the introduction and detailed in the final section of this chapter. These actor networks, whilst resisting simplistic definitions, could be generally characterised as environmental, social justice, feminist and anti globalization movement actors. Disability Rights actors have also been traced and project work has sought out points of crossover amongst these different networks. Actors comprise both NGOs such as ETC¹⁶ who tend to

¹² Cited in <http://www.etcgroup.org/documents/comBANG2003.pdf>

¹³ *To take the step from “fabrication” to “manufacturing” is by no means something that will come easily. This is one important point at which “bio-nano” is expected to make a difference. Nanobiology holds, on the one hand the promise of providing new and more refined tools for the advancement of biotechnology, whereas on the other hand the “biogenic” strategies may be an effective way to produce nanostructures en mass....* (Glimell & Fogelberg, 2003, p. 89)

¹⁴ The primary research in this new field comes from the J. Craig Venter Institute (<http://www.jcvi.org/research/>) Some of the response from Civil Society organisations is presented at <http://wolbring.wordpress.com/category/synthetic-biology/> See also http://www.etcgroup.org/en/materials/publications.html?pub_id=631

¹⁵ This chapter has been written from findings of ESRC funded research; Cesagen flagship project “The Emerging Politics of Human Genetic Technologies”. <http://www.cesagen.lancs.ac.uk/research/projects/newgentechs.htm>

¹⁶ <http://www.etcgroup.org/>

primarily engage with the policy and regulatory sphere,¹⁷ and more radical, direct-action focused groups who generally do not. Critical frames in relation to nano CT are being identified by the UK radical environmental campaign and action networks who previously mobilized over agricultural GM; emerging from loose, biodegradable (Wall, 1999) activist networks like Earth First! and the Genetic Engineering Network.¹⁸ These networks have links to established NGOs such as GeneWatch, but are generally autonomous, decentralised dis-organisations who tend to deliberately stay outside of the policy processes emphasizing direct action (protest, civil disobedience) as their primary, or often only, tactical repertoire.

Whilst labels tend often to obscure, rather than clearly define, the discourses and identity of these fluid, shifting, radical networks (Seel & Plows, 2000; Plows, 2003), amongst them it is possible to identify New Luddites, including anarcho-primitivists who are anti-technology almost *per se*, and New Chartists who are primarily concerned with enclosures and ownership issues (patenting) in relation to CT. All groups/networks have strong ties¹⁹ links to environmental and anti-globalisation networks, and identify multiple forms of risk accruing to CT, whilst often specialising in particular frames/issues. Further, important ideological differences between NGO and more activist groups definitely exist, though it is vital to stress that all groups engaging with CT are explicitly articulating bigger picture frames incorporated by the politics of technology, as well as specific risk and grievance issues.

As the social movement literature would predict (Diani, 1992, 1995; Doherty et al., 2003), activists with pre-existing social bonds developed through previous cycles of contention, and new actors brought into these networks, are developing strategies to oppose the development and commercialisation of nanotechnology and CT. Whilst the NGOs tend to have a more formal and static identity, the more radical networks tend to develop multiple, micro identities and campaign brand names. These reflect the more informal, often biodegradable processes of social network interaction (Diani, 1995) which spawn specific direct action events. For example, on December 9 2004, THRONG (The Heavenly Righteous Opposed to Nanotech

¹⁷ For example, ETC was invited to take part in public engagement which led in part to the findings of the Royal Society (2004) publication; ESSF has sought, since its inception, to find allies within the EU to discuss core issues of political economy and “market- led science”, for example at the EU “Science and Society” conference in Berlin in March 2005, where the ESSF petition was launched.

¹⁸ See Plows (2003, 2004b) for an overview of the eco movement in the UK. Current and previous work by the project team (Welsh, 2000; Welsh & Chesters, 2004, 2005; Doherty et al., 2003) has emphasised how in the UK “radical environmental movement”, different currents of seemingly disparate “single issue” movements in fact emerge from a broad-based, occasionally latent, movement of “biodegradable networks” which have developed capacity through diffusing discursive and mobilization repertoires across “weak and strong ties” networks (Granovetter, 1973; Diani, 1992, 1995), over several decades of activist generations and cycles of contention (Tarrow, 1998; Doherty et al., 2003; Whittier, 1995).¹⁸

¹⁹ The term “strong ties” means direct connections. Compare Granovetter, “The Strength of Weak Ties” (1973).

