# Nanotechnology and the public interest: Repeating the mistakes of GM foods?

Georgia Miller

Nanotechnology Project Coordinator,
Friends of the Earth Australia,
P.O. Box 222, FITZROY VIC 3065, Australia
Fax: +61 (0)3 9416 2081
E-mail: georgia.miller@foe.org.au
Website: http://nano.foe.org.au

**Abstract:** There is a widespread perception that the public backlash against Genetically Modified (GM) food "effectively stalled a new industry". In this context, much has been made of the 'lessons' that governments and the burgeoning nanotechnology industry must learn from the experience of GM food. These include the importance of ensuring that the public has confidence in risk governance, that social and ethical issues are addressed alongside basic issues of safety, that applications are seen to be socially useful, and that opportunity for a two-way dialogue between the public and decision makers is established early in nanotechnology's development. Public engagement processes have identified that these issues are also important in relation to nanotechnology. And yet, despite the apparent importance attached to 'getting it right' this time around, there is a clear inconsistency between the 'lessons learnt' and the actions taken by government and industry.

**Keywords:** nanotechnology; genetically modified foods; governance; environment risks; health risks; social issues; public opinion; upstream public engagement.

**Reference** to this paper should be made as follows: Miller, G. (2008) 'Nanotechnology and the public interest: Repeating the mistakes of GM foods?', *Int. J. Technology Transfer and Commercialisation*, Vol. 7, Nos. 2/3, pp.274–280.

**Biographical notes:** Georgia Miller has been the national coordinator of the Friends of the Earth Australia Nanotechnology Project since 2005. She has worked with environment and social justice civil society organisations since 1994. She has a particular interest in ensuring that public priorities and preferences better guide new technology development. She has an Honours degree in Environmental Science (Terrestrial Ecology).

## 1 Public awareness about nanotechnology remains very low, but informed members of the public hold broad ranging concerns

In the context of very low levels of public awareness about nanotechnology (Cobb and Macoubrie, 2004; Priest, 2006), we have limited information regarding which aspects of nanotechnology concern members of the public, and what action they would like to see

taken in response. Studies or initiatives which provide members of the public with basic information about nanotechnology and its applications, then investigate and document their responses, can therefore provide valuable insights into public views and priorities. The results from one of the few quasi-experimental studies done to gauge public concerns associated with nanotechnology, and the principal findings from a two-year program of public engagement around nanotechnologies, are reported below.

### *1.1 Quasi-experimental study using randomly selected groups identifies and quantifies broad-ranging public concerns regarding nanotechnology (USA)*

Dr. Jane Macoubrie, Assistant Professor of Public and Personal Communication at North Carolina State University, conducted one of the first 'quasi-experimental' investigations of informed public attitudes towards nanotechnology and the challenges it presents (Macoubrie, 2006). The study involved 152 randomly selected participants, who formed four experimental groups across three different cities. Each participant was given information about anticipated benefits and risks associated with nanotechnology's development, before they were given the opportunity to record privately their views regarding risks and benefits. Table 1 lists the concerns identified by the individuals in descending order of frequency.

**Table 1** Informed public's concerns associated with nanotechnology

| | *Percentage* |
|---|---|
| Military uses and 'evil doers' | 17 |
| Long-term health effects | 15 |
| Environmental 'footprint' | 13 |
| Controllability of trajectory | 10 |
| Social footprint | 9 |
| Potential loss of freedoms and privacy | 7 |
| Regulators' loss of control | 6 |
| Losing funding for other priorities | 6 |
| The possibility of 'molecular manufacturing' | 5 |
| Ethics of uses and effect on nature | 4 |
| 'Insulated' scientists and regulators | 4 |
| Responsible control | 4 |
| Total observations | 100 |

*Source*: Adapted from Table 3, Macoubrie (2006)

### *1.2 Two-year public engagement program identifies key sources of community concern and delivers recommendations for nanotechnology policy development (UK)*

A "Nanotechnology Engagement Group" (NEG) was established by the UK's government in 2005

> "to document the learning from a series of groundbreaking attempts to involve the members of the public in discussions about the development and governance of nanotechnologies." (Gavelin et al., 2007)

The principal findings for government policy in relation to nanotechnologies were as follows:

