THE NEW ATLANTIS
A Journal of Technology & Society

Nanoethics as a Discipline?

Adam Keiper

Nanotechnology is all the rage. Its potential is touted not only in science fiction books and movies, but in front-page newspaper articles and in the halls of power. It has garnered great interest from industry and a sizeable line item in the federal budget. And the little prefix "nano" has become a high-tech buzzword, applied to products far and wide (even, in some cases, when they have nothing to do with nanotechnology).

In recent years, the most important developments for the future of nanotechnology have come from outside the laboratory, where growing ranks of policy analysts, advocacy groups, social scientists, and freelance futurists have begun to focus their attentions on the social and ethical implications of nanoscale science and technology. Some of these observers worry about the dangers that nanotechnology might pose for human health or the natural environment, and governments and corporations are beginning to take those concerns seriously. But others have a far larger if more vague idea in mind. They are trying to midwife a new academic discipline called "nanoethics" to think through the societal, moral, and broader human implications of advances in nanotechnology. The fledgling field is in some respects modeled on the development of bioethics, which began in earnest in the 1960s. But bioethics was decisively different in ways that cast a pall over the prospects of nanoethics as a serious discipline. By the time bioethics arrived on the scene, the subjects of its inquiries had already been long in existence. Modern human biotechnologies had been advancing for many decades, and of course the practice of medicine (which was the original chief focus of the field, and which remains its preeminent occupation) had been around since time immemorial. Bioethics involved the application of longstanding methods of ethics to longstanding problems of medicine and science, and to the way those problems might extend themselves into the future. Nanoethics, on the other hand, takes as its subject a science still aborning; many of the ethical and social ills it seeks to address are mere speculations about the hypothetical ramifications of theoretical technologies that may prove technically impossible. It is fair to say that no scientific field or technological innovation has ever faced such intense scrutiny so prematurely.

Adam Keiper *is editor of* The New Atlantis *and a fellow at the Ethics and Public Policy Center.*

Nanotechnology, Real and Imagined

Nanoethics is first and foremost plagued by a persistent confusion about what exactly nanotechnology is—a confusion that researchers themselves sometimes exacerbate. The term "nanotechnology" is used nowadays as a catch-all to describe a wide range of research efforts that involve understanding and manipulating matter at the molecular level. The great bulk of this research seeks to find new uses for nanoscale particles or to engineer new materials, some of which have been incorporated into consumer products you can buy today, such as cosmetics, stain-resistant clothing, and antibacterial food containers. This type of nanotechnology is essentially a branch of materials science, and in the years ahead it is expected to yield powerful medical diagnostic tools, ultra-efficient water-filtration systems, strong and lightweight materials for military armor, and numerous breakthroughs in energy, computing, and medicine.

The expectations for those nanomaterials, however, pale in comparison to the hope and the hype surrounding another kind of nanotechnology: theoretical nanomachines. This more radical vision, first described in detail by Eric Drexler in the 1980s, involves molecular manufacturing—building things "from the bottom up" by precisely placing atoms. Personal nanofactories the size of a microwave oven could, so the thinking goes, be programmed to convert raw materials into complex objects like laptop computers. Other nanomachines could replace or repair damaged cells in the body, helping to stave off aging. Still others could make terrible new world-destroying weapons.

The divide between these two versions of nanotechnology is stark. Today's work on nanomaterials is evolutionary. It promises to improve our lives relatively soon with better products and tools. Hundreds of companies and universities are engaged in this work. Governments around the world are pouring billions of dollars into such research—including the U.S. government, which is now spending around $1.4 billion each year through its National Nanotechnology Initiative (NNI), an umbrella program that coordinates nanoscale research among more than a dozen federal agencies. By contrast, the far more revolutionary notion of nanomachines, which has caught the eye of legislators and tickled the imagination of science fiction writers, is the bailiwick of a tiny group of researchers who spend their time on technical analysis and computer modeling of devices that do not now, and might not ever, exist. No federal R&D dollars have been spent on this kind of advanced nanotechnology, although that may change if the NNI follows the advice of a long-awaited report the

National Research Council released in late 2006. Noting that the preliminary work on nanomachines has primarily involved "abstract models," the report called for "experimentation leading to demonstrations" so as "to better characterize the potential for use of bottom-up or molecular manufacturing systems."

