CONTRADICTIONS IN NAN0-TECHNOLOGY'S

FUTURE SOCI0-ENVIRONMENTAL IMPACTS

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A. Nanotechnology as an *Instrument of Power* involves concerns about the emergence of a nanotechnocracy; the possibility of the structures within nature being copyrighted when the environment is a gift to all people; issues surrounding the establishment of a monitoring body to decide between societal or military research priorities (if this is non-governmental), difficulties in regulating nanotechnology to minimise inequalities at a social, cultural, economic and global level; the potentiality of "nano-rich" and nano-poor" countries, together with concerns about nano-colonialism or nano-imperialism, nano-surveillance and invasion of privacy. ..

Nanotechnology as *Threat* involves concerns about self-replicating organisms, nanoviruses, the reconfiguration of life-forms in nature, a potential depersonalisation of human life, and issues surrounding security, military applications and nanoterrorism....

Concern has been expressed..., regarding the potential misuse of nanotechnology and the possible risks associated with its widespread application of adverse ecological and health effects due to nanoparticles and self replicating systems entering the environment and in the human body. Public acceptance of nanotechnology is likely to be strongly influenced by the perception of the associated risks. The *precautionary principle* should therefore be applied and adequate monitoring systems set up to determine the true extent of these risks. In addition, an effective dialogue needs to be promoted between physical, biological and social scientists and the medical profession, together with patient groups, lawyers and policy makers in order to establish an appropriate legal and ethical framework for research and development and the implementation of nanotechnology in healthcare...

The manipulation of molecules to manufacture genetic material, including novel self-replicating substances with no equivalent in nature, poses many risks. What are these risks, how real are they now (given that one company has already built a fifth nucleotide base unknown in nature) and who is regulating them? What other environmental risks are posed through nanotech applications, either now or in the foreseeable future? ...

> The convergence of IT, biotech, atomic manipulation and artificial intelligence disciplines is seen as offering exciting synergies. *Will the convergence of companies from these different industrial sectors create yet larger corporations with even greater economic and political influence? If so, how can their impacts be effectively regulated.* There is clear potential for nano applications to enable the widespread and cheap surveillance of individuals. There is also the potential for far faster genetic profiling and other applications that will invade privacy. What are the implications of these potential applications of nanotech and how can they be effectively regulated? ...[UK: *Nanotechnology: What It's All About]*

<u>B. Potential risks from NT:</u>

> Economic disruption from an abundance of cheap products
> Economic oppression from artificially inflated prices
> Personal risk from criminal or terrorist use
> Personal or social risk from abusive restrictions
> Social disruption from new products/lifestyles
> Unstable arms race
> Collective environmental damage from unregulated products
> Free-range self-replicators (gray goo) —
> *downgraded as a risk factor*
> Black market in nanotech (increases other risks)
> Competing nanotech programs (increases other risks)
> Attempted relinquishment (increases other risks)
> [Center for Responsibe Nanotechnology: *Dangers of Nanotechnology*]

<u>A. PROFITABILITY CRITERIA VS. THE PRECAUTIONARY PRINCIPLE</u>

1. Basic contradiction in NT is the emphasis on heavy capital investment needed for nanotech as the <u>forces</u> of production, versus the inferences drawn as to the social <u>relational</u> impacts of nanotech resulting from this investment. Above, excerpt A from a recent report indicate the approach-avoidance orientations towards nanotechnology. There is a fairly clear divide between the APPROACH of private firms and their responsive scientists and technologists, on the one hand, and the AVOIDANCE orientation of social and environmental constituencies.

The issues may be reframed by the call for the "precautionary princple", which has been substantially opposed by the former, and supported by the latter in a variety of production technologies before the advent of nanotechnology. The state has been called upon by both groups – to subsidize nanotechnologies for economic growth (and vaguely, for tax revenues), by the first group, and to regulate/control/monitor such investments and their applications by the second group.

Excerpt B lists a range of potential problems, many of which have not been adequately dealt with in current and previous technologies. This suggests that not only will NT not solve existing problems of this type, but it will add to the current stock of "negative externalities" of modern production, and do little to address the existing distribution of this stock of "public ills", including existing patterns of environmental injustice (Pellow & Park 2003).

2. Motives for investment (rank-ordered):

1. profit-enhancing impacts
2. labor-saving effects
3. conservation of energy
4. conservation of materials
5. quality of life enhancement

3. Only **#1** is the ideologically-consistent message with contemporary capital allocation, viz. maximizing the share-holder returns to their capital invested. While #2-5 *might* accompany such a change in production technology, it will not displace #1 as the dominant form of capital allocation (and indeed, levels #2 and #3 are generally seen as valuable only insofar as they contribue to #1). Indeed, if we think about technical and economic trends, much more effort is being devoted to *commodification*, even of purely natural resources such as water, by the World Bank and national governments (Goldman 2006). So why would we expect that for-profit enterprises would de-commodify their production activities with just a change to nanotechnology??

4. Moreover, with the economic and political support (in the US especially) for #1 as the dominant criterion for allocation (and subsidizing) capital outlays for NT, we should be skeptical of exactly how much the total production **system** generated by NT investments will have characteristics of a-d as by-products.