- *Social distribution of benefits and risks*. Participants wanted technology development to meet social needs. They recommended that the allocation of public research funding should be informed by community views and targeted to socially useful research, and incentives provided for socially useful private research. Participants were concerned about the social distribution of benefits and risks – specifically that some sectors of industry may benefit, while risks or other costs were experienced universally or even disproportionately by the poor or marginalised: "There is a concern that nanotechnologies will be used to serve private interests, and that wider public interests will be overlooked" (Gavelin et al., 2007, p.41).
- *Uncertainty and regulation*. Participants were concerned with uncertainty about the risks presented by nanotechnologies and nanomaterials, how those risks are to be managed, and by whom. They were concerned that existing safety testing and regulatory oversight may be inadequate and that governments and industry may be unable to manage complex and unforeseen risks associated with nanotechnology development. They wanted nanomaterials to be classified as new substances and subject to new safety testing. They supported mandatory labelling of all manufactured nanomaterials in products. They were concerned that governments would lack the capacity to respond to complex and unanticipated challenges.
- *Openness, transparency and public engagement*. Participants wanted greater clarity and transparency regarding nanotechnology research, safety testing, government oversight and decision making.

> "Public participants' main concern has been that decision-making processes in science and technology are made more transparent and trustworthy, and that more effort is made to incorporate ethical and social considerations into the setting of research and funding priorities. Flexibility and openness have been stressed as important: people are keen for as many voices as possible – including scientists, members of the public, NGOs and industry – to be heard at different stages of decision making." (Gavelin et al., 2007, p.42)

## 2 The response of governments and industry to identified concerns is inadequate

### *2.1 Social distribution of benefits and risks: these issues are largely ignored in emerging discussion*

The public participants in the study and public engagement programs described above have low confidence in governments to manage technology risks to benefit the public interest. UK's participants cited their experience of GM food and BSE; US participants cited asbestos, Agent Orange, dioxin, PCBs, nuclear waste and Gulf War Syndrome. There was also a more overarching concern that benefits and risks associated with nanotechnology would not be shared equally, for example that benefits would accrue to a particular industry sector while risks or negative impacts, for example unemployment, would be experienced by everyone, or even borne disproportionately by poor or marginalised communities.

One of the principal wishes expressed by the participants in the study and public engagement programs is that nanotechnology's development be informed by community preferences and targeted towards socially useful outcomes. However few, if any, governments demonstrate a commitment to incorporating public views in decision making regarding allocation of public research funding, provision of incentives for private research, public policy development or governance issues. Similarly, there is little evidence to suggest that governments are taking seriously the challenge to maximise the social usefulness of nanotechnology research and development programs. This is problematic because the 'laissez-faire' approach of governments and industry towards nanotechnology's development has resulted in socially useful research attracting a very small proportion of public research funding, while nanotechnology's development remains driven by commercial and military objectives which do not reflect public preferences, and in some instances are a principal source of community concern.

In 2006, the USA government, the world's largest single funder of nanotechnology research, spent 33% of the US$ 1.3 billion National Nanotechnology Initiative budget on military applications (US National Nanotechnology Initiative, 2005). Yet the most prevalent concern identified by the US participants in the study cited above was that development of nanotechnology military applications could result in them falling into the hands of 'evil doers' (Macoubrie, 2006). That is, development of nanotechnology military applications by our allies may actually compromise our security. A NATO Parliamentary Assembly Committee has raised similar concerns (NATO Parliamentary Assembly Committee, 2005). It warned that the development of nanotechnology bio-weaponry by NATO allies may increase the probability that these weapons will also become available to 'imprudent' state militaries and terrorist groups, while counter measures developed by NATO may prove inadequate to mitigating the heightened risk.

The disproportionately large funding of military research also highlights the much lower priority accorded to socially useful research identified by the public as of primary importance – particularly in relation to health and the environment. The Woodrow Wilson International Centre for Scholars' Project on Emerging Nanotechnologies has estimated (Maynard, 2006) that highly relevant research into nanotechnology's health and environment risks receives less than 0.85% (US$ 11 million) of the US National Nanotechnology Initiative budget. World-wide, a tiny 0.4% of nanotechnology research spending is on research into risks for human health and the environment (European Trade Union Institute – Research, Education, Health and Safety, 2007).

