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"A TSUNAMI WAVE OF SCIENCE": HOW THE TECHNOLOGIES OF TRANSHUMANIST MEDICINE ARE SHIFTING CANADA'S HEALTH RESEARCH AGENDA

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> What is great in [humanity] is that it is a bridge and not an end: what can be loved in [humanity] is that it is an *overture* and a *going under*…
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> A dangerous across, a dangerous on-the-way, a dangerous looking back, a dangerous shuddering and stopping…
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> A rope tied between beast and overman – a rope over an abyss.[1]

In "Zarathustra's Prologue," Nietzsche imagines *homo sapiens* as a tightrope walker, beset by human doubts and frailties, making a slow and unsteady trek between two towers representing past and future stages of human development. The tower behind signifies the animal state from which we have evolved, whereas the tower ahead is the "*übermensch,*"[2] the ultimate stage in human evolution. As the story goes, the tightrope walker is interrupted by a jester who, enchanted by the promise of the *übermensch*, leaps over the hapless tightrope walker, causing him to fall into oblivion. The jester, eyes on the prize of human transcendence, rushes forward to claim it.

The notion of the human condition as transitional or liminal is, of course, central to many religious traditions, which often understand corporeal existence as a temporary state *en route* to some form of divinely-mediated transcendence. Nietzsche, however, rejected this framework, insisting in *Zarathustra* that the *disease* of being human ("more ape than any ape"[3]) is something that we ourselves must remedy. Defeating the jester requires a different antidote: human self-overcoming. As Nietzsche's Zarathustra puts it: "I teach you the overman. Man is something that shall be overcome. What have you done to overcome him?"[4]

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[1] Frederick Nietzsche, "Thus Spoke Zarathustra" in Walter Kaufmann, ed. & trans., *The portable Nietzsche* (New York: Penguin Books, 1976) at 126-127 [Nietzsche,"Zarathustra"].

[2] The German term "*übermensch*" has been rendered as "superman" and "overman" in various translations. In one of the most popular versions, translator and editor Walter Kaufmann explained that he preferred the latter term in order to "help to bring out the close relation between Nietzsche's conceptions of the overman and self-overcoming… ." Kaufmann was also attuned to the unhelpful meanings placed on the term "superman" both by George Bernard Shaw and by D.C. Comics. See *ibid*. at 115.

[3] *Ibid.* at 124.

[4] *Ibid.* at 125.

While many philosophers have come to understand the evolutionary path prescribed by Nietzsche as a kind of moral (r)evolution, others have taken Nietzsche to mean that the human body itself must be overcome.[5] For example, philosopher and futurist Max More has interpreted Nietzsche's *übermensch* as "the *transhumans* who will emerge from the integration of biology and [technology]."[6]

More belongs to a growing movement known as *transhumanism*. With thousands of members from various backgrounds and academic disciplines assembled at prestigious institutions around the world, this group is *morally committed* to the idea that technology *ought to be used* to radically alter the human condition. More, for example, believes that medical science should be used to make such "fundamental and sweeping modifications to our inherited genetics, physiology, neurophysiology and neurochemistry" that "we can no longer be usefully classified with *homo sapiens*."[7]

While the transhumanist stance may appear to most doctors, lawyers, health care workers and policy makers to be radical or fringe, in this article we argue that the project of *transhumanist medicine* is to be taken seriously because its underlying philosophies are already embedded in the mainstream North American health research agenda, resulting in a recent shift towards "enhancement" medicine. As James Watson, co-discoverer of DNA, recently put it: "[I]f we could make better humans, why shouldn't we?"[8]

In Part I of this article, we briefly outline the core principles and practices of transhumanism. In Part II, we examine nanotechnology as transhumanism's technologies of choice, illustrating the transhumanist vision of medical science as a self-enabled, interventionist, enhancement-focused enterprise. In Part III, we examine a shift in agenda in Canadian federal research and development towards an enhancement-focused medical science and highlight ways in which state-sponsored medical research and development appear to have uncritically accepted that radical nanobiotechnological intervention into individual bodies is a desirable and necessary element of human progress.[9] Finally, in Part IV, we suggest two possible implications of this shift towards a transhumanist medicine.

I. Transhumanism

Commenting on himself and his own ideas, Nietzsche once remarked that, "[o]nly the day after tomorrow belongs to me. Some are born posthumously."[10] This notion might likewise apply to

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[5] Nietzsche described this revolution as a "revaluation of all values" in Frederick Nietzsche, "The Antichrist", in Walter Kaufmann, *supra* note 1, at 656 [Nietzsche, "Antichrist"]. For commentary, see e.g. Walter Kaufmann, *Nietzsche*, *philosopher, psychologist, antichrist*, 4th ed. (Princeton, N.J.: Princeton University Press, 1974); Alexander Nehamas, *Nietzsche*, *life as Literature* (Cambridge, Mass.: Harvard University Press, 1985). Nick Bostrom, another of the transhumanist philosophers, is likewise careful to distinguish between Nietzsche's invocation of a transcendent "soaring personal growth and cultural refinement" and the transcendence brought about by "technological transformation": Nick Bostrom, "A History of Transhumanist Thought", online: (2005) 14:1 Journal of Evolution and Technology 1 at 4 <http://www.jetpress.org>.

[6] Max More, "Embrace, Don't Relinquish, the Future" (February 22, 2001), online: KurzweilAI.net <http://www.kurzweilai.net/meme/frame.html?main=memelist.html?m=17%23646> [emphasis added].

[7] Max More, "On Becoming Posthuman" (1994), online: maxmore.com <http://www.maxmore.com/becoming.htm>.

[8] Cited in Gregory Stock, "The Last Human" (2002), online: KurzweilAI.net <http://www.kurzweilai.net/meme/frame.html?main=/articles/art0473.html>.

[9] Or, as recently stated by the CIHR, "one of the most powerful tools available to improve the human condition…" Eric Marcotte, Molly Shoichet & Richard Chenier, "Defining the National Strategy: Regenerative Medicine in Tissue Engineering and Artificial Organs – Executive Summary", online: Regenerative Medicine & Nanomedicine <http://www.regenerativemedicine.ca/tissue/tissue-executive-summary-May2003.doc>.

[10] Nietzsche, "Antichrist", *supra* note 5 at 569.

transhumanism, a concept first articulated by evolutionary biologist Sir Julian Huxley. In 1957, some twenty five years after his brother, the novelist Aldous, dreamt of a *Brave New World*,[11] Sir Julian articulated the following statement:

> The human species can, if it wishes, transcend itself – not just sporadically, an individual here in one way, an individual there in another way – but in its entirety, as humanity. We need a name for this new belief. Perhaps *transhumanism* will serve: man remaining man, but transcending himself, by realizing new possibilities of and for his human nature. "I believe in transhumanism": once there are enough people who can truly say that, the human species will be on the threshold of a new kind of existence, as different from ours as ours is from that of Pekin man. It will at last be consciously fulfilling its real destiny.[12]

Julian Huxley was reflecting upon what he saw as a post-Darwinian explosion of scientific knowledge about humans and the world we inhabit, and he expressed a tremendous optimism about the uses to which that knowledge could be put. Although it was nearly fifty years before the word "transhumanism" began to take hold in the popular lexicon, Huxley's optimism eventually proved infectious, especially in the run-up to the new millennium when apocalyptic fears intermingled with millennialist fantasies of a fresh start for humankind.[13]

Today, the "transhuman" construct usually stands for a "transitional human," an intermediary form between the human and the posthuman,[14] where the "posthuman" is thought to include "future beings whose basic capacities so radically exceed those of present humans as to be no longer unambiguously human by our current standards."[15] Achieving a posthuman state is the goal of many transhumanists. Among other things, transhumanists "advocate the moral right for those who so wish to use technology to extend their mental and physical (including reproductive) capacities and to improve their control over their own lives."[16] Seeking "personal growth beyond our current biological limitations,"[17] transhumanists "foresee the feasibility of redesigning the human condition, including such parameters as the inevitability of aging, limitations on human and artificial intellects, unchosen psychology, suffering, and our confinement to the planet earth."[18]

The posthuman is often held out as the supreme achievement, if not the *telos,*[19] of scientific progress. Through it, Oxford-educated transhumanist philosopher David Pearce prescribes new forms of health and well-being as follows:

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[11] Aldous Huxley, *Brave New World, a novel by Aldous Huxley* (New York: Harper & brothers, 1946).