So if this is the lay of the land—a great flowering of research in an important and well-funded (if perhaps incoherently broad) field while a more distant field has seen only theoretical groundwork—then one of the difficulties facing aspiring "nanoethicists" becomes clear right off the bat: our ability to anticipate the societal and ethical consequences of nanotechnology will plainly be conditioned on what actually turns out to be possible. Nanomachines could well raise all sorts of social and ethical questions, depending on what form they end up taking, if any. But that kind of nanotechnology does not exist yet, and the kind that does raises only a fairly narrow set of familiar concerns. At the moment, in fact, there is only one issue in the realm of nanotech policy and ethics around which a broad consensus seems to be forming: the environmental and health effects of nanoparticles and nanomaterials need to be investigated with an eye toward possible regulation.

Regulating for Safety

It should come as no surprise that the question of safety has emerged as the first nanotech issue around which diverse stakeholders and observers can coalesce. It is low-hanging fruit, after all. Environmental activists worry about the damage that nanostructured materials could inflict on the natural world. Consumer groups worry that nanoparticles might cause cancer or have other adverse health effects. Business leaders worry that unfounded fears could lead to public rejection of nanotech products, akin to the European opposition to genetically modified foods.

Rice University nanotechnologist Vicki Colvin, the director of the university's Center for Biological and Environmental Nanotechnology, described in 2002 how, "in a field with more than 12,000 citations a year," her team had been "stunned to discover no prior research in developing nanomaterials risk assessment models and no toxicology studies devoted to synthetic nanomaterials." In the years since then, dozens of studies have begun to examine those problems, including a widely reported study showing that buckyballs—a type of manmade carbon molecule—could cause brain damage in fish. But the research done so far has only scratched the surface of potential nanotoxicology questions. Many unanswered

questions remain. Which nanomaterials are biodegradable and which persist in the body or the environment? Some nanoparticles kill microorganisms; could their increased production and eventual dispersal disrupt food chains? How can factory workers best be protected from exposure to nanomaterials that could damage their lungs or other organs? In a recent lecture at the National Academy of Sciences, Harvard researcher George Whitesides pointed to the deliciously convoluted acronym ADME/Tox/PK/PD—for adsorption, distribution, metabolism, excretion, toxicology, pharmacokinetics, pharmacodynamics—and warned, "We don't know anything about that. We don't know about *any* of those things for nanoparticles." Such questions would be complex enough if just one kind of substance were involved, but the variety and many different applications of nanoparticles and nanomaterials make the study of their health and environmental effects bewilderingly complicated.

Liberal environmental groups have been increasingly vocal about demanding regulation of nanomaterials. "The failure of government regulators to take seriously the early warning signs surrounding nanotoxicity suggests that they have learned nothing from any of the long list of disasters that resulted from the failure to respond to early warning signs about previous perceived 'wonder' materials (like asbestos, DDT, and PCBs)," said a recent report from Friends of the Earth. That organization joined several other liberal groups in 2006 in petitioning the federal government to start regulating products with nanomaterials. Another of the petitioners, the Action Group on Erosion, Technology, and Concentration (ETC Group), which has for a few years been calling for a "mandatory moratorium on the use of synthetic nanoparticles in the lab and in any new commercial products," in early 2007 held a contest to design a yellow and black "nano-hazard" symbol—a publicity stunt that brought in 482 entries from 24 countries.

More mainstream science policy voices have stopped short of calling for outright regulation. In 2004, the Royal Society and the Royal Academy of Engineering in the United Kingdom recommended that "all relevant regulatory bodies" should "consider whether existing regulations are appropriate to protect humans and the environment," and that "nanoparticles undergo a full safety assessment by the relevant scientific advisory body before they are permitted for use in products." In a follow-up report in late 2006, they said they were "seriously concerned at the lack of progress" in understanding the effects of nanomaterials. The U.S. National Research Council has reached similar conclusions. In a September 2006 hearing, Representative Sherwood Boehlert, then chairman of the House

Science Committee (he has since retired from Congress), summed up the federal government's approach to the uncertainties about nanomaterials safety: "We're on the right path to dealing with the problem, but we're sauntering down it at a time when a sense of urgency is required."