Greed) disrupted the “Nanotechnology-delivering business advantage” conference in Buckinghamshire, presenting a can of worms award to one of the conference participants, Harry Swan, formerly of Monsanto. The symbolic (Melucci, 1996) and playful nature of much UK direct action (Wall, 1999; Szerszynski, 2002) is evident; the THRONG activists dressed as angels to disrupt the conference, stating:

*Where these nano fools rush in we angels fear to tread*²⁰

The identification of specific corporations’ operations as a clear target for criticism and action, and the use of such action as a means of framing broader concerns about risk and uncertainty, echoes previous campaigns against GM crops which were focused on the operations of specific companies such as Bayer and Monsanto, with clear critical reference to globalization processes.²¹ Such actions are likely to seed further mobilizations within the UK. Similar actions are taking place in other countries. A less symbolic direct action took place in Grenoble, France, where the site of the proposed Minatech nanotechnology research centre was occupied by activists on December 12, 2004.²² Again this action is the visible peak of a more latent/nascent activist opposition, and there are network links between French and UK activists.

Risks and Benefits: Complexity and Ambivalence

A key finding of the “Emerging Politics of Human Genetic Technologies” project (from which this data is drawn) is that the engagement of different publics cannot be polarised into broad pro- and anti-positions on technologies, such as biotechnology, human genetics (Plows, 2004a; Evans et al., 2007). Having said that, in some contexts, clear battle lines are emerging. The social and political contexts in which the new technologies are being developed and introduced have catalysed many critical actors into taking an oppositional position. These critical actors are more likely to articulate, and mobilize over, risk frames, thus opposing nanobiotechnology and other CT (Table 1). At the same time possible benefits of the new technologies are also being highlighted by some of these critical civil society actors, such as better drug delivery or better solar power technology. For some actors (New Luddites), the threats of perceived risks mean that the technology is taboo per se; many actors also (re)emphasise an established critique of technological fixes for what are perceived as being socially created problems (such as oil spills). Other actors are much more ambivalent, acknowledging possible future promise medical

²⁰ From THRONG press release – quote by THRONG “angel” Sarah Phimms.

²¹ Links, both network and discursive, between “single issue” campaigns and the broader “anti globalisation movement” are thus in evidence. For a full discussion on the network links between activist groups, see Plows (2004b).

²² <http://www.indymedia.org.uk/en/2004/12/302727.html>

Table 1 Examples of UK critical actors predisposed to mobilise, or mobilising, over CT²³

Type of actor network/group	NGOs (policy, public engagement)	Social movements and SMOs (informal networks using radical forms of engagement e.g. protest)
<i>Environmental actors</i>	Greenpeace Friends of the Earth ²⁴	UK Earth First! Genetic Engineering Network
<i>Disability rights campaigners</i>	Disability Awareness in Action	Direct Action Network
<i>Technology and bioscience watchdogs</i>	Genewatch ETC group EcoNexus Institute of Science In Society	e-lists such as Techne
<i>Social justice, feminist, human rights, anti-globalisation, anti-corporate actors</i>	The Corner House Liberty Corporate Watch	Loose, informal, fluid and biodegradable networks, campaigns and protest identities emergent from broader activist networks such as Dissent (see also environmental actors above) – including New Luddites and New Chartists, THRONG, FemACT

applications such as better treatments for disease. Many activists, tellingly, admit to being confused about nanotechnology²⁵. The extent to which groups or individuals are completely opposed to CT per se, and the extent to which they are merely opposed to the technologies as they are likely to manifest under the current socio-economic paradigm (which primarily produces, they argue, the prioritisation of cures for the Western rich, and the medicalisation of syndromes for the worried well), is a complex point. This type of complexity and ambivalence is not easily summarised; risks and benefits are seen as tied together by many actor groups (Royal Society, 2004; Wood et al., 2004; Plows, 2004a; Evans et al., 2007). Thus many critical actors will cautiously also frame hopes and promise claims, and often refute the charge of being anti-science, as the quotation below highlights:

²³ It must be stressed that this is not a definitive table but rather presents some key examples. Further, these are by far from being the only critical groups and networks mobilising in this arena. The groups/networks in this table are representative of a particular “cluster” of actors.

²⁴ Only very recently have traditional large scale environmental organisations become concerned about CT. This new activity is evidence of emergent movement mobilization. See for example press release “Broad International Coalition Issues Urgent Call For Strong Oversight of Nanotechnology” July 31, 2007 (http://www.icta.org/press/release.cfm?news_id=26).

²⁵ Opinions expressed during activist workshop on nano and CT, Oxford, 2005. In part, this confusion is evidence of the mismatch between careful definitions of a specific technology (which would have been expected by communities previously engaged in GM crop politics) and the broad meaning of the word “nanotechnology” within market and governance settings as a label for a particular industrial strategy associated at the corporate level with acquiring competitive advantage and at the governance level with refashioning the “competition state”. As such the confusion is evidence for Wullweber’s thesis that “nanotechnology” is an “empty signifier” that serves “interests and strategies aimed at the reconstruction of industrialized states” (2007).