[12] Julian Huxley, *New Bottles for New Wine, Essays* (London: Chatto & Windus, 1957) at 17.

[13] *See, e.g.,* Umberto Eco *et al*, *Conversations About the End of Time* (London: Allen Lane, 1999); Ray Kurzweil, *The Age of Spiritual Machines*: *When Computers Exceed Human Intelligence* (New York: Penguin Books, 2000) [Kurzweil, *Age*]; Hans Moravec, *Robot: Mere Machine to Transcendent Mind* (New York: Oxford University Press, 1999). [Moravec, *Robot*].

[14] Nick Bostrom, "What is a posthuman?" in *The Transhumanism FAQ* Version 2.1 (2003) at 1.2, online: World Transhumanist Association <http://www.transhumanism.org/resources/faq.html>.

[15] *Ibid.*

[16] World Transhumanist Association, "The Transhumanist Declaration" (2002) at para. 4, online: World Transhumanist Association <http://transhumanism.org/index.php/WTA/declaration/> [World Transhumanist Association].

[17] *Ibid.*

[18] *Ibid.* at para. 1.

[19] James J. Hughes, "The Future of Death: Cryonics and the Telos of Liberal Individualism", online: (2001) 6:1 Journal of Evolution and Technology 1 <http://www.jetpress.org>.

> [O]ur descendants, and in principle perhaps even our elderly selves, will have the chance to enjoy modes of experience we primitives cruelly lack. For on offer are sights more majestically beautiful, music more deeply soul-stirring, sex more exquisitely erotic, mystical epiphanies more awe-inspiring, and love more profoundly intense than anything we can now properly comprehend.[20]

One wonders: how is all of this to come about?

II. Transhumanism's Technologies of Choice

According to many transhumanists,[21] the technologies by which these modes of being will become possible stem primarily from the emerging field of "nanoscience" — an umbrella concept that promises precise control over the building blocks of life and matter. Though today nanoscience includes a convergence of numerous disciplines including chemistry, biology, mathematics, materials science, computer science and engineering, its origins are in physics, dating back to a famous 1959 address to the American Physical Association given by Nobel laureate Richard Feynman. Feynman challenged the scientific community with the question: "What would happen if we could arrange the atoms one by one the way we want them?"[22]

Fifty years later the field remains nascent, but the ability to manipulate matter at the molecular level is getting better and better[23] and the possibility of molecular manufacturing is thought by some[24] to be more and more likely. This "science of small" is being packaged and pushed by industry and government under the rubric of "NBICS," an acronym purporting to signify the

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[20] David Pearce, "Introduction 0.4: Life in Dopaminergic Overdrive", *The Hedonistic Imperative*, online: HedWeb <http://www.hedweb.com/hedethic/hedonist.htm>. One can only imagine the skyrockets that went off in Pearce's head when he first encountered Nietzsche's *Zarathustra*: "All beings so far have created something beyond themselves; and do you want to be the ebb of this great flood and even go back to the beasts rather than overcome man? What is the ape to man? A laughingstock or a painful embarrassment. And man shall be just that for the overman: a laughingstock or a painful embarrassment. You have made your way from worm to man, and much in you is still worm. Once you were apes, and even now, too, man is more ape than any ape." Nietzsche,"Zarathustra", *supra* note 1 at 124.

[21] See e.g. Kurzweil*, Age, supra* note 13; K. Eric Drexler, *Engines of Creation: The Coming Era of Nanotechnology* (London: Fourth Estate, 1996); K. Eric Drexler, *Nanosystems: Molecular Machinery, Manufacturing, and Computation* (New York: Wiley, 1992); Immortality Institute, *The Scientific Conquest of Death* (Buenos Aires: LibrosEnRed, 2004); Robert A. Freitas, Jr., *Nanomedicine, Vol. I: Basic Capabilities* (Austin, Tex.: Landes Bioscience, 1999) online: NanomedicineBookSite <http://nanomedicine.com> [Freitas, *Nanomedicine*].

[22] Richard P. Feynman, "There's Plenty of Room at the Bottom: An Invitation to Enter a New Field of Physics" (Lecture deliverred at the annual meeting of the American Physical Society, California Institute of Technology, 29 December 1959), (1960) 23 Engineering and Science 22, online: Zyvex <http://www.zyvex.com/nanotech/feynman.html>. For an examination of the social and political implications of Feynman's question, *see* Ian Kerr & Goldie Bassi, "Building a Broader Nano-Network" (2004) 12:3 Health L. Rev. 57.

[23] Molecular manufacturing is simply the deliberate creation of objects at a molecular scale, although many proponents suggest that it also requires the development of self-replicating "nanofactories" in order to be feasible. C. L. Peterson, "Nanotechnology: From Feynman to the Grand Challenge of Molecular Manufacturing" (2004) 23:4 IEEE Technology and Society Magazine 9; Max Nelson & Calvin Shipbaugh, *The Potential of Nanotechnology for Molecular Manufacturing* (Santa Monica, Calif.: Rand Corporation, 1995) online: RAND Corporation <http://www.rand.org/pubs/monograph_reports/MR615/index.html>.

[24] *See e.g.* Battelle Memorial Institute & Foresight Nanotech Institute, *Productive Nanosystems: A Technology Roadmap* (2007), online: Foresight Nanotech Institute <http://www.foresight.org/roadmaps/Nanotech_Roadmap_2007_main.pdf>; National Institute for Nanotechnology, "Supramolecular Nanoscale Assembly", online: National Research Council of Canada <http://nint-innt.nrc-cnrc.gc.ca/research/supra/index_e.html>.

philosophical and operational convergence of: **n**anotechnology, **b**iotechnology, **i**nformation technology, **c**ognitive science[25] and **s**ynthetic biology.[26]

There is little doubt that innovations in these fields will directly affect health care and medicine, which are now in turn being repackaged as "nanomedicine."[27] As sociologist Nikolas Rose explains, "life now appears to be open to shaping and reshaping at the molecular level: by precisely calculated interventions that prevent something happening, alter the way something happens, [and] make something new happen in the cellular processes themselves."[28] At its core, nanomedicine seems to contain the potential and the mandate to "alter the structure, function, and capabilities of human bodies and brains."[29] Human bodies may be analyzed, repaired, and *enhanced* in ways that may engender fundamental changes to species-normative capacities, abilities and behaviours.