A covey of federal agencies shares regulatory jurisdiction over nanomaterials in the United States, including the Environmental Protection Agency (EPA), the Food and Drug Administration, the Consumer Product Safety Commission, and the Occupational Safety and Health Administration. It is still too early to tell whether the statutes those agencies enforce will be sufficient to prudently regulate risky nanomaterials. And some existing statutes have bizarre loopholes that will affect the regulation of nanomaterials. This became clear in just the past few months when the EPA announced that Samsung's SilverCare washing machine could be regulated as a pesticide. The EPA justified that odd classification for a washer on the grounds that Samsung claims the 100 quadrillion silver ions released during a washing cycle sanitize laundry by killing bacteria. Environmentalists worry that silver particles discharged with the wastewater could accumulate in the environment, killing microbes in the wild. But to evade EPA regulation, all Samsung would have to do is stop *claiming* in its ads that the SilverCare washer kills germs; it need not alter a thing about the washers themselves. Other companies have reportedly since removed similar claims about antimicrobial nanotech from their marketing materials.

Maddened by federal inaction, state and local governments might soon start regulating nanomaterials on their own. The only such regulation so far is, unsurprisingly, in Berkeley, California, where an ordinance enacted late in 2006 requires any company using or researching nanomaterials within the city to disclose the nature of its work. (As of this writing, the city council of Cambridge, Massachusetts is reportedly considering a similar measure.) Anything more restrictive would be regulating from ignorance, for the plain fact is that we still know very little.

Even though more federal funding is expected to be directed to research on the health and environmental effects of nanoparticles in the years ahead, that research remains fundamentally disorganized. This may change, though, both because of growing awareness of the chaos that now reigns, and because of a research agenda proposed in the journal *Nature* in November 2006 by fourteen prominent nanotoxicity researchers and analysts. They call for a set of "grand challenges" to unfold over the next fifteen years, all intended to "bring focus to a range of complex multidisciplinary issues." These include the development of instruments

for detecting nanomaterials in air and water, methods for evaluating the toxicity of nanomaterials, and new ways to predict and evaluate the effects of nanomaterials "from cradle to grave"—that is, from a product's "manufacture, through its use, to its ultimate disposal." This broad-based agenda, if taken up, could bring some much-needed order and direction to today's scattershot nanotoxicity research.

Beyond Safety

Discussions about the implications of nanotechnology extend far beyond research on its health and safety effects, of course. In just the past few years, a great and growing number of advocacy groups, think tanks, and university centers in the humanities or social sciences have begun to work on nanotechnology. There are so many conferences and seminars and government-funded workshops, so many reports and studies and white papers, that the literature on the social and ethical implications of nanotechnology can be overwhelming—even if much of it is redundant.

The motivation for many of these meetings and for much of this spilled ink is the largely unexamined assumption that nanotechnology will transform the world and will have profound ethical and social consequences. There are perhaps a dozen print and online scientific and technical journals that focus specifically on nanotechnology; some of them occasionally publish articles on its ethical and social implications. Many other science magazines and journals, both academic and popular, have recently published editions focusing on nanotechnology; they generally take for granted that major social and ethical issues are impending as nanotechnology develops. This literature is littered with acronyms like *SEIN* (for the social and ethical implications of nanotechnology), *NELSI* (a nanotech version of the "ethical, legal, and social implications" rubric first associated with the Human Genome Project), and NE^3LS (nano ethical, environmental, economic, legal, and social issues).

When members of Congress speak about nanotechnology, they regularly pay lip service to the "host of novel social, ethical, philosophical, and legal issues" nanotechnology will raise. So certain are some legislators that such issues will arise that Congress has required by law that a portion of the federal dollars spent on nanotech research be directed toward funding interdisciplinary research centers to look into the "societal, ethical, and environmental concerns" related to nanotechnology, "including the potential use of nanotechnology in enhancing human intelligence and in developing artificial intelligence which exceeds human capacity."

While a number of American universities have received such federal support, the two chief recipients today are a pair of Centers for Nanotechnology in Society, one at the University of California, Santa Barbara, the other at Arizona State University. The latter group is remarkable for its calendar teeming with lectures and events, its prolific faculty and graduate students, and its ambitious plans for new projects—like the establishment of an International Nanotechnology and Society Network to serve as a clearinghouse for the work of dozens of scholars from around the world.