To cut short on all sorts of silly accusations that are frequently made to criticisms of technological development...let us state clearly that we are neither obscurantists nor «against science».

(From French anti nanotech action December 04 press release;
English version, emphasis in original)²⁶

Section 3: Convergent Discourses on Converging Technologies – The Politics of Technology

As well as emphasising completely new (health, environmental) risks or (much less often) promises associated with CT, the actors in this case study frame their concerns within a broader challenge to the epistemological and value claims of more traditional technology narratives, for example the preconception that technology equals progress and that there is only one correct direction of technical development. The critique also draws attention to the implications of an economic mandate driving the pace and nature of development (Mayer, 2002; Wood et al., 2004; Birch, 2006), and the perceived lack of citizen input into this process. Thus opposition to nanobiotechnology is currently being framed by prime movers in UK activist networks within the broader framework of the politics of technology. As discussed at the start of the paper, this developing epistemic culture (Glimell & Fogelberg, 2003) with its explicit master frame (Snow & Benford, 1992) is a significant theme in civil society engagement with CT, and demonstrates discursive convergence. Nanobiotechnology and other CT become spaces in which pre-existing discourses and critiques, across a broad range of issue frames, are further explicated and developed. As a key interviewee noted,

what we need to get to is ... the politics of new technologies ... that people can engage with, so that we're not dealing with nuclear power and then dealing with genetic engineering and then dealing with...those mutually just separate local little areas... [but] to have a real live politics of how new technologies impact on society, how society has some control over that.

(“Mike”, technology watchdog campaigner in interview January 2004)

Many other actors, explicitly rejecting claims of a value-neutral, objective science, also identify emergent technologies as political, noting that

*technology is political. Social forces shape technology...technology... becomes a social force that in return shapes society...The desires and interests (or ignorances) of those who control the design process are what shape technology.*²⁷

The above quotes are examples of critiques which have been developed over time, by many different social movements and social networks, in multiple arenas – converging in the new arena of nano-related CT. This master frame or epistemic

²⁶ <http://www.indymedia.org.uk/en/2004/12/302727.html>

²⁷ From “Technology, Politics and Democracy”: Green Action briefing for the European Peoples Global Action 2004 conference, held in Slovenia.

culture is, in the context of nanobiotechnology, concerned with broad themes about the relationship between science and society, political economy, and cultural value systems. Power, social control,²⁸ ownership, commodification, the impact of market mechanisms on the science and society relationship, the lack of public engagement in the agenda-setting process are all familiar themes in many previous scientific controversies (Wynne, 1996, 2006). Under these conditions, CT as a *fait accompli* is a core grievance (see for example Mayer, 2002; Corporate Watch, 2005a, 2007).²⁹ This final section uses preliminary analysis of ethnographic data to provide some examples of these core converged frames articulated by the critical and oppositional actors. While the examples are not definitive, they nevertheless serve to highlight the depth and breadth (Welsh et al., 2007) of convergent discourses of opposition, some of which are summarised in Table 2 below.

Such frames are highly complex, interlinked in many ways, and require more elaboration than this chapter, which aims simply to provide an overview of an emergent ethnographic field, can provide. Some of these key converged discourse frames are discussed in more detail in the following sub-sections.

Table 2 Converging discourses: emerging epistemic culture/master frame³⁰

The politics of technology is a broad discourse, comprising multiple, cross-cutting frames and issues, some of which are included in the following list:

Critical perspectives on Market-led science, economic globalisation pushed forward by a Neoliberal agenda

Discourses on ownership, control, surveillance, enclosure (patents, biocolonialism, intellectual property regimes), commodification of knowledge

Concerns over environmental and health risks which are specifically identified; also indefinite risks and the threat of uncertainty more generally

Risk and concern discourses in relation to human nature, culture, identity, and values. Specific issues cited include therapy/enhancement, cures, eugenics, bio subjectivities, Disability

Rights, feminism, and threats to indigenous peoples and their cultures

Critical perspectives on public engagement practises, power dynamics, the defining and privileging of specific forms of knowledge and expertise; as indicated above over the contested meanings of terms (enhancement) and their implicit values

Calls for sustainable development and social justice approaches to health and equity; critiques of medicalisation and biological reductionism

²⁸ Surveillance is another core risk/grievance frame in terms of opposition to nanotech applications (in particular military surveillance inventions such as nano “smart dust” – linking again to eco/health risks) – surveillance/privacy issues have also been a central grievance frame for opposition to DNA biobanks (see for example <http://www.genewatch.org/HumanGen/GeneticResearch.htm>)

²⁹ These are of course also familiar themes in STS and PUS literature – Bauer (1995), Fischer (2000), Wynne (1995, 1996).

