House of Representatives Foreign Affairs Committee

Subcommittee on Terrorism, Nonproliferation and Trade

Hearing, Thursday June 19: "Genetics and other Human Modification Technologies: Sensible International Regulation or a New Kind of Arms Race."

Prepared Witness Testimony

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Mr. Chairman, Ladies and Gentlemen:

I am Nigel Cameron, Research Professor at the Illinois Institute of Technology and President of the Center for Policy on Emerging Technologies, a new nonpartisan think tank focused on the policy implications of the technologies that are set to shape tomorrow. It is an honor to be invited to testify before the Committee on matters of profound consequence for the human future. I should state that I speak on my own behalf today and not for either of these institutions and my various colleagues. Much of my professional life has been devoted to questions raised at the interface of emerging technologies, ethics and public policy. It is my view that questions of this kind are of increasing import, and will permeate every policy discussion of the 21st century. We would do well to be better prepared.

This is nowhere more the case than in the context of asymmetries and the risk that flows from them. Our tendency has been to avert our eyes from the societal implications of technologies, except in specific hot-button issues such as research involving human

embryos or, particularly in Europe, so-called GMO foods. In fact the implications of emerging technologies, especially in relation to their increasing speed of progress and their tendency to converge, are far greater. To the extent that we choose not to be cognizant of this fact, we raise considerably the risks involved. Our policy response to these two sets of issues has been to segment them from broader questions of technology and address them on their own terms. It is needful also to see them as flashpoints of controversy within the wider context of a social order that is increasingly pervaded by transformative and disruptive technologies, the future significance of which is very hard to assess though which will undoubtedly be both vast and comprehensive in its impact on our social and individual life, as on that of our nation and the wider world.

As 9/11 demonstrated, the increasing complexity of the global order and the open-textured nature of our societies have brought us to a point where asymmetric possibilities are reshaping our notions of security and threat.

The transformative impact of emerging technologies is best understood with reference to the "convergence" of nanotechnology, biotechnology, information technology, and cognitive science (sometimes referred to as NBIC). This is the theme of several substantial documents issuing from the National Science Foundation, the first published in 2002 under the title *Converging Technologies for Improving Human Performance*. The report suggests that the chief goal of "convergence" lies in "improving human performance," a fundamental change in human capacities. This is where I am focusing my remarks today, since the prospect of a race to enhance human performance through re-engineering the brain, and developing the brain-machine interface so that a cyborgs model emerges, could lead to both destabilization and the final subsuming of the Renaissance and Enlightenment ideals that have birthed and sustained democracy through the making of a super-race. While this may seem far-fetched, my point this morning is that there are many smart and influential experts in these technologies who do not believe that to be the case. They may be mistaken, but the issue must be addressed with a far greater degree of seriousness, both within the United States and the wider global community.

Among the goals and anticipated results are listed the following: "enhancing individual sensory and cognitive capacities . . . improving both individual and group creativity . . . communication techniques including brain-to-brain interaction, perfecting human-machine interfaces including neuromorphic engineering . . . ."[1] The report asks: "How can we develop a transforming national strategy to enhance individual capacities and overall societal outcomes? What should be done to achieve the best results over the next 10 to 20 years?"[2] And, at the end of one list of long-term implications, it specifies a basic shift in "human evolution, including individual and cultural evolution."[3] Then this:

> Technological convergence could become the framework for human convergence. The twenty-first century could end in world peace, universal prosperity, and evolution to a higher level of compassion and accomplishment. . . . [I]t may be that humanity would become like a single, distributed and interconnected "brain" based in new core pathways of society.[4]

While this document has plainly been influenced by the futurist ideology called "transhumanism," which couches the prime purpose of emerging technologies as the transformation of human functioning into something ultimately "posthuman," the point to be noted is that senior NSF figures see these ideas as congruent with the potential of emerging technologies, and view the prospect with enthusiasm and optimism.