### *2.2 Uncertainty and regulation: people and the environment remain exposed to poorly understood nanotoxicity risks; broader uncertainties surround nanotechnology's 'revolutionary' potential*

Nanotoxicity risks to health and the environment are universally acknowledged as key sources of public concern. There is a rapidly expanding body of scientific evidence demonstrating that many nanomaterials in widespread commercial use can be toxic to humans and the environment (Brunner et al., 2006; Hoet et al., 2004; Lovern and Klaper, 2006; Magrez et al., 2006; Oberdörster et al., 2005a, 2005b; Templeton et al., 2006). The Royal Society and Royal Academy of Engineering have recommended that nanomaterials should be treated as new chemicals and be subject to new safety assessments prior to their inclusion in consumer products (Royal Society and The Royal Academy of Engineering, 2004, pp.85–86). They further recommended that factories and

research laboratories should treat nanomaterials as if they were hazardous, and the release of nanomaterials into the environment should be avoided as far as possible (Royal Society and The Royal Academy of Engineering, 2004, p.85). Swiss Re, the world's second largest reinsurance agent, has said that:

> "In view of the dangers to society that could arise out of the establishment of nanotechnology, and given the uncertainty prevailing in scientific circles, the precautionary principle should be applied whatever the difficulties." (Swiss Re, 2004, p.47)

Governments and industry have increasingly recognised the need to ensure greater research into nanotoxicity risks, although to date such research remains grossly under funded. However the immediate need to ensure that the public, workers and the environment do not face unsafe exposure to nanomaterials remains unaddressed. There are now many hundreds, if not thousands, of commercially available products which contain nanomaterials, including cosmetics, clothing, paints, household appliances and even some food products. Yet there is still no nanotechnology-specific regulation to ensure the safety of these products in England, the USA, Australia or Japan (Bowman and Hodge, 2006, 2007), among many other countries.

Governments' failure to ensure appropriate nanotechnology-specific regulatory safeguards is made worse by industry's failure to undertake appropriate risk assessment and safety testing. Swiss researchers recently sent a survey regarding risk assessment of nanomaterials to 138 Swiss and German companies that produce or apply nanomaterials. Of the 40 companies who responded, 65% indicated that they perform no risk assessments at all and only 32.5% said that they performed risk assessments 'sometimes or always' (Siegrist et al., 2007).

A further significant source of public concern identified by both Macoubrie (2006) and Gavelin et al. (2007) is uncertainty around the 'controllability' of nanotechnology's trajectory. This relates not to scientifically defined toxicity risks, but rather to the capacity to guide or influence nanotechnology's future applications and the direction of its development. Participants feared that governments and industry will be unable to control a technology predicted to bring 'revolutionary' changes to every aspect of our individual lives and social and economic systems, or to manage the complex and unpredictable challenges associated with it.

### *2.3 Openness, transparency and public engagement: inadequate efforts made to date*

The participants in the study and public engagement programs described above expressed a firm desire for greater openness and transparency in all aspects of nanotechnology decision making. In particular, participants want more information about safety assessments and government decision making around nanotechnology governance. Furthermore, labelling is consistently highlighted as important; consumers want product labels to indicate the presence of nano ingredients to enable them to make informed purchasing choices.

Further to the need for openness and transparency regarding current applications, participants in both the study and the public engagement programs want future nanotechnology development and governance to more accurately reflect community values and needs. The UK process, which identified policy recommendations,

recommended that public engagement should inform decision making regarding research, development, commercialisation and governance. However while there are a burgeoning number of public engagement exercises on nanotechnology in the UK, the USA, France, Germany and elsewhere, many lack clarity of purpose (Jones, 2007). In the absence of formal links to the decision making and policy development processes, it has yet to be demonstrated that the outcomes of these exercises will actually inform decision making.

## 3 Experience to date suggests that 'lessons' learned in the GM food controversy are not being applied to nanotechnology

Informed members of the public have identified many concerns in relation to nanotechnology that also characterise public concerns about GM food. These include a lack of transparency and choice about exposure, risks to health and environment, unfair distribution of risks and benefits and a lack of socially useful applications. It is significant that as with GM foods, public concerns extend beyond narrowly defined issues of scientific risk to broader questions over the control, purpose and predictability of nanotechnology's application.

Given that the public concerns identified in relation to GM foods have failed to result in practical changes to government and industry's actions in relation to nanotechnology, there is little evidence that governments and industry have learned the 'lessons' associated with the GM food experience. This suggests that as public awareness about nanotechnology grows, so too will the level of discontent with current government and industry approaches to its development and governance.

Actions that are required to implement the 'lessons' learned from GM foods include: government action to protect the public, workers and the environment from unsafe exposure to nanotoxicity; a full and frank dialogue about the extent to which management of nanotechnology's broader risks and challenges is possible, and how this may be achieved; attention to and analysis of social and ethical issues in the allocation of public research funding and provision of incentives for private research as well as in decision making about governance; and a commitment to ensure that robust public participation at each stage of nanotechnology's development informs decision making to make nanotechnology development responsive to identified community needs.

## References

Bowman, D. and Hodge, G. (2006) 'Nanotechnology: mapping the wild regulatory frontier', *Futures*, Vol. 38, pp.1060–1073.