³⁰ These frames continuously surface in a variety of ethnographic contexts (interviews, weblogs, workshops, press releases and so forth), are explicitly linked together by actors, and tend to consistently surface in relation to multiple “single issues” such as the development of specific technological applications or technological domains; here, the context is CT.

Market-Led Science

A lot of the body of the risk associated with genetic technology actually comes from the capitalist structure underlying the usage of that technology....

(Interview with "Alice", genetic sequencer, November 2003)

The impact of market mechanisms, a sustained critique of competitiveness and Neoliberalism forms a substantive part of the converged master frame or epistemic culture of activists challenging the politics of technology and articulating opposition to technologies of control. Activists (with strong ties links to anti-globalisation networks) mobilising over nanobiotechnology emphasise the unequal power relations which ensure that market mechanisms drive the pace, nature and applications of change in society. Highly critical of the impacts of such globalized processes, they also highlight the production (or reinforcement) of potentially harmful social and cultural norms that are intrinsic to the demand for specific products and services.

It's to do with the bigger picture which is the framework within which science is working... if the framework which science is working in [is] a neo liberal version of a market economy which is the rich get richer and the poor get poorer, you are going to get the one version of human genetics.

(“James” GM activist and journalist in interview January 2004)

Nanobiotechnology markets are developing rapidly already having first world applications particularly in cosmetics – face and suntan creams (Wood et al., 2004; Corporate Watch, 2007).³¹ Emphasising the inter-connectedness of specific eco/health risks and the bigger picture, many actors feel that market mechanisms are more likely to produce medical risk scenarios than publicly funded science:

The rush to market means that we rush it before we really have a full understanding....

(“Mike”, technology watchdog campaigner in interview January 2004)

Activists who frame these types of critiques have developed the capacity to do so though years of engagement with environmental and social justice issues. It is these types of networks which formed the backbone to the anti-globalization movement. It is significant that opposition to GM crops was explicitly framed in conjunction to critiques of emergent WTO policy and patenting strategies via the TRIP (Trade Related Intellectual Property) agreements (Plows, 2004b; Purdue, 2000). Thus, broader critiques of nanobiotechnology are set in the context of global opposition to the “economic competitiveness” and “biotech competitiveness” (COM, 2001; Salter & Jones, 2002) driving the Research and Development agenda (Birch, 2006) presenting

³¹ *Cosmetics and personal products companies have been extremely active in using nanotechnology to improve their existing products and to develop new ones. The company L’Oreal famously holds more nanotechnology patents than many companies in high technology sectors (though again this is in part a matter of labeling). Cosmetics companies were among the first to get products that were labeled as being nano-enhanced to market. Shampoos and skin creams, containing nanoparticles with the ability to deliver the desired ingredient to where it is needed, for example deeper into the epidermis, are already on the market. (Wood et al., 2004, p. 21)*

society with a *fait accompli* (Mayer, 2002), i.e. the “juggernaut of modernity” (Giddens, 1990; Habermas, 2003; Bauman, 1994). While modernity is not reducible to the associated economic motives, certainly the links between modern technologies and the economic motives that drive development can be drawn. From many activists’ perspectives, the economic imperatives driving the speed and directions of research mean that any resulting regulation or mitigation (governance) is simply “shutting the barn door” after the horses have already bolted.³² Hence the market-led science frames are intrinsically connected to the public engagement process and calls from activists for a broader debate on the politics of technology. In this context, anti-nanotech activists were disappointed by the Royal Society’s (2004) rejection of a moratorium on nano-products, and it would appear that the “realpolitik” of economic competitiveness as the primary driver in EU policy is not likely to be seriously challenged by policy makers, as the Royal Society report makes clear:

Nanoscience and nanotechnologies are evolving rapidly and the pressures of international competition will ensure that this will continue.

(Royal Society (July 2004) “Nanoscience and nanotechnologies: opportunities and uncertainties”; Summary and Recommendations, p. 7)

In direct response to this perceived lack of appropriate governance in the face of identified risks, the NGO Corporate Watch in its 2007 publication on nanotechnology calls for a moratorium on industrial nanotechnology, together with several other key UK NGOs.