Such dramatic claims have focused on the role of nanotechnology, or nanoscale convergence, in enabling innovation and control that is at present far beyond us. It is no simple matter to assess likely outcomes in an area where much research is still at a fundamental level. But in developing policy to ensure appropriate policy responses to

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[1] Roco, M. and Bainbridge, W. S., eds. (2002). *Converging Technologies for Improving Human Performance*, pg. ix. Retrieved October 17, 2006, from http://wtec.org/ConvergingTechnologies.
[2] *Id* at x.
[3] *Id.* at 4.
[4] *Id.* at 6.

what may ensure, it is prudent to assume that the expectations of leading researchers may come to fruition. One of the founders of nanoscale science, the late Nobel laureate Richard Smalley, used these measured terms: "There is a growing sense in the scientific and technical community that we are about to enter a golden age…. These little nanothings, and the technology that assembles and manipulates them – nanotechnology— will revolutionize our industries, and our lives."[5] Less modest projections, referenced in NSF publications, have included something akin to eternal life, and an end to scarcity.

Six distinct sets of questions are raised for ethics and policy by developments on the nanoscale. From one perspective they represent the familiar ethical questions that all technologies entail. Yet the hopes and expectations that have been raised for the application of nanotechnology to human well-being are so great that its ethical implications are potentially of a proportionately higher order of magnitude. Indeed, they have the effect of transforming discussion of the particular applications of a particular technology at the nanoscale into a point of focus for our consideration of the place of technology in relation to human nature and human society.

Several key questions are raised.

1. The question of hazard: what risks are appropriate? While issues of safety are always also issues of ethics, the ethical dimension of nanotechnology risk is in proportion to the potential dangers of the technology. The cautious approach taken in the 2004 SwissRe report[6] suggests that while some of the detractors of nanotechnology may overstate its risks to health and the environment, and while the likelihood of unintended harm may be low, the scale of damage that would result from a serious misjudgment could prove very great.
2. Broader challenges that these new technologies present for the social order and the wider human community include threats to

[5] Richard E. Smalley, Oral Testimony Before United States House of Representatives Science Committee Subcommittee on Basic Research (June 22, 1999).
[6] SWISS RE, NANOTECHNOLOGY: SMALL MATTER, MANY UNKNOWNS (2004).

confidentiality. Such prospects as large-scale diffusion of radio-frequency identifier chips (RFIDs), retinal scanning, face identification technologies, and so far undeveloped options that may render privacy in general a costly commodity. The preservation of medical confidentiality has already been rendered enormously more difficult by the development of electronic databases.

3. Issues of equity, which have been termed the "nano-divide," since despite the hopes of some that technology at the nanoscale will prove ultimately cheap, it is a reasonable to assume that its distribution applications will follow current economic patterns. Thus the suggestion that "all cancer" will be curable or become chronic and manageable by 2015 is unlikely to include the cancer of all persons afflicted with the disease in parts of the globe struggling to establish basic public health.
4. Special issues raised by military applications of these technologies.
5. The question of the human condition, which may seem at an intuitive level clear though is hard to define. A major theme of the President's Council on Bioethics report on enhancement technologies, *Beyond Therapy*, is the difficulty we face in drawing such lines. But there is no more important question, since the fundamental challenge of this technology is to our anthropology and the assumptions we make about human being and what is proper to ourselves.[7]

[7] By way of illustration, a recent document from the World Health Organization, in the context of a generally sympathetic review of artificial reproduction technologies, places them in this anthropological framework: "What are the consequences for a society of having chosen to develop a medically mediated form of reproduction? . . . *What seems to be at stake in the development of these practices is a transformation of the anthropological conditions of procreation.*" Simone Bateman, When reproductive freedom encounters medical responsibility: changing conceptions of reproductive choice, in Current Practices and Controversies in Assisted Reproduction. Report of a meeting on "Medical, Ethical and Social Aspects of Assisted Reproduction," September 2001, Geneva: World Health Organization, 2002, at 330. Our emphasis. She states: "The fact that would-be parents, whatever their social status, are asking physicians to provide the means of accomplishing what was once an intimate act is hardly an anodyne fact. Whatever the differences in technical variants, reproductive technology appears essentially to be "emancipating" procreation from the usual conditions of heterosexual commerce. Artificial insemination has long since desexualized the act of conception. IVF has now disembodied conception, a trend that could be extended to the rest of pregnancy by creating the conditions for ectogenesis. The prospect of cloning now augurs the emancipation of procreation from what still remains the fundamental requirement of sexual reproduction, the participation of sexually differentiated beings, and introduces the possibility of using reproductive cells (embryonic stem cells) for non-reproductive therapeutic purposes."

