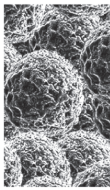
ARMIN GRUNWALD

RESPONSIBLE NANOBIOTECHNOLOGY



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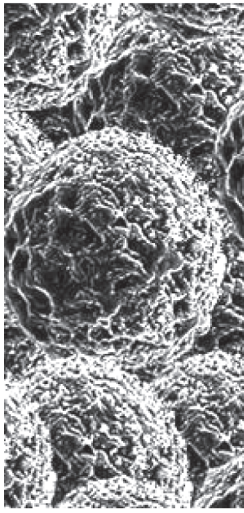
Philosophy and Ethics



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Preface

Nanotechnology is one of the most prominent emerging technologies. It has been heralded as a key technology for the twenty-first century that — according to the expectations of a broad alliance of policymakers, scientists, and industry representatives — will contribute to economic prosperity and sustainable development. Via its enabling role in nanobiotechnology and in concert with "converging technologies," nanotechnology could also influence the future of human nature and play a role in creating artificial life. The development of nanotechnology is thus also related to new debates about the *human condition* and the future of society as well as to man's relationship with nature and technology.

In view of the revolutionary potential frequently attributed to the nanosciences and nanotechnology with respect to nearly all fields of society and individual life, it is not surprising that research and reflection on their presumed societal consequences started early. Technology assessment (TA) and studies of the ethical, legal, and social implications (ELSI) began analyzing issues related to nanotechnology and society about 10 years ago. The analysis, deliberation, and assessment of the expected impact of nanotechnology on future society are now regarded as necessary contributions to the present and further development of nanotechnology and its enculturation into society. Ethical reflection on nanotechnology, in particular on its relationship with living systems in nanobiotechnology, has emerged quickly and led to the new term "nanoethics," which has been elaborated on and debated at workshops, conferences, and summer schools as well as in books and scientific journals.

In the present book, I review the considerations of nanotechnology elaborated in philosophy, ethics, and the social sciences and systematize and develop them further. The focus is on issues

of ethical responsibility regarding chances and risks of nanotechnology and its possible applications. From this analysis of the normative challenges posed by nanotechnology, my goal is to derive orientation for further, responsible work in research and development. I thus put the book in the context of the keywords "responsible innovation" and "reflective sciences" which have been central concepts in the debates about the relationship between science and society for the last few years.

To a not unsubstantial extent, the analyses presented in this book are based on my own previous studies. Nearly 10 years ago I began to concern myself with the societal and ethical aspects of nanotechnology. This research has led to a number of publications that I have been able to use as a starting point for the present work. I would like, above all, to mention the book *Auf dem Weg in eine nanotechnologische Zukunft. Philosophisch-ethische Fragen* (The Path to a Nanotechnological Future: Philosophical and Ethical Issues), published in German by Verlag Karl Alber in 2008. The major developments versus that book are the introduction to the historical development of the field, the mapping of the ethical issues posed by nanotechnology, the addition of the field of animal enhancement, the programmatic focus on the explorative role of ethics and philosophy, as it has been formed in the debates on speculative nanoethics, and the concentration on aspects of responsibility.

My thanks go to my many colleagues in Germany, Europe, and around the world with whom I have had the opportunity in the last few years to discuss the philosophical and ethical aspects of nanotechnology. This has taken place both within these disciplines as well as within the framework of interdisciplinary dialogue, for example in the fields of technology assessment and of STS studies (i.e., on science, technology, and society). To represent these many people, I would here like to name just a few: Alfred Nordmann, Arie Rip, and Tsjalling Swierstra. My special thanks for long and ongoing cooperation on questions related to nanotechnology and for a number of valuable substantive suggestions go to my colleagues in Karlsruhe Christopher Coenen, Michael Decker, Torsten Fleischer, and Peter Hocke-Bergler as well as to Hans-Jürgen Link.

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Armin Grunwald
Karlsruhe, January 2012