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BOOK REVIEWS

Fritz Allhoff, Patrick Lin, James Moor, and John Weckert (eds.), ***Nanoethics: The Ethical and Social Implications of Nanotechnology***. Hoboken, NJ: Wiley-Interscience (2007), 385 pp., $42.50 (paper).

The editors of *Nanoethics* have produced a wide-ranging anthology that provides a valuable introduction to the major concerns associated with this rapidly developing area of research. Those looking for deep ethical analyses will be disappointed, and the quality of the essays varies widely. Nevertheless, the editors designed the volume "to be accessible to a broad audience with little familiarity with either nanotechnology or ethics, particularly since it is the general public who may be the largest beneficiary—or victim—of nanotechnology, and so the everyday person needs to understand its possible impact" (xvi). The book fulfills the goal of providing an accessible introduction to a very diverse set of important ethical and societal issues. It also provides a good starting point for philosophers of science interested in exploring how they can contribute to these discussions.

Although it is difficult to formulate a satisfactory definition for nanotechnology (see Chapter 22, by Joachim Schummer), it is often characterized as "a new category of technology that involves the precise manipulation of materials at the molecular level or a scale of roughly 1 to 100 nanometers . . . in ways that exploit novel properties that emerge at that scale" (5). Some of this work is just an extension of previous research in materials science and chemistry. For example, carbon nanotubes and buckyballs display impressive mechanical and electrical properties that researchers hope to exploit for a wide range of applications. Similarly, nanoscale particles of numerous substances display novel properties that are not displayed by bulk materials, partly because of quantum effects and partly because of the higher surface-area-to-volume ratios of smaller particles. These technological developments raise fairly traditional ethical questions about how to regulate environmental and public-health hazards in the face of uncertainty about particle behavior and toxic effects. On the other end of the spectrum, some nanotechnologists have extremely radical visions for their field, accompanied by much more complex ethical and societal scenarios. These controversial accounts of nanotechnology include the creation of nanoscale "assemblers" that can fabricate almost anything from the molecular level, as well as the convergence of nano-

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and biotechnologies to halt the aging process or to enable the downloading of the human brain into computer systems.

The field of nanotechnology is sufficiently new and interdisciplinary that few volumes have addressed its ethical and social ramifications in a comprehensive fashion. A few anthologies have examined nanotechnology from a broadly STS-oriented perspective (see Baird, Nordmann, and Schummer 2004; Schummer and Baird 2006), but they have not focused exclusively on ethical considerations. Therefore, the present collection (along with the recently launched *Nanoethics* journal from Springer) meets a significant need for focused attention on these issues. The book is divided into seven parts, with a brief introduction to each part and tweny-six total chapters. The first part introduces the major issues and includes classic perspectives from Bill Joy and Ray Kurzweil. The second and third parts introduce current initiatives to fund nanotechnology research, especially the National Nanotechnology Initiative in the U.S., and explore the complexities of predicting future technological developments. Parts IV through VI address major ethical and societal issues associated with nanotechnology: environmental health and safety risks associated with nanoparticles and nanomedicine, questions about human enhancement, concerns about loss of privacy, challenges associated with international regulation, pitfalls and possibilities for developing countries, and ramifications for national defense and the military. The last part addresses more long-term and controversial issues, including artificial intelligence, space exploration, molecular manufacturing, and life extension.

Several essays are particularly worthy of note. The first chapter, by Patrick Lin and Fritz Allhoff, provides a helpful introduction to debates about whether nanotechnology is even a distinct discipline, whether the ethical issues associated with it are unique in any important sense, and what the most important issues to address might be. In the fourth chapter, Christine Peterson and Jacob Heller offer an excellent overview of the major ways that nanotechnology can contribute to meeting six contemporary societal goals: clean energy sources, clean water, increased human health and longevity, improved environmental quality, more powerful information technology, and enhanced space exploration. The thirteenth chapter, by theologian Ted Peters, makes some questionable metaethical claims but nevertheless offers an intriguing account of what it means to "play God" in the context of human enhancement.