Intellectual Property

Linked closely in with the above anti-globalization discourse, is opposition to patenting – key words here are the enclosure, ownership, commodification and privatisation of nature, life and the human. These are core frames raised in relation to patents on genes and plant, human or animal DNA sequences. These previous stances inform the immediate opposition to nanobiotechnology and the patenting of nano particles/organisms. Privatising nature, the commodification and ownership of life, and the risks associated with the uncertainty of molecular manipulation were the core grievance frames articulated by the THRONG during the angels against nanotech action. The enclosures metaphor used for over a decade by UK GM activists in the context of patenting is reflexively converging centuries-old grievances about elites owning the commons, linking past and future together. The enclosures frame grounds the nanobiotechnology debates about the patenting of genomic, proteomic and atomic information in the history of the Diggers and Chartists’ fights for

³² *Use of nanotechnology has already begun ... by the time we can easily notice its presence (including its environmental and civil society effects) it will be firmly established in the economy, difficult to uproot. By the time we can see it coming it will already be here.* (Green Action briefing, 2004)

common ownership of the land, of shared resources.³³ The abstract information codes (which New Chartists define as a shared resource rather than claimable territory or property) are made more real through this association with land. New Chartists is one way of understanding the perspectives of civil society actors who are framing critiques in relation to corporate enclosures and corporate power.

Risk and Uncertainty – Health and Environment

Civil society articulations of risk and unquantifiability have been core themes in many previous scientific controversies; hence the actor groups discussed throughout are predisposed to identify similar risk potential in relation to nanobiotechnology, most notably through their oppositional engagement with agricultural GM. Whilst the concept of risk is thus a converged frame, the latest nanobiotechnology developments would mean that these are often specifically new risks. Critical and oppositional actors identify that nanobiotechnology poses qualitatively new health and environmental risks of types not seen before. The potential toxicity of nanoparticles raises medical and environmental risks. Significantly, these are not only addressed by oppositional groups but are also raised within the regulatory and scientific sphere. Two examples are the (2004) Royal Society report³⁴ and a recent ESRC report (Wood et al., 2004). Despite their acknowledgement of uncertainty in the domain of risk and the emphasis on the need to uphold the precautionary principle, neither of these reports supported civil society calls for a moratorium on development or for a recall of nanoproducts already on the market³⁵; despite the fact that only a handful of toxicology studies have been funded (ETC, 2003; Corporate Watch, 2007). This lends further weight to Mayers' (2002) warnings that nanotechnology is likely to trigger a public backlash which mirrors that of GM crops. The ecological and health risks accruing to nanobiotechnology specifically are explicitly addressed by what might be the leading NGO in the field, ETC group, who also identify specific risks of what they term "green goo":

Nanobiotech raises many potential concerns: will new life forms, especially those that are designed to function autonomously in the environment, open a Pandora's box of unforeseen and uncontrollable consequences? That's the specter of green goo. (ETC, 2004)³⁶

³³ Some potentially important "strange bedfellows" in the form of assemblages (convergences) of opposition to patenting are emerging (Plows, 2004a), the most interesting of which in terms of sustained critiques of market processes on science perhaps coming from the advocates of IT and molecular biology "open source" within the science community. See for example <http://science.slashdot.org/science/05/01/18/2120255.shtml?tid=191&tid=155>

³⁴ Royal Society report (2004).

³⁵ Anecdotally, campaigners have reported that over 300 products using nanotech are already on the market.

³⁶ ETC Group (2004).

As with crop GM, it is the uncertainty of as yet unimaginable impacts and interactions of nanobiotechnology out in the environment (e.g. clean-up nanobiotechnology organisms) which is the core environmental/health risk frame for actors. Nanobiotechnology also significantly converges ecological risk with medical risk, i.e. a nanobiotechnology organism or supervirus loose in the environment might well have both environmental and human health impacts; and nanobiotechnology also collapses the boundaries between human and non-human, life and non-life, with yet unconsidered massive philosophical implications. Whilst the atomic manipulation of particles and their potential to interact in unquantifiable ways with DNA and cultured GM viruses once loose in the environment *is* new, this is not a completely new risk area, as, for example, genetically engineered superviruses as vectors for “cut and paste” gene therapy have long been identified as potentially encapsulating a mix of eco and medical risk (Mae-Wan Ho, 2003).³⁷ Likewise military research on deliberately created superviruses for germ warfare (Altmann, 2004) is a previous and continuing concern issue. The risk of nanoparticle release and unquantifiable toxicity as discussed above is identified by the Royal Society (2004) nanotechnology report which again emphasises the need for the precautionary principle. The point that nano production processes are already in motion without standardised, legalised, safeguards is not addressed in the Royal Society report, but it is one of the core concerns of leading critical NGOs ETC group and Corporate Watch. Nor are ETC group and other actors’ concerns about “green goo” perceived as legitimate within the few policy documents which currently chart any civil society responses at all (Royal Society, 2004; Wood et al., 2004), this despite uncertainty, risk and the precautionary principle being identified as core policy issues (Wood et al., 2004).