It is important to note that such ambitions are not merely those of futurists, fantasy writers, and "trekkies with tenure."[30] For example, renowned Cambridge University biogerontologist Aubrey de Grey, proponent of "Strategies for Engineered Negligible Senescence" [SENS], is of the view that nano-enabled health technologies will make it feasible to radically extend human lifespan well beyond current species-typical norms.[31] de Grey has spent much energy and ink rallying against the traditional approach to biogerontology which, he claims, "is living a lie."[32] According to de Grey,

> [i]t asserts that the ultimate goal of research into the biology of ageing is to increase the average healthy lifespan (''healthspan'', as it is commonly termed these days) *without appreciably increasing average total lifespan*, and thus to shorten the average period of frailty and ill health at the end of life....[33]

de Grey rejects this approach, claiming that the prevailing pace of biotechnological progress is bringing ever closer the day when humans will be able to live much longer, healthy lives. He in fact believes that emerging technological advances in nano-medicine and other fields during the next fifty years will create a biological infrastructure making it possible that he himself will live

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[25] Mihail C. Roco & William Sims Bainbridge, eds., *Converging Technologies for Improving Human Performance: Nanotechnlogy, Biotechnology, Information Technology and Cognitive Science* (Boston, Mass.: Kluwer Academic Publishers, 2003) at ix, online: World Technology Evaluation Center <http://wtec.org/ConvergingTechnologies/> [Roco & Bainbridge, "Converging"].

[26] Gregor Wolbring, "Bio-tech, NanoBio-Tech, SynBio-tech, NanoSynBio-tech? The changing face of biotech law? (Part I)" (2007) 4:5 Journal of International Biotechnology Law 177.

[27] In this article we use the term nanomedicine as a catch-all for a variety of biotechnological diagnoses, interventions, and enhancement technologies that claim to operate at a molecular scale. Transhumanist physician and medical researcher Robert Freitas, who may have coined the term, defines it broadly as "the preservation and improvement of human health using molecular tools and molecular knowledge of the human body." See Robert A. Freitas, Jr., online: NanomedicineBookSite <http://nanomedicine.com>.

[28] Nikolas Rose, "The Politics of Life Itself" (2001) 18:6 Theory, Culture & Society 1 at 16 [Rose].

[29] ETC Group, *Nanotech Rx: Medical Applications of Nano-Scale Technologies: What Impact on Marginalized Communities* (September 2006) online: ETC Group <http://www.etcgroup.org/en/materials/publications.html?pub_id=593> [ETC Group, *Nanotech RX*].

[30] The latter phrase was used by bioethicist Carl Elliott in an article in which he likewise suggests that transhumanism is to be taken seriously in part for the embeddedness of some of its proponents in respectable and influential institutions. Carl Elliott, "Humanity 2.0" (2003) 27:4 Wilson Quarterly 13

[31] Aubrey D. N. J. de Grey, *The Mitochondrial Free Radical Theory of Aging* (Austin, Tex.: Landes Bioscience, 1999).

[32] A. D. N. J. de Grey, "Life extension, human rights, and the rational refinement of repugnance" (2005) 31:11 Journal of Medical Ethics 659.

[33] *Ibid*. [emphasis added].

to be one thousand years old, barring accidental death.[34] No typo. One thousand years, he claims.

de Grey and other transhumanist advocates of nanomedicine, who are by no means a unified caucus, are increasingly well-funded, influential individuals belonging to highly respected and established organizations and institutions. For instance, the Institute for Ethics and Emerging Technologies [IEET], founded by transhumanist professors Nick Bostrum and James Hughes, and affiliated with Stanford University's Center for Law and Biosciences, states that part of its mission is to "defend individuals' rights to use human enhancement technologies."[35] Bostrom is also the Director of the Future of Humanity Institute of the James Martin 21st Century School at Oxford University, where he directs research into operational and ethical issues of human enhancement. Mihail Roco and William Bainbridge, strong proponents of NBICs convergence for "improving human performance," work within the U.S. National Science Foundation, a federal organization which funds 11,000 projects in the sciences each year.[36] Other thought leaders, such as MIT's Marvin Minsky, Carnegie Melon's Hans Morovec, and the renowned inventor, entrepreneur and best selling author Ray Kurzweil, have all lent star power to the movement, each professing human enhancement through a merger of humans and technology within our lifetime. Leveraging the credibility of these and other high power and high profile individuals and institutions, transhumanist ideas are hardly relegated to the margins of academia, government or society. To the contrary, many proponents of this agenda can be found in traditional institutions and organizations as well as mainstream popular culture venues that shape academic research, government policy and public opinion.

III. Canada's Shifting Health Research Agenda

At a gala event in 2003, Dr. Alan Bernstein, then President of the Canadian Institutes of Health Research [CIHR], gave a talk entitled "The Global Revolution in Health Research."[37] Deploying an oft-used metaphor for scientific change, he described his vision of the effects of emerging technologies on the purpose and practice of medicine as follows:

> This Tsunami wave of science is already starting to reach the shores of the health system, transforming medicine from a reactive and descriptive art to an activity that will be increasingly *proactive, mechanism-based and individualized*.[38]

Dr. Bernstein's use of such violent imagery is interesting in light of his subject matter and its enormous social implications. The "tsunami" to which he referred consists in part of a set of techniques and fields of study that he himself placed under the heading of "nanomedicine."

Beginning just prior to the new millennium but intensifying in 2002-2003, the Government of Canada's research and development bureaucracy started to take official notice of certain developments in science related to the manipulation of matter at the molecular level. Not coincidentally these developments (also hyped under the prefix "nano") had been under way for

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[34] Ben Best, "Wellness Profile: Aubrey de Grey", online: (February 2006) Life Extension Magazine <http://www.lef.org/magazine/mag2006/feb2006_profile_01.htm>.

[35] See Institute for Ethics and Emerging Technologies [IEET], online: <http://ieet.org/index.php/IEET/about>. The IEET publishes the Journal of Evolution and Technology, a biennial publication dating to 1999 that discusses issues around human enhancement.

[36] Roco & Bainbridge, "Converging", *supra* note 25.

[37] Alan Bernstein, "The Global Revolution in Health Research" (Presentation at the Gairdner Foundation International Awards Gala, Toronto, Ont., 23 October 2003), online: Canadian Institutes of Health Research <http://www.cihr-irsc.gc.ca/e/19161.html> [Bernstein, "Global Revolution"]. Bernstein spoke in his capacity as CIHR President, posting his speech on the CIHR website. CIHR distributes nearly $1 billion in funding annually, primarily in support of biomedical scientific inquiry. Bernstein's public comments can therefore be understood as representing or at least reflecting the aspirations of the Government of Canada's approach to science and medicine.

