Nanotechnology Challenges: Implications for Philosophy, Ethics and Society

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BIOGRAPHICAL NOTES ON THE CONTRIBUTORS

Davis Baird is Dean of the Honors College, Professor of Philosophy, and Associate Director of the NanoCenter at the University of South Carolina. He received his PhD (1981) from Stanford University in philosophy of science, language, and logic. His research has focused on the history and philosophy of scientific instruments, particularly for analytical chemistry and, more recently, for nanotechnology. He leads a NSF funded interdisciplinary team of 20 researchers from ten departments in six colleges at USC on the societal and ethical interactions of nanotechnology. He is the author of *Thing Knowledge: A Philosophy of Scientific Instruments* (University of California Press 2004) and *Inductive Logic: Inferring the Unknown* (Prentice Hall 1992, Pearson Publishing 1999), and co-editor of *Heinrich Hertz: Classical Physicist, Modern Philosopher* (Kluwer 1994), *Discovering the Nanoscale* (IOS Press 2004), and *Philosophy of Chemistry: Synthesis of a New Discipline* (Springer 2005). He is editor-in-chief of *Techné: Research in Philosophy and Technology*.

Bernadette Bensaude-Vincent is Professor of History and Philosophy of Science at Université Paris X. Her research interests focus on the history and philosophy of chemistry and on the history of the science and the public issue. Her current research is on ethical and philosophical issues of nanotechnologies. She is a member of the Académie des technologies and of the Comité d'éthique du CNRS. Her book publications include *Lavoisier, mémoires d'une revolution* (1993), *A History of Chemistry* (together with Isabelle Stengers, 1996), *Eloge du mixte Matériaux nouveaux et philosophie ancienne* (1998), *La science et l'opinion. Histoire d'un divorce* (2003), *Se libérer de la matière? Fantasmes autour des nouvelles technologies* (2004), and *Faut-il avoir peur de la chimie?* (2005).

Otávio Bueno is Associate Professor of Philosophy at the University of South Carolina (USC), and a member of the NanoScience and Technology Studies in that institution. His interests in nanotechnology focus on the issues of the epistemology of microscopy, on mechanisms of representation at the nanoscale, and on the critical analysis of images in nanotechnology. Some of these issues are examined in his paper "Representation at the Nanoscale", forthcoming in *Philosophy of Science*, 2006. His research in nanotechnology has been funded by

the National Science Foundation (NSF). He has been a co-PI in two major grants, funded by NSF, to examine the societal implications of nanotechnology. This work has been developed in collaboration with an interdisciplinary research team at USC.

Marc J. de Vries is Assistant Professor of Philosophy and Ethics of Technology at the Eindhoven University of Technology, and an affiliate professor in Reformational Philosophy at the Delft University of Technology, both in the Netherlands. His main research interests are in characterizing technological knowledge (Eindhoven) and analyzing the complexity of technological developments in its interaction of scientific, technological and social aspects (Delft). He is interested in nanotechnology both because of its complexity and because of the way scientific and technological knowledge are intertwined in that field. He has recently published a book that presents an overall introduction to the philosophy of technology (*Teaching About Technology*, Springer 2005) and a book about the history of the main laboratory in Philips Research. He is editor-in-chief of the *International Journal of Technology and Design Education* (published by Springer).

Jean-Pierre Dupuy is Professor of Social and Political Philosophy at the École Polytechnique, Paris, and at Stanford University, California. He is a member of the Académie Française des Technologies. His current research program includes the paradoxes of rationality, or the classical philosophical problem of the antinomies of Reason at the age of rational choice theory, analytic philosophy, and cognitive science; the ethics of nuclear deterrence and preemptive war; the philosophy of risk and uncertainty; the philosophical underpinnings and the future societal and ethical impacts of the convergence of nanotechnology, biotechnology, information technology, and cognitive science. His latest publications include *The Mechanization of the Mind* (Princeton University Press, 2000), *Pour un catastrophisme éclairé* (Paris, 2002), *Avions-nous oublié le mal? Penser la politique après le 11 septembre* (Paris, 2002), *Petite métaphysique des tsunamis* (Paris, 2005).