Specific medical risks are also being identified by oppositional actors, such as potential toxicity of nanoparticles in face and sun creams already on the market (Wood et al., 2004; Corporate Watch, 2007). There is some evidence, for example, that nano particles become stored in the liver, and are not flushed out of the body (ETC, 2003). There is a potential for adverse auto-immune responses to nano-scale interventions in the human body, similar to the risks highlighted through the case of Jesse Gelsinger - whose death halted many first generation somatic gene therapy trials when his body had a massive immune rejection response to the GM virus vector transmitting the replacement gene (Bowring, 2003).³⁸ It is the unquantifiability, the uncertainty, of risk in these circumstances which is triggering much of the criticism amongst oppositional actors (Mayer, 2002; ETC, 2003, 2004; CorporateWatch, 2005b).³⁹ In the light of the recent FMD (foot and mouth) outbreak in the UK in

³⁷ *SARS Virus Genetically Engineered?* <http://www.i-sis.org.uk/SVGE.php>

³⁸ It is worth emphasising that caution and risk, and unquantifiability of outcomes, are also often explicitly framed by scientists carrying out these types of research.

³⁹ Adverse reactions to the TGN1412 immunity drug by volunteers in the UK in March 2006 is another example of a similar type of risk and uncertainty controversy. See for example “*Volunteers never think it will happen to them*”, p. 10, *The Daily Telegraph*, March 16, 2006.

late 2007,⁴⁰ one should also consider bio risks in the form of *accidental* release of nanobiotechnology organisms/applications from the lab, as well as their (potential) deliberate release in the future.

Knowledge and Expertise

Contested definitions of knowledge and expertise arose in relation to public engagement with science and technology during previous environmental and other controversies, such as nuclear power, climate change, and GM crops (Bauer, 1995; Wynne, 1996, 2006; Fischer, 2000; Welsh, 2000; Purdue, 2000; Horlick-Jones et al., 2007). These tensions included calls for better public engagement in the context of an epistemological debate on what science is for, the nature of knowledge, and the value systems which inform science. At the core of the debate are disputes about who has discursive legitimacy to discuss, let alone to set the terms of the debate in the first place (Grove-White et al., 2000; Horlick-Jones et al., 2007; Wynne, 2006). While these types of debates are well detailed in Science and Technology Studies (STS) literature, the critiques are heard most stridently from the grassroots groups framing challenges to the specific issue in the first place (Mayer, 2002; Plows, 2003; Plows & Boddington, 2006; Welsh et al., 2007).

Linked closely with the challenging of specific forms of knowledge is the controversy over who counts as experts in the debate (Fischer, 2000; Irwin & Michael, 2003; Wynne, 1996, 2006; Kerr et al., 1998a, 1998b; Collins & Evans, 2002; Evans & Plows, 2005, 2007; Plows & Boddington, 2006). Challenging the discursive legitimacy of certain types of knowledge, and certain types of expertise, has also formed a core part of radical environmental activist opposition to different issues over decades. This is in fact one of the core reasons why radical groups choose not to engage with the policy process, but instead take direct action of various types, stating that the regulatory process is a *fait accompli*, as Research and Development agendas have already been set by vested interest in the form of powerful lobbyists, and by experts; a process from which they are excluded (Doherty et al., 2003; Plows, 2003; Seel & Plows, 2000). It is now acknowledged that local and lay expertise, embodied expertise, expertise organically acquired through personal involvement, should be acknowledged within the policy making process (Evans & Plows, 2007; Wynne 1995, 1996; Grove-White et al., 2004). What is seen as relevant or useful knowledge, as expertise is also a complex subject.⁴¹ These are well established debates within academic and civil society domains are converging once again via the nano frame.

⁴⁰<http://www.defra.gov.uk/footandmouth/latest-situation/index.htm>

⁴¹ Although some commentators appear to continue to privilege scientific and medical accounts (see in particular Collins & Evans, 2002), where the most relevant forms of knowledge and expertise intrinsic to the issue may well be at the socio-political/ cultural level.

Human “Nature” and Identity

Changing the atomic nature of our own bodies, as nanobiotechnology is potentially capable of doing, also re-invokes, or converges, an established discourse on challenges to human identity and human nature. What might be termed socio-cultural risk frames have been raised in relation to gene therapy and interventions at the genetic level (Habermas, 2003; Fukuyama, 2002; Bowring, 2003). Civil society groups have been framing such opposition at the grassroots for some time:

And it worries me particularly that the definition of what is normal is this cultural thing, and... human nature, we don't really know what it is to be human... and yet that's being... decided for us. And the technology to enforce that decision is being put in place to improve profits at the end of the day.