The fourteenth chapter, by David Guston, John Parsi, and Justin Tosi, provides an illuminating analysis of the extent to which nanotechnology is likely to strengthen or challenge three important political values: (1) social and economic equality, (2) autonomy and freedom, and (3) pluralist perspectives on human good. In Chapter 19, Jeroen van den Hoven provides one of the more ethically sophisticated analyses of the book in the

course of examining how nanotechnology creates privacy concerns. Finally, Joachim Schummer contributes an enlightening and somewhat pessimistic overview of nanotechnology's ramifications for developing countries in Chapter 22. He argues that lack of infrastructure and education, rather than technological barriers, are the primary difficulties for the world's poor. Moreover, he points out that current intellectual property systems are tilted so that developed countries are most likely to prosper from technological advances, and he suggests that nanotechnology could weaken global dependence on the natural resources that are currently an important source of income for developing economies.

A central theme of the book is the context-dependence and unpredictability of nanotechnology's societal effects. As a result, it is important to create institutional frameworks in which significant ethical problems can be anticipated or addressed as soon as possible after they begin to arise. In Chapter 16, Colin Farrelly examines the merits of deliberative democracy as an approach for structuring societal debates about nanotechnology. Although his essay leaves one hoping for more specific examples of how to implement a deliberative democratic framework, Jack Stilgoe and James Wilsdon provide some concrete illustrations in Chapter 18 (see also Rogers-Hayden and Pidgeon 2006). These essays reflect a widespread contemporary interest in incorporating societal values "up-stream" during the process of scientific research and development, rather than engaging in democratic discussion only after technological developments are already in place (Guston 2004). Examining the points at which public values can and should permeate scientific research is a research topic that merits further consideration from philosophers of science (see, e.g., Douglas 2005).

The philosophy-of-science community could also contribute to at least three other issues that arise in the *Nanoethics* anthology. First, Parts II and III highlight a number of methodological and conceptual questions about how to define nanotechnology, how it relates to other fields, and how outside forces have contributed to shaping its character. Nanotechnology provides an excellent case study for critically evaluating how ethical, political, and epistemic factors converge in the development of research questions and funding priorities (see, e.g., Kitcher 2001). A second topic for investigation arises in ethical discussions about nanomedicine. A number of authors appear to rely on a naïve reductionism about biological processes that merits critical reflection from philosophers of biology. For example, Robert Freitas, one of the leading lights in nanomedicine, argues in Chapter 12 that the molecular structures of the human body should be fairly well analyzed within the next 10 to 30 years. He claims, "Once these parts are known and understood . . . nanomedical-based discovery will consist principally of examining a particular sick or

injured patient to determine how he or she deviates from molecular reference structures" (162). Thus, he seems to overemphasize the importance of static molecular *structures*, neglecting the biologically crucial and incredibly complex *regulatory processes* that are likely to resist any comprehensive understanding in the near- or medium-term (Moss 2003; Burian 2007). A similar reductionism may be responsible for Ray Kurzweil's surprising confidence in Chapter 3 that nanomedicine will be able to "keep our bodies and brains in a healthy, optimal state indefinitely" (41; see also Chapter 26).

A third role for philosophers of science is to contribute methodological sophistication to questions about research ethics and risk assessment. Several of the book's chapters (especially 10 and 11) examine how to address uncertainty about the biological effects of nanoparticles. Heather Douglas (2000) has emphasized that societal values about how carefully to avoid particular risks cannot be divorced from the practice of scientific research. Choices about how to design experiments, analyze data, and interpret experimental results can all influence the likelihood of false positive and false negative conclusions about risks, with subsequent consequences for environmental and public health. Reflecting on these sorts of concerns, Deborah Mayo and Aris Spanos (2008) have argued that bioethical issues can be addressed adequately only if they are accompanied by a methodological critique of associated scientific research, which they call "bioevidential" scrutiny. Philosophers of science are well placed to contribute to the field of nanoethics in this manner. Thus, given the growing interest among philosophers of science in making their field more socially relevant, nanotechnology appears to provide a promising subject for future analysis.[1]

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REFERENCES

Baird, Davis, Alfred Nordmann, and Joachim Schummer, eds. (2004), *Discovering the Nanoscale*. Amsterdam: IOS Press.