B. THE EVALUATION OF PUBLIC SUBSIDIES OF PRIVATE-SECTORS

5. The most interesting US examples include the early generalizations made about "atomic energy" (Duncan), on the one hand, and about "computer chip" development in Silicon Valley in the US (Pellow and Park). In both cases, the "publics" were persuaded on the wisdom of investment in the new technology, on the basis on how much this would improve everyday life – boundless cheap energy in the first case, and boundless information technology and the easy computerization of life tasks, in the latter.

6. One major difference in the two cases was that nuclear energy was overtly publicly funded and heavily subsidized, so that citizen-publics needed to be persuaded to support their representatives in offering massively support for nuclear power. In the case of computer chips, the overt investment was private. Yet the central role of the defense industry in supporting the development of new chips provided substantial public investment as well (Pellow and Park). This had long-term impacts of different types for the two technologies. The hazards and economics of nuclear power eventually led to the state's reduction in support, and was followed by increasing costs and reduced revenues for private electrical utility corporations.

There is, interestingly, a renewal of economic and political interest in nuclear power in the US, because *direct* nuclear power production of electricity reduces the direct impact of utilities on greenhouse gases and global warming. Yet many of the attributes of a nuclear powered *system* of energy production both continue to require public subsidies, on the one hand, and may promote global warming, on the other hand (e.g., energy uses for waste processing and haulage).

7. Conversely, computer chip technology – which the US introduced – was mainly concentrated in one state (California) and locale (Silicon Valley, around San Jose). The industry slowly polluted many local water and land areas with toxic wastes, and it even more powerfully created workplace hazards for its shopfloor workers. Because the latter were often newly-arrived Asian immigrants and women, they had little influence in changing production technology (Schnaiberg 1986) . Ironically, the publicly-touted

"clean rooms" for chip production were simultaneously hazardous workplaces for assembly workers, using toxic solvents to "clean" the products while absorbing many of these toxics on their persons (and even in their homes, where they took piecework for extra income).

The occupational hazards *in the US* were only reduced when the corporations began outsourcing production to Asia, thereby skirting the political efforts by US workers' organizations. As with many other occupational and environmental risks posed by manufacturing in the North, a number of treadmill firms have relocated production in countries with both cheaper labor <u>and</u> lower regulation in workplaces and communities (cf. Pellow and Park).

8. The likely trajectory of NT is also likely to be influenced more by #1than #2-5 because so little of the prior technological change has actually been systematically *evaluated.* Despite several decades of "environmental impact assessment" and "social impact assessment", my earlier concerns (Schnaiberg 1980: ch vii, Meidinger & Schnaiberg 1981) about "impact assessment" largely has remained. "Program evaluation" in the US for social programs in the 1970s, entailed systematic evaluation of program achievements relative to promises built into the very design and funding of such public programs. In contrast, the complex mix of private production and public subsidization has never been scrutinized in the same way. This has been true of major *economic* policy shifts, such as NAFTA, which have never been officially evaluated.

9. Generally, there has been little dedication to evaluation when there are *private* sector interests predominating (perhaps on the assumption that "the market" makes it own profitability calculations). Thus, claims about the future impacts of nanotechnology are essentially unsubstantiated. Note that exceptions to this typically arise when there are conflicting interests opposing public subsidization of private-sector programs –e.g., when Ralph Nader's group evaluated NAFTA, or when Tufts' GDAE center evaluated US investment in *maquilla d'oros* and other US investments in Mexico. And even in these cases, there is limited data available that can serve as definitive outcomes of the program, as distinct from other elements of change in the socio-economic setting.

C. WHICH ENVIRONMENTAL & SOCIAL OUTCOMES ARE MOST LIKELY THROUGH NANOTECH-BASED INDUSTRIAL TRANSFORMATIONS?

10. It is important to recall that the initial developers of NT (Taniguchi & Drexler) were a precision engineer and a physicist. Neither of these had any expertise in the impacts of NT beyond a particular production operation. Yet many subsequent claims about environmental and social protection have been made by Drexler and a variety of scientific "experts" (cf Dietz & Rycroft).

11. In terms of specific applications of NT, the most widely-feared ecological hazard is a kind of "runaway technology". NT applications will not prove capable of being stopped, and a kind of "primordial ooze" will proceed to spread to ecosystems. [labor, wages, displacement of workers, tax credits for investment vs. support of existing industries, etc.] Excerpt B at the start of these notes suggests that the primary *accidental* "grey goo" risks may have been overstated by opponents of NT. But they also caution that

deliberate or *threatened* creation of grey goo may emerge as a strategy by terrorists, or even competing firms.

12. In social impacts, using Theodore Lowi's terms, nanotechnology is at best going to be non-redistributive: i.e., it will maintain the existing distribution of socioeconomic goods and bads. More likely, it will be negatively redistributive, transferring the wages of workers displaced by NT into larger profits by investors.