(“Mike”, technology watchdog campaigner in interview January 2004)

Such clashes over meanings and definitions, provide contextualised examples of debates over knowledge and expertise discussed above, not to mention ethical stakes. Such definitions (enhancement, normal functioning and so on) are quite clearly normative and value-laden, and it is often the case that the civil society prime movers discussed here have difficulty getting this fact across; that there are even knowledge gaps about the very existence of their knowledge claims. Evidence of more discursive clusters or convergence around these identity and human nature concerns are, interestingly, in some cases well framed by some within the scientific community in relation to opposition to reproductive cloning. Identity and human nature risks from nanobiotechnology cures or treatments are also accompanied by another familiar frame – what Habermas (2003) like many civil society actors, identifies as “market-led eugenics”. Many activists articulate a concern that the push to maximise profit predictably drives research and development into a socio-cultural context which perpetuates and even exacerbates dominant and problematic ideals of enhancement and normality.⁴² The text below is taken from the press release of the 2004 French anti-nanotech protest discussed earlier.

*In the name of medicine or progress, are being launched research programs, aiming at body manipulations, cerebral control, and human beings standardization, whose practical uses are closer to eugenistic and Orwellian nightmares, and do not deal with any kind of promotion of... social links and diversity.*⁴³

The potential for technologies to exacerbate existing socio-cultural divides and inequalities are already familiar debates for disability rights, feminists, social justice and some ecology activists in the context of “red”, or medical, genomics. They are also well documented in academic literature (Kerr & Shakespeare, 2002), where the cures for disease frame is heavily problematised. Similarly, feminist and disability rights actors are articulating concerns about transhumanist/enhancement

⁴² See “Nano, Bio, Info, Cogno, Synthetic bio, NBICS: Where I post what I find interesting in regards to NBICS and social implications”. <http://wolbring.wordpress.com/>

⁴³ <http://indymedia.org.uk/en/2004/12/302727.html>

discourses and accompanying possible nanobiotechnology applications. Feminist opposition to sexual stereotyping is likely to be a recurring theme in opposition to developments in cosmetic enhancement. This is yet another example of converging discourses.

The cautious support from some oppositional actors regarding the potential for diseases to be cured⁴⁴ is usually accompanied by ambivalence about the use of drugs and interventions, particularly in when and why they might be used. Many actors such as patient groups frame such applications, straightforwardly as an unproblematic potential to find cures or treatments, i.e. avoiding suffering or early death. Familiar social and cultural critiques are also being raised about what it means to be cured, and “where to draw the line” (Kerr et al., 1998b). Disability Rights (DR) perspectives on difference, diversity, the blurred boundaries between abnormal/normal, and therapy and enhancement are core (Wolbring, 2006)⁴⁵; DR campaigners and others indicating that the push for cures could translate as a form of “eugenics by the back door”. This debate is well under way in the case of genetic embryonic screening⁴⁶ (see also the 2004 Human Genetics Commission consultation on PGD and PND⁴⁷). It is likely to re-emerge again in the context of nanobiotechnology and its many possible screening applications, if the future promise (Brown & Michael, 2003) of the technologies manifests. Calls for sustainable development, social justice approaches to health and equity, critiques of medicalisation and of biological reductionism are all part of the cautious approach that oppositional actors bring to their ambivalent support for some types of medical innovation (Plows & Boddington, 2006).

Conclusion

This chapter has presented an ethnographic narrative of identifiable UK groups and networks which are relatively understudied, showing their converging discursive frames in relation to nanobiotechnology/CT. Preliminary lines of conflict and likely ethical concerns regarding nanobiotechnology can be discerned in these converging discussions, which are now sometimes described as the politics of technology. While some of this discourse is not any more specific to nanobiotechnology than it

⁴⁴It should be emphasised that patient and patient advocacy groups such as “Seriously Ill for Medical Research” and Genetic Interest Group are highly pro “cures for disease” and do not problematise this frame in ways that disability rights groups do.

⁴⁵See Aldred et al. (2003) for a highly controversial account of where the acceptable limits of genetic screening should be.

⁴⁶These issues were the focus of an anti-eugenics protest event in September 2004; see <http://www.indymedia.org.uk/en/2004/10/298454.html>. Whilst it would be useful to give more detail about these and other protests mentioned in this chapter, constraints of space mean that a broad ethnographic overview, rather than a detailed focus, is possible.