Bowman, D. and Hodge, G. (2007) 'A small matter of regulation: an international review of nanotechnology regulation', *The Columbia Science and Technology Law Review*, Vol. VIII.

Brunner, T., Piusmanser, P., Spohn, P., Grass, R., Limbach, L., Bruinink, A. and Stark, W. (2006) 'In vitro cytotoxicity of oxide nanoparticles: comparison to asbestos, silica, and the effect of particle solubility', *Environmental Science and Technology*, Vol. 40, pp.4374–4381.

Cobb, M. and Macoubrie, J. (2004) 'Public perceptions about nanotechnology: risks, benefits and trust', *Journal of Nanoparticle Research*, Vol. 6, No. 4, pp.395–405.

European Trade Union Institute – Research, Education, Health and Safety (2007) *Nanoscience: More Research and Transparency Wanted*, News story 30.03.2007 Available at: http://hesa.etui-rehs.org/uk/newsevents/newsfiche.asp?pk=823 Accessed 10.08.2007

Gavelin, K, Wilson, R. and Doubleday, R. (2007) *Democratic Technologies? The Final Report of the Nanotechnology Engagement Group*, Involve, London.

Hoet, P., Bruske-Holfeld, I. and Salata, O. (2004) 'Nanoparticles – known and unknown health risks', *Journal of Nanobiotechnology*, Vol. 2, No. 12.

Jones, R. (2007) 'What have we learned from public engagement?', *Nature Nanotechnology*, Vol. 2, pp.262, 263.

Lovern, B. and Klaper, R. (2006) 'Daphnia magna mortality when exposed to titanium dioxide and fullerene (c60) nanoparticles', *Environmental Toxicology and Chemistry*, Vol. 25, No. 4, pp.1132–1137.

Macoubrie, J. (2006) 'Nanotechnology: public concerns, reasoning and trust in government', *Public Understanding of Science*, Vol. 15, No. 2, pp.221–241.

Magrez, A., Kasa, S., Salicio, V., Pasquier, N., Won Seo, J., Celio, M., Catsicas, S., Schwaller, B. and Forro, L. (2006) 'Cellular toxicity of carbon-based nanomaterials', *Nano Letters*, Vol. 6, No. 6, pp.1121–1125.

Maynard, A. (2006) *Nanotechnology: A Research Strategy for Addressing Risk*, Woodrow Wilson International Center for Scholars Project on Emerging Nanotechnologies, Washington DC, Available at http://www.nanotechproject.org/reports

NATO Parliamentary Assembly Committee (2005) *179 STCMT 05 E – The Security Implications of Nanotechnology*.

Oberdörster, G., Maynard, A., Donaldson, K., Castranova, V., Fitzpatrick, J., Ausman, K., Carter, J., Karn, B., Kreyling, W., Lai, D., Olin, S., Monteiro-Riviere, N., Warheit, D. and Yang, H. (2005a) 'Principles for characterising the potential human health effects from exposure to nanomaterials: elements of a screening strategy', *Particle and Fibre Toxicology*, Vol. 2, No. 8, pp.823–839.

Oberdörster, G., Oberdörster, E. and Oberdörster, J. (2005b) 'Nanotoxicology: an emerging discipline from studies of ultrafine particles', *Environmental Health Perspectives*, Vol. 113, No. 7, pp.823–839.

Priest, S. (2006) 'The North American opinion climate for nanotechnology and its products: Opportunities and challenges', *Journal of Nanoparticle Research*, Vol. 8, pp.563–568.

Royal Society and The Royal Academy of Engineering (2004) *Nanoscience and Nanotechnologies*, UK, Available at http://www.royalsoc.ac.uk/

Siegrist, M., Wiek, A., Helland, A. and Kastenholz, H. (2007) 'Risks and nanotechnology: the public is more concerned than experts and industry', *Nature*, Vol. 2, p.67.

Swiss Re (2004) *Nanotechnology: Small Matter, Many Unknowns*, Available at http://www.swissre.com

Templeton, P., Ferguson, P., Washburn, K., Scrivens, W. and Chandler, G. (2006) 'Life-cycle effects of single-walled carbon nanotubes (SWNTs) on an estuarine meiobenthic copepod', *Environmental Science and Technology*, Vol. 40, pp.7387–7393.

US National Nanotechnology Initiative (2005) 'Research and development leading to a revolution in technology and industry', *Supplement to the President's 2006 Budget, Nanoscale Science, Engineering, and Technology Subcommittee on Technology*, National Science and Technology Council. Available at: http://www.nano.gov/NNI_06Budget.pdf