[38] *Ibid.* [emphasis added].

some time in the U.S., and were already the target of substantial R&D funding there.[39] Nanotechnology, defined broadly as "research and technology development at the atomic, molecular or macromolecular levels,"[40] was entering the public consciousness as the "next thing," a set of innovations that, even in the less hysterical assessments, "could achieve an age of innovation and prosperity that would be a turning point in the evolution of human society."[41]

Even in its early stages, nanotechnology created interest for its potential uses in biomedicine, initially for the expansion of knowledge about biological processes, then for the diagnosis of disease, next for the creation of new medical tools and interventions, and finally for the enhancement of human bodies through bioengineered prosthetics or through *in situ* modifications using molecular engineering. Robert A. Freitas Jr., an American nanotechnologist, is one of the biggest boosters of nanomedicine and has disseminated much of the hyperbole around it. In a book that might be said to take a decidedly Whiggish view of the history and purpose of medicine, Freitas positions nanomedicine as the end of medical history:

> Humanity is poised at the brink of completion of one of its greatest and most noble enterprises. Early in the 21st century, our growing abilities to swiftly repair most traumatic physical injuries, eliminate pathogens, and alleviate suffering using molecular tools will begin to coalesce in a new medical paradigm called nanomedicine.[42]

While Freitas is well known in the U.S. as a nano-enthusiast, he is not the only American to have made such a bold leap of faith. No less an authority than the U.S. National Science Federation announced that "improvement of human performance" through biomedical enhancement is a central goal of nanomedical R&D.[43] Even more dramatically, U.S. Undersecretary of State for Commerce Philip J. Bond stated in 2003:

> On a human level, nano's potential rises to near Biblical proportions. It is not inconceivable that these technologies could eventually achieve the truly miraculous: enabling the blind to see, the lame to walk, and the deaf to hear; curing AIDS, cancer, diabetes and other afflictions; ending hunger; and even supplementing the power of our minds, enabling us to think great thoughts, create new knowledge, and gain new insights.
>
> On a societal level, nanotechnology will deliver higher standards of living and allow us to live longer, healthier, more productive lives.[44]

Pronouncements like this have been further exacerbated by the marketing departments at large biotechnology corporations – especially in the U.S. - who promise products to make us "better

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[39] *See* Lisa Campbell, "Nanotechnology and the United States National Plan for Research and Development in Support of Critical Infrastructure Protection" (2006) 5:3 C.J.L.T.; Roco & Bainbridge, "Converging", *supra* note 25; Williams Sims Bainbridge & Mihail C. Roco, eds., *Managing Nano-Bio-Info-Cogno Innovations: Converging Technologies in Society* (Dordrecht, The Netherlands: Springer, 2006) online: World Technology Evaluation Center <http://www.wtec.org/ConvergingTechnologies/3/NBIC3_report.pdf>.

[40] National Science Foundation, "Nanotechnology Definition (NSET, February 2000)" , online: National Science Foundation <http://www.nsf.gov/crssprgm/nano/reports/omb_nifty50.jsp>.

[41] Roco & Bainbridge, "Converging", *supra* note 25 at x.

[42] Freitas, *Nanomedicine*, *supra* note 21 at s.1.1.

[43] Roco & Bainbridge, "Converging", *supra* note 25 at ix. See also European Technology Platform on NanoMedicine, *Nanotechnology for Health: Vision Paper and Basis for a Strategic Research Agenda for NanoMedicine* (Luxembourg: European Commission, September 2005) online: Community Research & Development Information Service <http://cordis.europa.eu/nanotechnology/nanomedicine.htm> [European Technology Platform].

[44] Philip J. Bond, Undersecretary of Commerce for Technology, "Technology Administration: Remarks as Prepared for Delivery" (Remarks delivered at the World Nano-Economic Congress, Washington, D.C., 9 September 2003), online: Technology Administration <http://www.technology.gov/Speeches/p_PJB_030909.htm>.

than well," blurring or eliminating the distinction between therapy and enhancement.[45] A number of commentators have noted that these developments appear to be transpiring with little meaningful input or critique from civil society and in something of an ethical and legal vacuum.[46]

Shortly after hearing the buzz in the U.S., the Government of Canada, flush with fiscal surpluses, also began to take some of these claims seriously. In 2003, Canada's three most important scientific funding bodies convened a workshop entitled "Nanomedicine/Nanohealth" that was intended to survey the "relative position of nanomedicine in Canada" with the aim of making the country a "significant player."[47] In preparation for the meeting, the CIHR commissioned the Canadian Nanobusiness Alliance [CNA] to assemble a report on nanotech applications in medicine. Drawing heavily on work by American researchers, the CNA outlined a selective taxonomy of existing nanomedical fields of research. In the introduction to this report, the authors adverted to the apparent health care crisis in Canada and the rising cost of health care caused (according to them) by an aging population. Stating that "the need for new solutions is vast," the CNA outlined existing research that focused exclusively on nano-enabled drugs, implantable devices, tissue engineering, sensory aids, and new diagnostic technologies — in other words, interventionist medicine.[48] The CNA summed up its report with the suggestion that, through the development of such interventionist technologies, Canada's "progress in scientific research including health can be greatly accelerated leading to new discoveries never before imagined."[49]

This Report, in conjunction with the presentations by the assembled scientists and researchers at the "Nanomedicine/Nanohealth" workshop, sparked the imaginations of technocrats. That same year, CIHR launched a Regenerative Medicine and Nanomedicine Initiative [RMNI] to coordinate and fund nanomedical research. Announcing the initiative, Dr. Remi Quirion made explicit the stake that the government was placing in these new technologies:

> Recognizing that Regenerative Medicine *may well become one of the most powerful tools available to improve the human condition*, the Canadian Institutes of Health Research

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[45] See e.g. Carl Elliott, *Better Than Well: American Medicine Meets the American Dream* (New York: W.W. Norton, 2004) [Elliott, *Better Than Well*]; Sheila M. Rothman & David J. Rothman, *The Pursuit of Perfection: The Promise and Perils of Medical Enhancement* (New York: Vintage Books, 2004) [Rothman & Rothman].

[46] See the special Nanotechnology issue: (2004) 24:1 Bulletin of Science, Technology & Society for a number of articles highlighting unanswered ethical and legal questions in nanotechnology. See also Anisa Mnyusiwalla, Abdallah S. Daar & Peter A. Singer, "Mind the Gap: Science and Ethics in Nanotechnology" (2003) 14:3 Nanotechnology R9.

[47] "NanoMedicine/NanoHealth Workshop: Workshop Background," (February 13 & 14, 2003) online: Regenerative Medicine <http://www.regenerativemedicine.ca/nanomed/>.

[48] In essence, the term "interventionist medicine" as we use it here refers to a set of values and expectations about the power of science-based medicine to intervene in bodies to restore or create health. Medical historian Michael Neve offers the following explanation:

> … [A] commitment to explaining illness by invoking diseases that have an independent natural existence is a hallmark of the [Western] idea of medical progress. Other areas of 'reality' (the psychological, the social, and the moral) become cover stories, that hide the bedrock of natural truth. The medical practitioner, freed from the need for an individual patient's version of their story to be seen as part of their history, looks through the patient to the disease. Illness as an experience becomes replaced, or pushed to one side, as the trained doctor tracks the authentic but hidden world of disease as *biological pathology*… Medicine has, in that sense, departed from the population and community-based public health orientations that constituted the explanatory systems of early man. The backbone of progress that makes up this version of the Western medical tradition is formed out of the possibility of *the successful application of biomedicine and its technology* [Emphasis added].

Michael Neve, "Conclusion" in Lawrence I. Conrad *et al.*, eds., *The Western Medical Tradition: 800 B.C.-1800 A.D.* (Cambridge: Cambridge University Press, 1995) 477 at 481-2 [Neve].