The many other institutions with nano-and-society projects run the gamut from the Woodrow Wilson Center (whose project spotlights the intersection of nanobusiness, consumer safety, and policy) to the Illinois Institute of Technology (whose nanotech project is described as having a "special focus on the human condition") to the Foresight Nanotech Institute (created back in 1986 by Eric Drexler and colleagues as the first organization to focus on nanotechnology, this group is badly adrift, having gone through three presidents in the past three years). The Center for Responsible Nanotechnology is a two-man operation that worries about the implications of molecular manufacturing; the Nanoethics Group is a three-man operation that believes "we haven't imagined enough of the implications of nanotechnology." When you add into the mix all the think tanks (liberal, conservative, and libertarian), advocacy groups (especially environmental activists), and international institutions (most notably agencies within the United Nations bureaucracy) that have had something to say about the social and ethical implications of nanotechnology, you might be forgiven for wondering whether there is a saturation point for commentary on nanoethics—and when that point might be reached.

Rise of the Nanoethicist

The growing interest among academics and activists in the implications of nanotechnology is surely, in some ways, to be welcomed. Serious scholarship and responsible advocacy can serve to enlighten and invigorate policy disputes and thereby play an important role in democratic self-rule. After all, as anyone who follows nanotech policy debates even from a distance can tell you, those debates are awash in spin and misinformation. Environmental groups exaggerate the known dangers of nanoparticles. Firms involved in nanotech investment vie with one another in hyping their projections of how many trillions of dollars the "nanotechnology market," defined as expansively as possible, will be worth in a few years' time.

Some analysts are ludicrously credulous, while others are just plain confused—like the panelist at a conference in Washington in April 2006 who fretted about Pentagon-funded research on nanosatellites. (Nanosatellites are just small satellites; they have even less to do with nanotechnology than Apple's "iPod nano" does.) Commentators who are ill-informed or disingenuous or just "shooting from the lip" may, in time, cede the sound bites and the airwaves to the growing ranks of better-informed and more responsible scholars—or at least that's the theory.

Indeed, that theory seems itself to be the core of nanoethics at the moment. A recurring theme in much of the social-science writing about nanotechnology is the importance of social-science writing about nanotechnology. When you sift through the growing piles of scholarship about media coverage of nanotechnology, about the public understanding of and attitudes toward nanotechnology, about whether there are multiple "publics" who need to be "engaged" in nanotech policy, one sentiment in particular becomes clear—social scientists' sense of self-importance. The social scientists studying nanotech write a great deal about themselves. Sometimes this comes across as jargon-filled gobbledygook of the sort that would make any policymaker or scientist cringe, like this passage from University of South Carolina Professor David Berube's 2006 book *Nano-Hype*:

> The decision-making axiology of an established science team may be codified, and the attached team of social scientists may find their role additive and subtractive only. As a result, negotiating a calculus or algorithm of societal and ethical implications that is fully integrative into *if*, *how*, and *when choices are made*, becomes seriously impaired.

In other instances, social scientists verge on self-pity in bemoaning their apparent exclusion from the early days of nanotech policy, as in this passage from an article by Arizona State University scholars Ira Bennett and Daniel Sarewitz in the December 2006 issue of the journal *Science as Culture*:

> Science studies scholars were largely absent from the processes by which the social meanings and implications of nanotechnology became part of public discourse. They were also, at best, marginal players in the U.S. while bureaucrats and lawmakers began to set an agenda for discussion about, and research into, the societal implications of nanotechnology. As a result, nanotechnology got a fifteen-year head start on serious thinking about how society ought to govern its emerging capability in molecular manipulation, and the science studies commu-

> nity—much like society at large—finds itself in a position of reaction and dependence relative to nanotechnology.

It would be wrong to dismiss these and the many similar examples of nano-social scientists writing about themselves as scholarly navel-gazing. Social scientists are convinced that the work they are doing on nanotechnology is vitally important. But to them, that work obviously represents more than just an effort to meet the challenge of governing a new technology wisely; it is also an opportunity to test the many theories and techniques they have created in recent decades. They are palpably excited by the chance they will have, using government dollars, to tinker with "citizen juries" and "consensus conferences" and "upstream engagement"; they are delighted that they will get to experiment with different risk analysis methodologies; they are looking forward to deploying the tools of "real-time technology assessment." But as Charles T. Rubin has argued, experience suggests that the professional tenor of these efforts—as all that "interdisciplinary" work grows into just another sub-discipline—is likely to yield groups of intelligent and well-intentioned people who end up largely talking to each other in the specialized language they create to define the boundaries of their field. Their success will be measured by conferences, hyper-specialized journals, and successful grantsmanship, all punctuated by periodic lamentations that the "real world" does not pay more attention to what "we" are saying.