The Prospect of Human Augmentation

One recent writer has put the matter thus: "Among the applications of nanotechnology that some researchers consider 'science fiction,' while others are actively attempting to implement, are enhancements to human memory, physical strength, and other characteristics. Though usually framed as attempts to monitor or repair ailments or disabilities such as Parkinson's disease or genetic abnormalities, some of these technologies can simultaneously be used to control or enhance particular human characteristics in 'normal' humans as well."[8] In his widely-noted essay, "Why the Future doesn't need us," technology guru Bill Joy proffered alternative scenarios of doom: either unintended disaster or intentional enhancement will bring about the end of human nature as we know it.[9]

Recent discussion of "converging technologies" as the context for nanotechnology draws attention to the interconnected challenges they present, above all to human nature. Leon Kass, then chairman of the President's Council on Bioethics, remarked on the inter-relations of these technologies, such that advances in genetics "cannot be treated in isolation" but must be correlated with "other advances in reproductive and developmental biology, in neurobiology, and in the genetics of behavior – indeed, with all the techniques now and soon to be marshaled to intervene ever more directly and precisely into the bodies and minds of human beings."[10]

A critique of the NSF's 2002 NBIC report has come from a High Level Expert Group (HLEG) established by the European Commission. It offers a useful counter-weight to the NSF report's embrace of "transhumanist" aspirations that have seen nanotechnology as a route to the transformation of human nature as we know it into some "posthuman" form - whether that of radically enhanced human being, or machine intelligence that supplants corporeal Homo sapiens altogether.

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[8] Bruce V. Lewenstein, *What Counts as a 'Social and Ethical Issue' in Nanotechnology?* 11 HYLE-INT'L JOUR. PHIL. CHEM. 5, 12 (2005).
[9] Bill Joy, *Why the Future Doesn't Need Us*, WIRED, April 2000.
[10] Leon R. Kass, *The Moral Meaning of Genetic Technology*, Commentary, Sept. 1999, at 34, 35.

The major area of concern, as noted in the HLEG report, lies in cognitive science.[11] Concerns may perhaps be most starkly illustrated with reference to the prospect of cognitive "enhancements" that involve the manipulation of perception and memory, whether through neuro-pharmacology (including what has been termed "cosmetic neurology") or cognitive prostheses. A recent editorial in the journal Neurology discussed the challenge of such technological use in these terms: " . . . its presence is already beginning to be felt in neurology. Cochlear implants are the sentinel example of mechanical interfaces providing sensory input to the human nervous system. Neural stimulators – for movement disorders and epilepsy – are other examples of technologies currently in (increasing) use. Some worry that these successes represent the beginnings of Cyborgs – individuals who are part human and part machine. For more than 50 years science fiction writers have imagined the potential for such human-robotic chimeras. Nanotechnology promises the potential of designing micromachines capable of dramatically advancing the potential of such interfaces."[12] Since development of such technologies will be invariably "dual use" – with initial applications that are legitimately therapeutic – the policy challenges they raise are profound.

Concluding observations

These developments undoubtedly require global assessment. This is the case not simply because U.S., European and Asian governments and corporations are alike embarked on the same enterprise, but because the implications of work on the nanoscale concern the future of the global community, and potentially that of the human species itself. Such efforts as the UNESCO Universal Declaration on Bioethics and Human Rights, setting questions of emerging technologies within the framework of "fundamental human rights and freedoms," offer a precedent. In seeking to set the pace in global biopolicy for the 21st century, the Declaration takes as its point of departure the Universal Declaration on

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[11] *Foresighting the New Technology Wave: Converging Technologies – Shaping the Future of European Societies*, HLEG Report, at 12.

[12] Neurology 2004, 63: 949

Human Rights. It sets the new technology questions in the framework of human values, with special focus on the rights and dignity of the individual. Yet the location of global governance discussions has yet to be clarified, with OECD and various ad hoc bodies engaged.

While the dividing line between therapy and enhancement is not easily drawn, the principle is clear: the restoration of human function lies in a separate category from the development of functions not found in humans, or the upgrading of human functions (and especially human intelligence) to a level not found in humans. While this may appear an issue of ethics or simply one of choice, its implications for the global community remain to be addressed.