[49] Neil Gordon & Uri Sagman, "Nanomedicine Taxonomy Briefing Paper" (Canadian Institutes of Health Research; Canadian NanoBusiness Alliance, February 2003) at 1, online: Regenerative Medicine & Nanomedicine <http://www.regenerativemedicine.ca/nanomed/Nanomedicine%20Taxonomy%20(Feb%202003).PDF> [Gordon & Sagman].

> (CIHR) has embarked upon a strategic initiative to establish a national agenda for Regenerative Medicine in Canada with particular emphasis on tissue engineering and artificial organs.[50]

With these initiatives in place, the conditions were officially set for the acceptance and proliferation of nanomedical enhancements and interventions in federal science and technology policy and practice.

The RMNI is now 4 years old, and according to former National Science Advisor, Dr. Arthur Carty, it is "the largest targeted extramural nanotechnology program in Canada,"[51] having distributed a modest $30 million in research funds.[52] It has partnerships with numerous other government science and technology organizations, reflecting the cross-disciplinary penetration of nanomedical research. To date, the RMNI has concentrated its efforts on developing a few fairly narrow fields of nanomedicine. In the following subsections, we briefly outline each. Our goal here is not to canvass the full details of these emerging technologies, but merely to illustrate some of their more mainstream applications.

A. Tissue Engineering

In its most recent Strategic Initiative announcement, RMNI proclaims that "one of the key goals of regenerative medicine is to stimulate the renewal of bodily tissues or the restoration of function through the use of natural or bioengineered materials."[53] Whereas in the early days of bioengineering (and even in the initial statements emerging from the RMNI) it was thought that "growing" replacement organs was a near-term possibility, the cost and time required for such complex projects have required researchers to focus more on implantable technologies that assist bodies in self-repair.[54] These include synthetic and synthetic-biological "scaffolds" to promote cell growth, techniques for promoting regeneration within bodies, implantable tissues, and so on. Such techniques have implications for longevity and anti-aging research, which likewise fall under the RMNI umbrella.

The inaugural RMNI calls for research proposals have also foregrounded the "application of tissue-engineered biomaterials as conduits or shunts in the regeneration of the nervous system, visual and auditory systems, musculoskeletal, skin, and oral tissues, as well as blood vessels or other circulatory and respiratory components."[55] Also falling into this category are processes and products that permit the creation of organic/non-organic hybrid materials and mechanisms (e.g. the integration of muscle tissue with robotic or prosthetic apparatus). As a whole, tissue engineering is thought to hold considerable potential not only for helping enhance human

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[50] *Supra* note 9 [emphasis added].

[51] Dr. Arthur Carty speaking at "NanoForum 2005", online: RMNI <http://www.cihr-irsc.gc.ca/e/29544.html>.

[52] For an internal evaluation of RMNI and nanomedicine funding more broadly, see Eric Marcotte & Remi Quirion, "A Summary of Canadian Nanomedicine Research Funding: Strengths and Needs" in Jan J. Dubowski & Stoyan Tanev, eds., *Photon–Based Nanoscience and Nanobiotechnology* (Dordrecht, The Netherlands: Springer, 2005) at 361. The authors note that "CIHR is committed to long-term support of nanomedicine on an ongoing basis." For a still broader analysis of the Canadian R&D nanotechnology research landscape, see Linda Goldenberg, "Nanotechnologies and Society in Canada" in Geoffrey Hunt & Michael D. Mehta, eds., *Nanotechnology: Risks, Ethics, and Law* (London: Earthscan, 2006) at 105.

[53] Canadian Institutes of Health Research, "Regenerative Medicine and Nanomedicine - Strategic Initiative Announcement" (June 2007) at 3 ("Tissue Engineering"), online: RMNI <http://www.cihr-irsc.gc.ca/e/34336.html> [RMNI 2007].

[54] Nevertheless, as we were writing this, researchers at the University of Minnesota claimed that they had fabricated a beating rat heart in their laboratory. See Deanne Morrison, "Researchers create a new heart in the lab" *UMNnews* (14 January 2008), online: University of Minnesota <http://www1.umn.edu/umnnews/Feature_Stories/Researchers_create_a_new_heart_in_the_lab.html#>.

[55] Canadian Institutes of Health Research, "Regenerative Medicine and Nanomedicine - Innovative Approaches in Health Research (2003-2004) (Archived): Request for Applications", online: Canadian Institutes of Health Research <http://www.cihr-irsc.gc.ca/e/16044.html>.

capacities and abilities but also in helping Canadians escape species-typical morbidity and mortality.

B. Drug and Gene Delivery

Considerable medical interest has arisen in improving the effectiveness in "targeting" the delivery of pharmaceuticals to specific "kill zones" within the body. It has been proposed that these improvements can be realized either by molecular manipulation of the active ingredients themselves, or by the development of nano-engineered "containers" that effectively target diseased tissues or enhance the performance of healthy ones.[56] These containers may be composed of "smart" materials that release therapeutic agents upon detection of designated pathologies.[57] Although this science is nascent, the vision for achieving it has existed in science fiction literature for decades.

According to RMNI, another important and well-funded category of work in this field is the "development of safe and effective strategies for delivering and integrating therapeutic genes to different organs and tissues, including across the blood-brain barrier."[58] Genetic intervention, therapy and enhancement are becoming aspects of Canada's shifting approach to medical research and development.[59] The implications of this are significant, perhaps revolutionary. According to Dr. Steve Scherer, a geneticist at the Toronto Hospital for Sick Children, "With this type of knowledge now in hand, the stage is set for an era of personalized medicine, where genome sequence information becomes a critical reference to assist with health-related decisions."[60] In this field, nanotechnology is envisaged as providing the means to better introduce and assimilate bioengineered genes into the body, including (for instance) carrying modified genes across the blood-brain barrier.[61]

C. Molecular Diagnostics and Monitoring

Also high on the list of priorities for RMNI and other nanomedical research organizations is the development of new techniques for identifying disease, disorder, and defect at the molecular level. Armed with advances in computing technology, researchers are increasingly able to "see" disease where none was visible before. A recent RMNI funding call, for instance, prioritized the "development and application of novel physical, chemical, or electronic probes, tools, and techniques"[62] for the identification of pathology. Molecular imaging is one such tool that is specifically targeted for funding, for example, the deployment of quantum dots to locate cancerous cells at a very early stage of development.[63] Similarly, according to Pilarski *et al*, "automated chip platforms" (called microsystems) offer the potential for *in vivo* individual disease profiling and more directed individual treatment.[64]

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[56] Gordon & Sagman, *supra* note 49 at 7-10.

[57] Canadian Institutes of Health Research,"RMNI Showcase, Excellence in Research: Probing the Secrets of Cells" (2006), online: Canadian Institutes of Health Research <http://www.cihr-irsc.gc.ca/e/36165.html>.

[58] *Supra* note 9.

[59] Canadian Institutes of Health Research, "Regenerative Medicine and Nanomedicine - Strategic Initiative Announcement (Archived)" (June 2005), online: Canadian Institutes of Health Research <http://www.cihr-irsc.gc.ca/e/28268.html>[RMNI 2005]; RMNI 2007, *supra* note 53 at s. 1.b ("Novel Drug Delivery Approaches, including Gene Therapy and Vaccines").