Alongside the social scientists there are the many other academics—mostly humanities scholars—who have begun to adopt the neologism "nanoethics" to describe their work. Here "ethics" is generally not meant to describe a professional code of conduct but a specialty of applied ethics, in the sense of all the many other "ethics of" sub-disciplines in which rarified academic orientations coexist only very uneasily with the "real world"—from computer ethics to environmental ethics to engineering ethics to bioethics.

A handful of critics have questioned whether nanotechnology merits its own "ethics" sub-discipline. Some have argued that the issues raised by nanotechnology are not recognizably different from those raised by other areas of emerging science and technology; others acknowledge that nanotechnology may raise unique issues, but think they aren't serious or immediate enough to deserve sustained attention. Even the editors of and contributors to the new journal *Nanoethics*, the first issue of which has just been published in early 2007, seem uncertain about their journal's eponymous discipline. "Can there be a dedicated nanoethics, just as there is, by now, a bioethics? And should there be?" asks one article's author before

ambivalently concluding that "there may not be a need of a dedicated nanoethics." Even the journal's editor, John Weckert, a professor of information technology at Charles Sturt University in Australia, explains in his inaugural editorial that it is "not clear that the issues will be new in any interesting sense" and there remain "uncertainties about nanoethics" as a discipline.

Nanoethics and the Knowable Future

And what of the substance of nanoethics? What issues are of concern to the new nanoethicists? When you set aside the questions that are obviously secondary—such as questions about how well the public understands nanotechnology—you are left with four very broad categories of inquiry.

The first is the question of safety, the most fundamental concern of the modern state. Although, as described above, researchers still understand very little about the health and environmental effects of nanoparticles, it seems likely that, as they learn more, some kind of regulatory regime will be developed. But what about the more distant dangers of more advanced forms of nanotechnology? While the "gray goo" apocalypse, in which uncontrolled self-replicating nanomachines devour Earth's biosphere, is now regarded as passé by the cognoscenti of nanotechnology, there are other potential physical dangers that far-out nanotech might bring. For instance, the Center for Responsible Nanotechnology frequently frets about the possibility of a dangerous "unstable arms race" that could follow the advent of molecular manufacturing; they worry that "gradual escalation" could lead to "conflagration," and caution that the "destruction caused by nanotech-based weapons could be more targeted and contained than nuclear explosions." Nanotech "arms control" is needed to avert the worst, they warn. Disregard, for a moment, the many simplistic political and social assumptions underlying both their description of the problem and their proposed solution—the point is that advanced nanotechnologies could conceivably pose dangers beyond the immediate concerns about the health and safety of nanoparticles.

The second category of concern to nanoethicists could, for the sake of convenience, be given the heading "social justice." This category includes questions about equity, access, and socioeconomics, as well as questions about how much control governments, militaries, or corporations should have over nanotechnology. Similar concerns have been raised about a broad array of new technologies, and they are now being dressed up with a "nano" prefix as in the past they have worn "bio," "digital," or "eco." So, for instance, the "digital divide," the 1990s-era fear that the computer

age might leave millions of poor people behind, has a nano-analogue: the worry of a potential "nano-divide" between nano-haves and nano-have-nots. Another byword for activists and academics for the last two decades, "sustainable development," is now being applied to nanotech. And countless other social and economic concerns, including the effects of globalization and the old Luddite worry about job displacement caused by technology, are now getting linked to nanotechnology.

The third area of nanoethical inquiry relates to vast and genuinely novel social changes that the development of nanotechnology might wreak. Could nanotechnology play a part in the development of artificial intelligence, and if so, would that development be as socially transformative as many of its advocates hope? Could nanotechnology radically erode privacy, as it becomes easier to gather vast amounts of information about each of us, not just through surveillance but through new kinds of genetic and forensic analysis based on nanotechnology (a prospect one scholar has dubbed "nano-panopticism")? Might molecular manufacturing bring about an end to scarcity?