13. The single best prediction of the socio-economic future of NT is, at root, a projection of recent trends. In the US and the global production and trading systems, technological innovation has increasingly benefited investors, not workers. Inequalities have been rising in developed and under-developed nations overall. The major treadmill firms that are able and willing to engage in risky R & D investments in NT are exactly the kinds of firms that have opposed social welfare and environmental protection by the state, as well as unionization by many of their workers.

14. Moreover, with the diffusion of neo-liberalism, this increase in private sector profitability has been accompanied by pressures to diminish the role of states and even transnational bodies (such as the World Bank: see Goldman, 2005) in providing social welfare for displaced workers and their families. Moreover, while state subsidization of new technologies (including, most recently, NT), has been increasingly rationalized as leading to *national* development under neoliberal theorizing and practice, state spending on all social expenses has been attacked as undermining economic expansion. This

echoes the 1934 assessments by the social analyst Lewis Mumford (*Technics and Civilization*) as another form of “neotechnic means, with paleotechnic ends”.

15. The major exceptions have been in selected infrastructure provisions, and defense contracting. But in both of these cases, there is a powerful distinction between social needs and contractual profitability. In the US, this has been true for both the war in Iraq (including benefits for both US soldiers and displaced hurricane/flood victims in Katrina’s wake). Far more interest has been displayed in returning to production petroleum and chemical refineries damaged by either war or ‘natural’ disasters. Interestingly, the model for both war and natural disasters seems to approach the development of the neutron bomb, which was designed to destroy civilians but maintain economic infrastructure intact [and both terrorism in Iraq and the inadequacies of the Federal Emergency Management Agency in the US both seem to reproduce much of this logic].

But of course, the *public* logic of both the war in Iraq and the role of FEMA has emphasized social and political objectives, not economic distribution issues. But in both cases, profits are being made by the throughput of capital from the state into private conglomerates and entrepreneurs, who are actually the main beneficiaries, as opposed to the civilian populations of Afghanistan, Iraq, and the Gulf Coast of the U.S. This essentially as a regressive form of capital allocation, transferring resources from the lower classes to the industrial elites (investors and managers). In general, the past 25 years have seen a substantially increased commitment to neoliberalism distributive policies, which increasingly favor stockholders and not stakeholders (workers and community residents).

background statements

Advanced nanotech can be very beneficial. (MORE) Manufacturing with nanotechnology can solve many of the world's current problems. Water shortage is a serious and growing problem. Most water is used for industry and agriculture; both of these requirements would be greatly reduced by products made by molecular manufacturing. Infectious disease is a continuing scourge in many parts of the world. Simple products like pipes, filters, and mosquito nets can greatly reduce this problem. Information and communication are valuable, but lacking in many places. Computers and display devices would become stunningly cheap. Electrical power is still not available in many areas. The efficient, cheap building of light, strong structures, electrical equipment, and power storage devices would allow the use of solar thermal power as a primary and abundant energy source. Environmental degradation is a serious problem worldwide. High-tech products can allow people to live with much less environmental impact. Many areas of the world cannot rapidly bootstrap a 20th century manufacturing infrastructure. Molecular manufacturing can be self-contained and clean; a single packing crate or suitcase could contain all equipment required for a village-scale industrial revolution. Finally, MNT will provide cheap and advanced equipment for medical research and health care, making improved medicine widely available. Much social unrest can be traced directly to material poverty, ill health, and ignorance. MNT can contribute to great reductions in all of these problems, and in the associated human suffering.

Advanced nanotech could be very dangerous. (MORE) Molecular nanotechnology will be a significant breakthrough, comparable perhaps to the Industrial Revolution—but compressed into a few years. This has the potential to disrupt many aspects of society and politics. The power of the technology may cause two competing nations to enter a disruptive and unstable arms race. Weapons and surveillance devices could be made small, cheap, powerful, and very numerous. Cheap manufacturing and duplication of designs could lead to economic upheaval. Overuse of inexpensive products could cause widespread environmental damage. Attempts to control these and other risks may lead to abusive restrictions, or create demand for a black market that would be very risky and almost impossible to stop; small nanofactories will be very easy to smuggle, and fully dangerous. There are numerous severe risks—including several different *kinds* of risk—that cannot all be prevented with the same approach. Simple, one-track solutions cannot work. The right answer is unlikely to evolve without careful planning.

Simplistic regulation won't work. (MORE) Molecular nanotechnology manufacturing creates several severe risks, and each risk tempts a simple and extreme solution. However, a patchwork of extreme solutions will be both destructive and ineffective. For example, Bill Joy and others have proposed halting nanotechnology research entirely. This would not actually work; instead, it would relocate the research to less responsible venues. The risks might be delayed by a few years, but would be far worse when they appeared because the technology would be even less controllable. To take another example, economic upheaval might be prevented by strict commercial licensing of all uses of the technology. This has two problems. First, digital protection schemes for commercial products have often proved quite easy to crack. Second, if the technology is so restricted that it cannot disrupt existing economic systems, continuing poverty will kill millions of people each year, fueling backlash, social unrest, espionage, and independent development. Each risk must be reduced by some means that does not exacerbate others. This will not be easy, and will require creative and sensitive solutions