[60] Carolyn Abraham, "This Human's Life, Decoded" *Globe and Mail* (3 September 2007), online: Globe and Mail <http://www.theglobeandmail.com/servlet/story/RTGAM.20070903.wgenemap0903/BNStory/Science/home> [Abraham, "Decoded"].

[61] RMNI 2007, *supra* note 53 at s. 1b.

[62] RMNI 2005, *supra* note 59.

[63] Linda M. Pilarski *et al*, "Microsystems and Nanoscience for Biomedical Applications: A View to the Future" (2004) 24:1 Bulletin of Science, Technology & Society at 41.

[64] *Ibid.* at 41-42.

Two important sub-fields of diagnostics are: (i) data collection and (ii) health monitoring. A central interest of the RMNI is to develop new models or standards of "normalcy" against which to identify difference and pathology. To this end, federally-funded research includes the development of "small, highly distributed nano-sensors"[65] that may be used *in vivo* and to collect real time data and to help characterize normal functioning, perhaps creating the equivalent of a new "normal curve" based on molecular analysis. Funding opportunities have also been made available to develop permanent or semi-permanent *in vivo* monitoring systems that permit doctors to immediately detect changes in bodies that could signal pathology.[66]

Through the application of these technologies, the body itself may be transformed into a health surveillance system. Consider a recent, popular definition of nanomedicine in this context:

> the comprehensive monitoring, control, construction, repair, defense, and improvement of all human biological systems, working from the molecular level, using engineered nanodevices and nanostructures.[67]

Recall former CIHR President Alan Bernstein's promise of an era of "individualized medicine."[68] If, for example, researchers are able to achieve rapid and inexpensive "single molecule DNA sequencing",[69] diagnostics might one day escape the realm of probabilistic medicine. In other words, doctors might no longer be limited to offering statistical notice that "seven of ten women who receive chemo will still die of cancer." Instead, these gene scans will tell us which seven women should decline chemotherapy.

While this astounding possibility may be good news for at least three of these ten women, the prospect of individualized medicine would at least initially be less than beneficial for anyone for whom a precise diagnosis is not accompanied by available treatment. The social implications and stigma of a diagnosis without a cure could be staggering. As one critic recently pointed out:

> [t]hose with access to nanomedicine will face a different cruel divide, created by the inevitable time lag between the availability of diagnostic tools and efficacious cures. This gap, perhaps a decade or more, will raise its own set of unprecedented ethical questions — ones that will get even thornier once those cures are available. In the near future this tsunami of nanomedical choices could literally drown our healthcare and insurance systems.[70]

In sum, we have suggested that nano-enabled: (i) tissue engineering, (ii) drug and gene delivery and (iii) molecular diagnosis, as promulgated in the Government of Canada's R&D initiatives set

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[65] Raymond Bouchard, "*Bio-Systemics Synthesis*: *Science and Technology Foresight Pilot Project (STFPP) Research Report # 4* (June 2003), online: STFPP <http://2100.org/Nanos/biosystemics-canada.pdf>.

[66] Canadian Institutes of Health Research, "RMNI Showcase, Excellence in Research: Going Micro in Search of Cancer Culprits" (2006), online: Canadian Institutes of Health Research <http://www.cihr-irsc.gc.ca/e/36165.html>.

[67] Nanotechnology Now, "Nanomedicine Glossary: Nanomedicine", online: Nanotechnology Now <http://www.nanotech-now.com/nanotechnology-medicine-glossary.htm#Nanomedicine>. For an interesting thought experiment, substitute the words "human biological systems" with "Homeland Security systems."

[68] Bernstein, "Global Revolution", *supra* note 37.

[69] Craig Venter, an American geneticist, recently completed the sequencing of his own DNA at a cost of about $10 million. His company, J. Craig Venter Inc., offered a $500,000 prize to the first person who could sequence a complete human genome for under a thousand dollars. This competition has been amplified by the X-Prize Foundation which has offered an award of $10 million to the first person who sequences one hundred people's genomes in ten days or less. See for details*, Fact Sheet - First Publication of an Individual Diploid Human Genome Sequence,* online: J. Craig Venter Institute <http://www.jcvi.org/cms/fileadmin/site/research/projects/huref/huref-fact-sheet.pdf>; Archon X-Prize in Genomics, "The Promise of Personalized Medicine, online: X Prize Foundation <http://genomics.xprize.org/>.

[70] Alan H. Goldstein, "Nanomedicine's brave new world" online: (2005) Salon Magazine <http://dir.salon.com/story/tech/feature/2005/11/28/nanomedicine/index.html>.

out above, will each contribute to laying the groundwork for the alteration and enhancement of human bodies beyond species-typical functioning. Put differently, they enable innovation not just to techniques for working on bodies, but *innovation to bodies themselves*. They also enable a shift from Darwinian "natural selection"[71] to what philosopher John Harris has recently styled "deliberative selection."[72] While the interventionist nature of these technologies is perhaps conspicuous, the ethical and legal implications of their role in a potential shift towards enhancement-based medicine and its underlying philosophies, thus far, are seldom articulated or studied. What does seem clear is that the dream of making people "better than well" is alive-and-kicking in our medical laboratories.

IV. Implications of Transhumanist Medicine

Although there are numerous potential legal and ethical implications of Canada's shifting health research agenda,[73] we will focus briefly on its entrenchment of: (a) a dangerously expanding conception of health; and (b) a potentially problematic sense of entitlement to it.

A. Entrenchment of a Transhumanist Conception of Health

The decision(s) to allocate significant funding and research expertise within Canada's health research agenda to R&D that focuses so heavily on radical biotechnological interventions and enhancements risks a certain kind of *ought-ism*: namely, that anything which *can* be "fixed" through the discoveries of these research programs *ought* to be "fixed."[74] Consider, for example, the diagnostic lens of nanomedical technology. Its potential is tremendous. It could one day allow us to see pre-symptomatic "defects" that are undetectable even with genetic screening. In fact, early diagnosis and treatment of disease is the stated goal of many government health entities and funding organizations.[75] This creates a situation where ever more precise detection and prediction methods identify ever more bodies as defective or disabled, requiring ever more invasive or transformative measures or enhancements to correct, bringing us finally to a point where what once looked like a "normal" human body is now *per se* defective.[76]

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[71] Charles Darwin, *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life* (London: J. Murray, 1859).

[72] John Harris, *Enhancing Evolution: The Ethical Case for Making Better People* (Princeton N.J.: Princeton University Press, 2007) at 11 [Harris].

[73] See e.g. Gregor Wolbring, *The Triangle of Enhancement Medicine, Disabled People and the Concept of Health: A new challenge for HTA, health research and health policy* (Calgary Alta.: Health Technology Assessment Unit, Alberta Heritage Foundation for Medical Research, 2005), online: Institute of Health Economics <http://www.ihe.ca/documents/hta/HTA-FR23.pdf> [Wolbring, *Triangle*].

[74] See e.g. European Technology Platform, *supra* note 43 at 5: "Our improved understanding of the functioning of the human body at the molecular and nanometre scale as well as our ability to intervene at pre-symptomatic acute or chronic stages of an illness are of utmost importance…" The classic (and frequently contested) critique of this approach to health and medicine is Ivan Illich, *Limits to Medicine: medical nemesis, the expropriation of health* (London: Boyars, 1976) and Ivan Illich, "Brave New Biocracy: Health Care from Womb to Tomb," (1994) 11:1 New Perspectives Quarterly 4. See also a special issue of the British Medical Journal assessing the contemporary relevance of Illich's critique in Richard Moynihan & Richard Smith, "Too much medicine?" (2002) 324:7342 British Medical Journal 859.