⁴⁷<http://www.hgc.gov.uk/choosingthefuture/index.htm>

is to other CT, nanobiotechnology is likely to be one of the early concerns of Civil Society actors because it can be seen as a direct continuation of recent and continuing conflict around biotechnology. This interlocking set of discursive frameworks, now being described as the politics of technology, is the way that these actors are approaching nanobiotechnology. They indicate the actual ethical conflicts present and latent within the developing field of nanobiotechnology. The stakes are nascent, multiple, not to say messy; it is crucial to trace these emergent, shifting network patterns and key discourses as they shape up within the public sphere, and to be open to the many different directions towards which such discourses point. In addition to the predictable concerns, nanobiotechnology is likely to produce specific conflicts that have not been present in previous new technology debates. Nonetheless, the importance of convergence as a metaphor should be reiterated here. Whilst some of the risk frames highlighted here are definitively new, broader debates on, for example, the impact of globalization and the market on science and society; knowledge, power, control, in relationship to the nature of expertise and the necessity for better public engagement, are not new frames at all, but are increasingly louder, and perhaps better heard, critiques being articulated once again, often by the usual suspects in a new arena (CT). The clarity of the repetition has been partially responsible for the current emphasis on the necessity for “upstream public engagement” (Willis & Wilsdon, 2004) and “horizon scanning”⁴⁸ in emerging areas of potential scientific controversy.

This paper has outlined an emergent epistemic culture or master frame amongst certain actors critical of nanobiotechnology/CT, and detailed how these technologies are triggering frame convergences. Familiar discourses which have been expressed in relation to many different issues (see Nelkin’s, 1995) concept of “discursive linkage”) are now, through the CT nano lens, being explicitly framed as a broader critique of the politics of technology. As the social movement literature would suggest (Melucci, 1996; Tarrow, 1998), the prime movers mobilising over CT articulating predominantly critical and oppositional frames, are generally from predisposed actor groups who were already mobilising over other related issues, such as agricultural GM, feminism, and Disability Rights.

Just as technological convergences are triggering convergences within science and industry (Glimell & Fogelberg, 2003), they are set to trigger more convergences within and between different civil society actor groups (Evans et al., 2007; Welsh et al., 2007). However, it is likely that the more radical oppositional actor groups predominantly focused on in this chapter will tend to mobilize through the strong ties networks established within their own communities, taking confrontational direct action as their primary strategy for achieving change, given that they feel they have relatively little incentive to engage with the policy process as it currently stands. However, other civil society actors, such as NGOs, are engaging with the regulatory sphere, as evidenced in this chapter.

Whilst this chapter focused on data drawn from case study work in oppositional/critical radical activist networks, it should be reiterated that other pre-existing civil

⁴⁸http://www.hgc.gov.uk/subgroups/horizon_scanning.htm

society campaign groups such as patient groups, faith groups, animal rights activists and pro lifers also existed as campaign networks before the advent of genomics, pharmacogenomics, and nanobiotechnology, and they have incorporated these new technologies into their existing epistemologies and mobilisation repertoires. Thus “progress, hope and cure” frames, for example, are core components of many civil society groups mobilising broadly in support of genomic technologies (Brown & Michael, 2003; Rose & Novas, 2004; Plows, 2004a; Plows & Boddington, 2006). Similarly the ways scientists, industry and regulators interact over, and set, Research and Development agendas and legislative frameworks and talk up, or talk down, risks/benefits associated with scientific development, are established patterns of interaction, involving many established actors (Glimell & Fogelberg, 2003). Thus the phenomenon of frame convergence in relation to CT/nanobiotechnology is not exclusive to the usual suspects highlighted here; many actor groups have developed capacity, meaning that multiple convergences of predisposed, well resourced, actor groups in this arena are likely and are in fact occurring.

It must be reiterated that most “anti” technology networks and groups are not, despite receiving this label, opposed to technology per se. Many activists critical about the potential risks associated with CT and bioscience more generally, can also identify potential benefits such as better drug delivery, although health, cures, treatments and disease are themselves highly complex and contested fields (Plows & Boddington, 2006). Again, the socio-political/economic conditions under which CT science and products are being developed, and demands for civil society control (as opposed to corporate control) over the direction of development, are perhaps the core frames. The specific risks accruing to CT are generally expressed in relation to critiques of the continuing EU push for biotech competitiveness, and opposition to economic globalization and capitalism. Many risk frames articulated by radical and critical actors are also being framed by conventional and supportive ones, perhaps in particular the growing critique of patents (see for example Royal Society, 2003). It will be interesting to see whether more attention is paid, in the regulatory sphere, to the policy potential for strange bedfellow discursive crossover between these different groups where such ambivalence exists. However given their critical stance on how science and technology agendas are set, many activists will continue to feel that the policy process as it stands is “too little, too late”.⁴⁹

⁴⁹“The left-wing think-tank Demos has... produced a report, *See Through Science*, that calls on industry, government and scientists to involve concerned groups in shaping research into problematic subjects such as nanotech at a much earlier stage than commercialisation. The problem with this argument is that for a development to be seen as “concerning”...usually happens well after industry and government have set their targets...” *Corporate Watch*, Newsletter 22, p. 8, February/March 2005.

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