Alexei Grinbaum is CNRS postdoctoral fellow at LPHS – Archives Henri Poincaré in Nancy, France. He received his Ph.D. in philosophy of science from the École Polytechnique in Paris in 2004, after having studied theoretical physics and cognitive science. His research interests include foundational problems of quantum theory and societal implications and ethics of the new technologies. His recent work on nanotechnology investigated uncertainty with respect to future events and methodological aspects related to cognitive barriers in the public perception of nanotechnology. He is currently participating in the first French government sponsored research program on nanoethics.

Sven Ove Hansson is Professor and Head of the Department of Philosophy and the History of Technology, Royal Institute of Technology, Stockholm. His books include *Setting the Limit. Occupational Health Standards and the Limits of Science* (OUP 1998), *A Textbook of Belief Dynamics. Theory Change and Database Updating.* (Kluwer 1999) and *The Structures of Values and Norms* (CUP 2001). His current research focuses on the philosophy of risk and on ethical aspects of new technologies. Homepage: http://www.infra.kth.se/~soh.

Jochen Hennig studied physics at the universities of Münster, Edinburgh, Granada, and Oldenburg and finished with a thesis on astrophysical experiments in the 19th century. He is research associate at the Hermann von Helmholtz Center for Cultural Techniques, at the Humboldt University Berlin. In his current PhD project he analyzes the construction and epistemological status of pictures in the rise of nanotechnology. Further research interests include images in the history of physics, the epistemology of experiments, science policy studies, visual science communication, and the history of science in education. In addition, he has developed concepts for various science exhibitions, *e.g.* at Deutsches Museum Munich. Recent publications in English include: 'Bunsen, Kirchhoff, Steinheil and the Elaboration of Analytical Spectroscopy' (*Nuncius*, 2003, 741-754); 'The Instrument in the Image: Revealing and Concealing the Condition of the Probing Tip in Scanning Tunneling Microscopic Image Design' (in: H. Schramm *et al.* (eds.), *Instruments in Art and Science*, 2006).

Arne Hessenbruch is research fellow at the Dibner Institute for the History of Science and Technology, MIT, where he is working on the Materials Science and Engineering subsite of the History of Recent Science and Technology project. He had previous positions at Harvard, City University, University of Cambridge, University of Manchester, Royal Institute of Technology, Siemens UK plc, and Kiepenheuer Institute for Solar Physics. He is the editor of the *Reader's Guide to the History of Science* (London & Chicago 2000) and author of several papers on the history of materials science and X-ray technologies.

Osmo Kuusi is an expert in futures studies, innovation studies, foresight and technology assessment. He was President of the Finnish Society for Futures Studies 1998-2001 and is a fellow in futures and innovation studies at the Technical University of Helsinki and Scientific Adviser of the Futures Research Centre in Turku. Since 1999 he has worked as the Permanent Scientific Adviser in technology assessment in the Committee for the Future of the Finnish Parliament. Together with Martin Meyer, he has studied in several papers technological paradigms or different 'leitbilds' of nanotechnology, *e.g.* in 'Technological generalizations and leitbilder – The Anticipation of Technological Opportunities', *Technological Forecasting & Social Change*, 69 (2002) 625-639. Recently

Kuusi and Meyer have investigated technological leitbilds related to nanotubes based on recent patents in the field.