[75] See e.g. National Sciences and Engineering Research Council of Canada, "Biomedical Technologies: Research Topics" *Strategic Project Grants Target Area Descriptions*, online: NSERC <http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=target_areas#2>.

[76] See e.g Gregor Wolbring, "The unenhanced underclass" in Paul Millar & James Wilsdon, eds., *Better Humans? The Politics of Human Enhancement and Life Extension* (London: Demos, 2006) 122 at 125-126, online: Demos <http://www.demos.co.uk/publications/betterhumanscollection>. For a theory of normalcy and pathology that posits these binary notions as concepts of value that are imbued with political, economic and technological imperatives, see Georges Canguilhem, *The Normal and the Pathological* (New York: Zone Books, 1991).

From an industrial or governmental perspective, this may not be seen as a bad thing. As Alan Bernstein put it, while speaking about the very technologies we have discussed above:

> We are indeed at a unique moment when the spectacular advances being made in our understanding of human health and disease are being fuelled by new ways of thinking, new technologies, new partnerships, and new industries.[77]
>
> . . . .
>
> *Our future success as a society depends on the health and well being of all Canadians*. That success requires harnessing Canada's most important natural resource — the intelligence and innovativeness of Canada's health professionals, researchers, and policy makers, to … build a health system for the 21st century.[78]

At the same time, once we accept this reification of technological enhancement as the panacea to ills in the body politic, it perhaps becomes easier to accept the corollary: that ills of the *individual* body can and should be eradicated primarily through technological innovation. It also becomes easier to accept that an unenhanced body, like an unenhanced body politic, is sick and in need of intervention.

Nikolas Rose theorizes that societal acceptance of this framework is already well advanced, noting that through the 20th century, "the very idea of health was re-figured – the will to health would not merely seek the avoidance of sickness or premature death, but would encode an optimization of one's corporeality…."[79] He concludes:

> [T]he dream – of doctors, geneticists, biotech companies, and many 'afflicted individuals' and their families – is that of pre-symptomatic diagnosis followed by technical intervention at the biological level to repair or even improve the sub-optimal organism. For the political vocation of the life sciences today is tied to the belief that in most, maybe all cases, if not now then in the future, the biologically risky or at risk individual, once identified and assessed, may be treated or transformed by medical intervention at the molecular level.[80]

William Vanderberg has likewise articulated the manner in which biomedicine, with its commitment to individualized technological interventions in disease, dominates our understandings of what health is and how it can be achieved.[81] Canada's shifting approach, in contrast to other, more holistic models of health and disease, imagines ill-health as springing primarily from distinct biological flaws, deviances, or entities that may be *fixed or removed* in the individual body.[82] At the root of this approach are notions of "normal" physiology or species-normative functioning which serve as inflexible comparators for identifying disease. With the advent and uptake of enhancements, however, achieving species-typical norms is no longer the endpoint of medicine. *Transhumanist medicine*, as one might call it, enables the continual creation of new and ever-expanding health norms with each novel round of technological innovation.

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[77] Bernstein,"Global Revolution", *supra* note 37.

[78] Alan Bernstein, "Building a 21st Century Health Care System" (Op-Ed Submission to the *Globe and Mail*, 14 September 2004), online: RMNI <http://www.cihr-irsc.gc.ca/e/24645.html>.

[79] Rose, *supra* note 28 at 17.

[80] *Ibid.* at 21. In support of Rose's contention, see European Technology Platform, *supra* note 43 at 6: "In nanodiagnostics, the ultimate goal is to identify disease at the earliest stage possible, ideally at the level of a single cell."

[81] Willem H. Vanderburg, "The Autonomy of Technique Revisited" (2004) 24:6 Bulletin of Science, Technology & Society 515.

[82] There is an entire historical literature chronicling the victory of this framework over other explanations for and approaches to disease. See for example Lawrence Conrad *et al*, *The Western Medical Tradition: 800 BC to 1800 AD* (Cambridge: University of Cambridge Press, 1995).

This expanding model of health and its implicit dictum of self-overcoming-through-technological-transformation appears to be gaining currency. Will this be to the detriment of other frameworks that characterize health through broader notions of "well-being" which require social inclusion, justice, equitable access to resources, ecological balance, and so on?

With the co-emergence of nanomedicine and transhumanism, it seems that we are witnessing a further reification of the belief that biomedical innovation and intervention — now at the molecular level — represent the primary determinants of health. The philosophies embedded within these technologies further push us to accept the assumption that reshaping bodies using sequential interventions will free us not only from the shackles of disease and defect, but from the supposed pre-programmed limitations of our genetic, cognitive and biomechanical realities. This epitomizes the transhumanist infatuation with *morphological freedom* — "an extension of one's right to one's body, not just self-ownership but also the right to modify oneself according to one's desires."[83] With the freedom and desire to *morph* ourselves at our whim (at least, for those who can afford it), our bodies are becoming less distinguishable from the material products used to enhance them. Like our computers and other electronic devices, we are being seen to require regular upgrades and updates. From this perspective, human bodies are valued only to the extent that they represent the current state of the art.

There is, of course, another attendant danger. This shifting conception of health and well-being will, for some, be accompanied by a shifting sense of entitlement to it.

B. "I Want my PDV"[84]

The *kinds* of developments we have outlined here are not exactly new. As we noted above, throughout the latter part of the 20th century, Western society had already begun to expect and demand enhancement as a method of improving and extending life. Developments such as vaccination, mood- and behaviour-modifying prescription pharmaceuticals, cosmetic surgery, growth and estrogen hormone therapy, artificial organs, hair implants, steroids, biochemical and physiological sexual aids, cochlear implants, laser eye surgery, and other prosthetics have represented incremental changes that, taken together, perhaps constitute the crossing of the threshold between therapy and enhancement, and a growing intolerance of sub-normative or even normative human functioning.[85] As Nicholas Rose puts it, "the line of differentiation between interventions targeting susceptibility to illness or frailty on the one hand, and interventions aimed at the enhancement of capacities on the other, is beginning to blur."[86]

A recent court case in Alberta perhaps illustrates one potential repercussion of this series of incremental changes.[87] In 2006, William Murray, an accountant from Calgary, filed a *Charter of Rights and Freedoms* section 7 challenge against an Alberta health insurance policy that prohibited funding a cutting edge, expensive hip repair procedure for patients over a certain age.

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[83] Anders Sanberg, "Morphological Freedom -- Why We not just Want it, but Need It", online: School of Computer Science and Communication, Stockholm University <http://www.nada.kth.se/~asa/Texts/MorphologicalFreedom.htm>; Dale Carrico, "The Politics of Morphological Freedom," online: IEET <http://ieet.org/index.php/IEET/more/carrico20060803>.

[84] To be sung in a high falsetto, accompanied by a killer Mark Knopfler guitar riff. "PDV" is a shorthand for "Plant Derived Vaccine." See e.g. Charles J. Arntzen & Richard T. Mahoney, "Plant-derived Vaccines: A new approach to international public health" online: MolecularFarming.com <http://www.molecularfarming.com/plant-derived-vaccines.html>.