Burian, Richard (2007), "On MicroRNA and the Need for Exploratory Experimentation in Post-genomic Molecular Biology", *History and Philosophy of the Life Sciences* 29 (3): 285–312.

Douglas, Heather (2000), "Inductive Risk and Values in Science", *Philosophy of Science* 67: 559–579.

——— (2005), "Inserting the Public into Science", in Sabine Maasen and Peter Weingart

1. For evidence of social concern among philosophers of science, consider the founding of the Society for Philosophy of Science in Practice, the recent attempts to study socially engaged historical figures like Otto Neurath, and a variety of workshops on making philosophy of science socially relevant.

(eds.), *Democratization of Expertise? Exploring Novel Forms of Scientific Advice in Political Decision-Making*. Dordrecht: Springer, 153–169.
Guston, David (2004), "Forget Politicizing Science. Let's Democratize Science!", *Issues in Science and Technology* 21: 25–28.
Kitcher, Philip (2001), *Science, Truth, and Democracy*. Oxford: Oxford University Press.
Mayo, Deborah, and Aris Spanos (2008), "Risks to Health and Risks to Science: The Need for a Responsible 'Bioevidential' Scrutiny", *Human and Experimental Toxicology* 27, forthcoming.
Moss, Lenny (2003), *What Genes Can't Do*. Cambridge, MA: MIT Press.
Rogers-Hayden, Tee, and Nick Pidgeon (2006), "Reflecting upon the UK's Citizens' Jury on Nanotechnologies: NanoJury UK", *Nanotechnology Law & Business* 3: 167–178
Schummer, Joachim, and Davis Baird (2006), *Nanotechnology Challenges: Implications for Philosophy, Ethics, and Society*. Hackensack, NJ: World Scientific.

John W. Carroll (ed.), ***Readings on Laws of Nature***. Pittsburgh: University of Pittsburgh Press (2004), 296 pp., $26.95 (paper).

Laws of nature support counterfactuals, explain various events and predict others, are confirmed by their instances and help justify induction. Over the past few decades, philosophical interest in just what laws are and how they fulfil this role has grown considerably. This collection brings together a number of important papers from the 1970s onward, covering three central issues.

1. *The metaphysics of laws of nature.* Are laws entities that 'govern'? Are they regularities of a certain sort? Both Fred Dretske and Michael Tooley argue that contingent nomic relations between universals (such as *F nomically necessitating* [or *yielding*] *G*) ensure corresponding regularities (such as that all *F*s are *G*), and so govern the way things are and behave. The regularity that all actual *F*s are *G* cannot support the counterfactual 'if *a* had been *F*, it would have been *G*', since it is about a *possible* but non-actual *F*. But the nomic relational entity *F yields G* can support counterfactuals, since the closest possible world to ours where *a* is *F* also contains that nomic relational entity, and anything that is *F* instantiates it, and so is *G*. Regularities, Dretske claims, are not confirmed by their instances; nomic relations between universals are (28). Interestingly, both take laws to be *propositions*, not the (in their view platonic) relations between universals that those propositions express (22, 68).

Bas van Fraassen criticizes the relations-between-universals account, and David Armstrong's version in particular. Armstrong takes laws to *be* nomic relations between universals. He also takes them to be immanent entities, rather than platonic. However, there is no reason to think that the proportion of *X*-particles decaying within two years is .5, even if it is a law that the probability of an *X*-particle decaying within two years is .5. So how, van Fraassen wonders, can probabilistic laws be immanent?