Louis Laurent is Head of the Matter and Information Department at the French National Agency for Research. He had worked for seventeen years in the field of thermonuclear fusion, before he joined in 1995 the DRECAM (Department of Research on Condensed Matter, Atoms and Molecules) of the French Atomic Energy Commission in Saclay. A significant part of the activity of this department is related to nanosciences (materials, information technology, interface with biology). In 2000, Louis Laurent was appointed Head of the DRECAM, and soon member of the steering committee of the French Program on Nanosciences. In the same time he published several articles about the societal impact of nanoscience including a book (in French) with Jean Claude Petit (*Should one be afraid of nanotechnology?*, Le Pommier 2005). From 2004 to 2005, he has been the organizer of an ESF forward look on Nanosciences and Information Technology.

Bruce V. Lewenstein (PhD, 1987, University of Pennsylvania) is Associate Professor of Science Communication at Cornell University. His research, teaching, and outreach focus on public communication of science and technology, which necessarily leads him to an interest in social and ethical issues associated with emerging technologies. He is co-chair of Cornell's committee on ethical, legal, and social issues in genomics, and is coordinator of the social and ethical issues component of the U.S. National Nanotechnology Infrastructure Network. His recent publications have looked at public opinion and media coverage of nanotechnology. He is co-author with Sally Kohlstedt and Michael Sokal of *The Establishment of Science in America: 150 Years of the American Association for the Advancement of Science* (Rutgers University Press, 1999), and co-editor with David Chittenden and Graham Farmelo of *Creating Connections: Museums and the Public Understanding of Current Research* (Altamira Press, 2004).

José López is Assistant Professor in the Department of Sociology at the University of Ottawa; he has taught at the University of Essex and the University of Nottingham. He is the author of *Society and Its Metaphors* (2003, co-author of *Social Structure* (2000) and co-editor of *After Postmodernism: An Introduction to Critical Realism* (2001). He has also published articles on sociological theory, metaphors, discourse analysis, the emergence of the ELSI field (Ethical, Legal and Social Implications) and bioethics. He is currently researching how ELSI expertise has been institutionalized as a mechanism for the legitimate governance of technoscientific practices such as nano and biotechnology.

Martin Meyer is a Senior Fellow with SPRU, a leading center for science and technology policy research at the University of Sussex in Brighton, England. He also holds visiting appointments at the Catholic University of Leuven (Belgium) and Helsinki University of Technology (Finland). He has published around 30 articles in international, peer-reviewed journals many of which cover developments in nanotechnology. His research interests include knowledge exchange processes between science and technology in emerging fields, technology foresight, and bibliometric and patent indicators. More recently, he was the rapporteur of a European Commission special expert group on mapping networks of excellence in nanotechnology. Currently, he contributes to a book project that aims to make issues related to the future opportunities and risks of nanotechnology more accessible to broader audiences.

Cyrus C.M. Mody received his Ph.D. in 2004 from the Department of Science and Technology Studies at Cornell. His dissertation surveyed the history of the community of scanning probe microscopists with particular attention to the role of pedagogy in community formation; the relationship between corporate and academic research; and the dynamics of interdisciplinarity and commercialization among instrument builders and users. He is now the program manager for Nanotechnology Studies in the Center for Contemporary History and Policy at the Chemical Heritage Foundation in Philadelphia. His current research on nanotechnology focuses on the constituent communities that make up the discipline, particularly the microfabrication and molecular electronics fields.

Alfred Nordmann is Professor of Philosophy and History of Science at Darmstadt Technical University, Germany. After receiving his doctorate in Hamburg (1986), he joined in 1988 the Philosophy Department at the University of South Carolina, USA, and has remained affiliated with it after his move to Darmstadt in 2002. One of his main interests is the concept of representation as it develops from Kant and Lichtenberg via Heinrich Hertz and Ludwig Wittgenstein to contemporary debates about models and simulations in science. He also studies the formation of new scientific disciplines and their implicit conceptions of objective knowledge. In 2000, his attention turned to nanotechnology as a symptom of larger changes in the culture of science and the relation of science and society. He served as rapporteur of the European Commission's expert group *Converging Technologies – Shaping the Future of European Societies* (2004). Recent publications include *Wittgenstein's Tractatus – An Introduction* (2005).