[85] See Elliott, *Better Than Well*, *supra* note 45 and Rothman & Rothman, *supra* note 45 for comprehensive analyses of these historical enhancements in the U.S. context.

[86] Rose, *supra* note 28 at 21.

[87] *William Lloyd Murray v. Alberta et al.*, Statement of Claim filed in the Court of Queen's Bench of Alberta 4 August 2006, cited in Patrick J. Monahan, "*Chaoulli v. Quebec* and the Future of Canadian Healthcare: Patient Accountability as the "Sixth Principle" of the Canada Health Act" *C.D. Howe Institute* (29 November 2006) at 24, online: C.D. Howe Institute, <http://www.cdhowe.org/pdf/benefactors_lecture_2006.pdf>.

Government insurance *did* cover a hip *replacement* procedure, but Mr. Murray and his doctor felt that the newer, non-funded "Birmingham hip resurfacing surgery" was even better.[88]

One way of understanding the basis of Murray's claim is that he was forced to accept a medical procedure that limits him to his former species-typical functioning (for a middle-aged man), despite the fact that enhancements are available to improve his hip well beyond normal function. Understood in this way, Murray is, in essence, claiming that a failure to provide the latest enhancements are an infringement of his "right to life" and "security of the person". His case is now in class action proceedings,[89] and if it is successful, it is expected that a flood of similar actions will result with the advent of each new technological innovation.

Are these class proceedings symptomatic of a new attitude towards what counts as being "healthy," and of a corresponding shift in the political economy of health and disease in Canada?

It is to be expected that health industries will offer an increasingly broad menu of available enhancement products, including: artificial and lab-grown organs, memory aids and implants, anti-aging and life extension treatments, pre- and post-natal genetic modifications, bionics, implantable computing and communication devices, transgenic plant-derived super-vaccines, and so on.[90] If citizens view access to better-than-normal hips as a *Charter* right (and, even then, only *the most hip* of hips, technologically speaking…), is it not reasonable to assume that they will also demand access to the broader menu of other enhancements on offer?[91]

Furthermore, as medical science and technology gain further mastery over the body, one might also ask whether business models from the technology sector will replicate themselves in the biomedical field. The technologies of today's transhumanist medicine, like all other technologies, will surely become obsolete over time. So, why not plan their obsolescence, the way that the industries that make computers and other electronic devices do?[92]

In any event, long before any C*harter* challenges concerning nanomedical enhancement technologies are resolved, enhancement devices, procedures and services will be readily available in some jurisdictions for those wealthy enough to pay for them. Make no mistake about it — there will be pressure in Canada to make at least some of these enhancements universally available, creating difficult challenges for distributive justice in our already under-funded, over-burdened health care systems.

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[88] John Carpay, "*Chaoulli* comes to Alberta" *National Post* (19 Sept 2006) A.21, online: Canadian Constitution Foundation <http://www.canadianconstitutionfoundation.ca/files/pdf/publication-09-19-2006.pdf>.

[89] *Murray v. Alberta (Minister of Health)*, 2007 ABQB 231, 76 Alta. L.R. (4th) 118 (motion by plaintiff to compel defendant to submit defence prior to class certification).

[90] For a comprehensive critical survey of extant and emerging medical enhancement technologies, see "The Choice is Yours," a blog maintained by Dr. Gregor Wolbring, online: Innovation Watch <http://www.innovationwatch.com/commentary_choiceisyours.htm> [Wolbring, "Choice"].

[91] In *Flora v. Ontario (Health Insurance Plan, General Manager)* (2007), 83 O.R. (3d) 721, 278 D.L.R. (4th) 45 (Sup. Ct. J. Div. Ct.), a plaintiff who paid $450,000 for an out-of-country liver transplant that was deemed "too risky" by OHIP experts, argued that OHIP's failure to provide the service or to reimburse him ran counter to his s.7 *Charter* rights. This was a "hard case" insofar as Mr. Flora's condition apparently arose from hepatitis incurred through a transfusion of tainted blood. The Divisional Court upheld the trial judge's finding that extant regulations and procedures for allocating the type and quantity of liver transplants were appropriate and constitutionally valid.

[92] As one author put it: "While the ancient Egyptians built great monuments to endure for countless generations, just about everything we produce in North America is made to break." Giles Slade, *Made to Break: Technology and Obsolescence in America* (Cambridge, Mass.: Harvard University Press, 2006) at 7. See also Vance Packard, *The Waste Makers* (New York: D. Mackay Co., 1960).

V. CONCLUSION

Less than one decade into a new millennium, it is tempting to picture ourselves — as has our former CIHR President — standing on the precipice of a new era for science and technology, pondering its enormous potential to transform medicine and perhaps even the human condition. The advocates of transhumanist medicine take this logic only one step further, suggesting that, with emerging and future technologies,

> "we will be able to assume different bodies and take on a range of personae at will. In practical terms, human aging and illness will be reversed; pollution will be stopped; world hunger and poverty will be solved. Nanotechnology will make it possible to create virtually any physical product using inexpensive information processes and will ultimately turn even death into a soluble problem."[93]

Wisdom, however, should gently remind us that ours is not the first decade or even century to think that science and technology will inevitably transform civilization to its benefit.[94]

While emerging and future human enhancement technologies may well have much to offer, Canada's health research agenda is shifting towards a self-enabled, interventionist, enhancement-focused enterprise without pausing to consider or address its underlying philosophies or implications. In this brief article, we suggest that there are significant ramifications in doing so, both in terms of our core conceptions of what health is and in our sense of entitlement to it. Although we offer no concrete answers to these issues here and, worse still, we leave many other core issues unattended, this work is intended as the preface to an enduring discourse that is long overdue in Canadian bioethics, health law and policy.[95]

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[93] Ray Kurzweil, *The Singularity is Near: When Humans Transcend Biology* (New York: Viking, 2005). The above quote comes from the promotional material on the jacket flap of Kurzweil's very popular book. What is striking is the way that these statements about the power of nanotechnology are echoed in statements by industry, government, and other enthusiasts, some of which are reproduced in our discussion above.

[94] And where our own wisdom fails us, historical philosophers like Ronald Wright (among many others) offers us a poignant reminder of the dangers of the "ideological pathology of progress" that often blinds us to the broader ramifications of our technological endeavours. Ronald Wright, *A Short History of Progress* (Toronto: House of Anansi Press, 2004); see also William H. Vanderburg, *Living in the Labyrinth of Technology* (Toronto: University of Toronto Press, 2005).

[95] We are, by no means, suggesting that there has been no writing on this subject. As readers of this journal will no doubt be aware, some excellent Canadian scholarship on the subject already exists. See e.g., Françoise Baylis & Jason Scott Robert, "The Inevitability of Genetic Enhancement Technologies" (2004) 18:1 Bioethics 1; Wolbring, *Triangle*, *supra* note 73; Wolbring, *Choice*, *supra* note 90; Michael D. Mehta, "Nanoscience and Nanotechnology: Assessing the Nature of Innovation in These Fields" (2002) 22:4 Bulletin of Science, Technology & Society 269; Geoffrey Hunt & Michael D. Mehta, eds., *Nanotechnology: Risks, Ethics, and Law* (London: Earthscan, 2006); Greg McMullen, "Breaking the Trance? Enabling Dissenting Views on Immortalism," (2006) 15:1 Health Law Review 47; ETC Group, *Nanotech RX*, *supra* note 29.