The final category is also revolutionary; it involves the use of nanotechnology not just to transform society but to redefine our very humanity. Some of the scientists and policymakers involved in the federal government's nanotechnology initiative have made extreme claims about the medical benefits nanotechnology will bring relatively soon. It is, for instance, slated to play a key role in the National Cancer Institute's plan to "eliminate suffering and death from cancer" by 2015. But even such grand ambitions pale in comparison to the claims made by National Science Foundation officials about the looming "NBIC convergence"—the notion that biological science, information technology, and cognitive research will all converge at the nanoscale, opening up new possibilities for the radical control and enhancement of the human form. The NBIC claims are just a stone's throw away from the transhumanist dreams of using nanotechnology and other new techniques to merge man and machine, and for man to fundamentally alter and eventually leave behind his given biological nature. The fact that some of those enamored of this absurd fantasy work for the National Science Foundation is worrisome, but it doesn't make the fantasy any less absurd.

Nanoethics as a Discipline?

These four areas of inquiry overlap, of course. And in all four areas, the work suffers from the same set of intrinsic problems that seem certain to

bedevil the emerging field of nanoethics in the coming years. The first problem relates to *facts*. It is difficult, if not impossible, to have any discussion, let alone serious ethical reflection, if there is not first some basic agreement about the facts at issue. There is no such agreement when it comes to nanotechnology. In much of the burgeoning nanoethics literature, there is a sloppy and lazy tendency to slip from today's cutting-edge science to the most far-out imaginings of futurists, as though the former were old news and the latter were ineluctable. This ignores the chain of uncertainties that makes the future unknowable: Just because a particular technological development is imaginable or conceivable doesn't mean it is possible; just because it is possible doesn't mean it will happen; even if it happens, it may not come to pass quite as anticipated; and even if it does happen approximately as anticipated, it will surely have unintended and unexpected consequences. These glaring epistemological problems of course confront anyone who engages in futurism and forecasting. But they are especially nettlesome for nanoethics, where they are compounded by technical ignorance and by fantasies both utopian and apocalyptic, and where—far more than in bioethics, for instance—the possibilities under discussion are often terribly implausible.

Still, as Bertrand de Jouvenal has written, "forecasting would be an absurd enterprise were it not inevitable." We *must* make predictions about the future in order to decide what to do now. And there is something to be admired about the impulse to anticipate the social and ethical consequences of advances in nanotechnology. But much of the nanoethics literature seeks to go further—not merely to anticipate, but to direct and to govern the consequences of nanotechnology. This is where the second problem of nanoethics arises: the problem of *politics*. Much of the nanoethics literature involves suggestions for concrete action to protect the promise nanotechnology may hold out and to mitigate or remediate the perils it may pose. But these suggestions are often severed from practical reality. What will be the use of a "global dialogue on nanotechnology"? How would "arms control" for nanotech ever come about before nanotech weapons even exist? If "public control" of nanotechnology is really more desirable than "private control," who could or would ever make that happen? How far should we go to prevent a "nano-divide"? What, for goodness sake, does it even mean for "an ethical nanotechnology initiative" to be "threaded into the social fabric of the persons and communities that have a stake in its appropriation"? A nanoethics so detached from practical politics will be useless—or worse.

The third problem facing nascent nanoethics is the problem of *values*. As Charles T. Rubin has suggested, when values enter discussions about

nanotechnology, as they must, they are generally treated as givens, either in the manner of survey research (how many people think this or that is good?) or by adopting uncritically the normative discourse of the moment (nanotechnology should contribute to sustainable development because whatever that means, it's supposed to be a good thing, right?). Today's early nanoethics literature evinces our postmodern inability to seriously discuss questions of ethics, and it reveals just how parched the language of academic ethics has become. What are the great social goods we seek to preserve? What are the high human goods we wish to defend? Those involved in nanoethics seem uninterested, unwilling, or unable to engage these deeper questions. The oft-heard refrain—that ethics has to "keep up" or "catch up" or "evolve" with advances in technology—is a prescription for a shallow and reactive ethics, one that ignores the questions that matter most.

Here again, the contrast with early bioethics is instructive. Every budding nanoethicist should be made to read Daniel Callahan's wise and humble 1973 essay "Bioethics as a Discipline" for a sense of how to approach the unknown and unknowable in a serious and organized way. Nanoethics, as it has begun to take shape, lacks exactly this sense of humility. And it lacks also a well-defined object of concern. Bioethics was, if anything, late in coming. Nanoethics, on the other hand, bears all the signs of prematurity. Its time may come someday, but it is too soon to say just when and how.