Jean-Claude Petit is head of the Molecular Chemistry Service Unit in the Department of Condensed Matter, Atoms and Molecules of the French Commissariat à l'Energie Atomique. He is author of many articles in the sociology of science.

Joseph C. Pitt received his Ph.D. from the University of Western Ontario. He began teaching at Virginia Tech in 1971 where he is currently Professor of Philosophy and Head of the Department of Philosophy. He is the author of three books and the editor or co-editor of an additional eleven volumes. He was the founding Director of the Center for the Study of Science in Society and the founding editor of the interdisciplinary journal *Perspectives on Science, historical, philosophical, social*. His research interests center on scientific change and increasingly on the role of technological innovation in scientific change.

Christopher J. Preston is currently a Visiting Assistant Professor in the Department of Philosophy at the University of Montana, Missoula. He is the author of *Grounding Knowledge: Environmental Philosophy, Epistemology, and Place* (University of Georgia Press, 2003). He is also the guest editor of a journal special issue on "The Epistemic Significance of Place" in *Ethics and the Environment* 10 (2)(2005). He has over a dozen journal article publications in the areas of environmental philosophy, ethics, and the philosophy of mind. He is currently working on an intellectual biography of Holmes Rolston III, with support from the John Templeton Foundation. He teaches classes in ethics, environmental ethics, ecofeminism, and contemporary moral issues.

Gregor Schiemann is Professor of Philosophy at the University of Wuppertal. After a first career as toolmaker, he received his diploma in physics from the ETH in Zürich (1988), and his PhD in philosophy from the University of Darmstadt (1995). His research interests focus on the philosophy of nature, science and technology, and the history of science. His publications include: *The Loss of Certainty. Herman von Helmholtz's Mechanism at the Dawn of Modernity* (in German: Darmstadt 1997, English translation in preparation); *Natur, Technik, Geist. Kontexte der Natur nach Aristoteles und Descartes in lebensweltlicher und subjektiver Erfahrung* (Berlin 2005); 'Criticizing a Difference of Contexts: On Reichenbach's Distinction between 'Context of Discovery' and 'Context of Justification'' (in *The Vienna Circle and Logical Empiricism*, Dordrecht 2003); 'Dissolution of the Nature-Technology Dichotomy? Perspectives on Nanotechnology from the Viewpoint of an Everyday Understanding of Nature" (in *Discovering the Nanoscale*, Amsterdam 2004).

Joachim Schummer is Heisenberg Fellow at the Technical University of Darmstadt. He graduated both in chemistry and philosophy and received his Ph.D. (1994) and Habilitation (2002) in philosophy from the University of Karlsruhe. From 2003 to 2004, he was Visiting Professor at the University of South Carolina and Director of Project Research of Davis Baird's interdisciplinary team to study the societal and ethical interactions of nanotechnology. His research interests focus on the history, philosophy, sociology, and ethics of science and tech-

nology, with emphasis on chemistry and, since 2002, nanotechnology. He is the author of *Realismus und Chemie* (1996) and more than fifty research articles; (co-)editor of *Philosophie der Chemie* (1996), *Glück und Ethik* (1998), *Discovering the Nanoscale* (2004) and five special journal issues; and editor-in-chief of *Hyle: International Journal for Philosophy of Chemistry*. He serves on various international committees, including the UNESCO expert group on Nanotechnology and Ethics.

Christopher P. Toumey is a cultural anthropologist who studies the hermeneutic dynamics of public scientific controversies. He has written about creationism, fluoridation, cold fusion, AIDS/HIV, smoking, and other topics. He is the author of *God's Own Scientists: Creationists in a Secular World*, and *Conjuring Science: Scientific Symbols & Cultural Meanings*, plus about forty articles on scientific controversies. His two main interests in nanotechnology are narratives that people tell to come to terms with nanotech, and question of democratic mechanisms by which nonexperts participate in processes of making nanotechnology policy.