Lecture 3: "Science and Ethics: The Choices that Confront Us"
SFU Harbour Centre, 21 March 2007

This is the third in a series of three lectures. To begin tonight I'd like to give a very brief overview of the first two, for those who missed them. **[Slides 1/2]**

Part I: A Brief Review [Slide 3]

In the first lecture, I suggested that recent developments in modern science have changed the meaning that science has for our lives. The trajectory of modern science and technology moves from the enhanced capacity to manipulate matter and energy in our external environment – the world "out there" – to the world of our personal space, that is, the sphere of our own bodies and minds. Phrased otherwise, we who seek to turn everything else in the world into "stuff" to manipulate, in order to better satisfy our needs and whims, become such stuff ourselves. Indeed, there is something eminently "logical" in the latest phase of development: The lens of science, focused for so long on the world outside, turns 180 degrees and now peers inside us. Every last aspect of the natural environment has been successfully analyzed, manipulated and steered toward the satisfaction of human purposes – and now it is our turn.

Science has begun to focus on the genetic structures that make us what we are, as a mammalian species, and especially – the great prize – on how our brains and minds work. **[Slide 4]** Neuroscientists want to know, for example, how the mass of tissue in our heads carries out its amazing, complex operations, the brain functions that we otherwise refer to as mental activity. And once we know how it works, we are on the way

to being able to play around with it – to repair it, say, when it's damaged, or perhaps even to upgrade its performance.

At the close of the first lecture I asked: Will we come to think of our brains in the same way as we do a Japanese auto racing engine? **[Slide 5]** Can we imagine just stripping it down, examining its components – memory, mood, learning, reasoning, feeling, and so forth – and then tinkering with the various parts? Is it only fair that we treat our own minds as we do the rest of nature, changing and controlling things to suit our every whim? Are you quite comfortable going down this road, knowing that whatever awaits us at the destination may be impossible to predict?

The first lecture ended with those kinds of questions. In the second, I suggested that we step back for a moment, and look more closely at the longer course of modern science and its social context – back to where it all started, in the late eighteenth century, to the period known as the French Enlightenment. **[Slide 6]** This is when Antoine Lavoisier, known as the "father of modern chemistry," lived. Another remarkable individual from that period was the Marquis de Condorcet, who, by a strange coincidence, has exactly the same dates of birth and death as does Lavoisier (1743–1794). **[Slide 7]** Condorcet, a brilliant mathematician who was elected a fellow of the Academy of Sciences at the age of twenty-six; after the overthrow of the monarchy he was an elected deputy in the Assembly, where he became a passionate champion of the rights of women and blacks. But just like Lavoisier, he was condemned unjustly and murdered during the Reign of Terror.

The remarkable coincidence of their lives and fates forms a kind of central motif for my lecture series: Lavoisier, one of the first great figures in turning modern science toward applications for improving the conditions of human life – the nexus of theory, discovery, invention, and, ultimately, industrial innovations and new products. And Condorcet, who worked out what changes were needed in society as a whole in order to complete the "scientific revolution."

In my last lecture I referred in particular to Condorcet's remarkable book, *Sketch for a Historical Picture of the Progress of the Human Mind*, which he wrote while he was on the run and in hiding from the agents of the Terror; it was published posthumously in 1795. **[Slide 8]** In his *Sketch* he developed the idea that the analytical approach developed for the sciences of nature should be applied to the study of society, where it would combat the historical accumulation of ignorance and superstition. The bright future he envisaged for humanity in this work contrasts tragically with the dark fate that, he knew, almost certainly awaited him.

If there is one core idea in Condorcet's conception, it is surely this: The "progress of the sciences" that defines the enlightenment project is a double-sided phenomenon. It encompasses both the physical and the moral sciences. **[Slide 9]** I call this duality inventive science and transformative science: **[Slide 10]**

(a) By the term *inventive science* I mean the promise of "the conquest of nature," the vision of an endless stream of new basic research and new technologies to enhance the material conditions of life and human well-being.

(b) By the term *transformative science* I mean the penetration of the "ethos" of the modern scientific method *throughout all of society and its institutions*.

I define the "enlightenment project," as envisaged by Condorcet, as a long historical development in which the two types of science would gradually succeed and mature in parallel formation, both in a theoretical and a practical sense. **[Slide 11]**

Part II:
The Fate of the Enlightenment Project [Slide 12]

Since Condorcet's time the physical sciences, and the stream of technological inventions based on them, have marched steadily from triumph to triumph. They now receive levels of funding across the globe that make the situation in earlier epochs appear laughable by comparison. The other major change in this period is no less significant: Over the course of the last half-century, science has become near-universal on the globe, spreading out from its original base in Europe first to North America and then to other continents.

Not so with transformative science, however. Here the enlightenment values are, basically, those of classical liberalism: tolerance, political equality and democracy, opposition to prejudice (racism, ethnicity, etc.), absence of the imposition of religious dogma, freedom of conscience and expression, universal education, gender equality, a humane approach to crime and punishment, a peaceful state of international relations, and so forth. My contention is that this side of the enlightenment project is still a hotly-contested zone, in the first place, even in the most "advanced" nations; whatever the gains that have been made there, they are by no means secure. In the aftermath of the

rise of Nazism in Germany many people asked themselves: How could this have happened in the land of Beethoven and Goethe? Many reasons have been adduced, including the severe social and economic collapse in the nineteen-twenties. It would be both foolish and shortsighted to think that it could never happen again. In the second place, more than two centuries after Condorcet formulated his agenda, there is hardly any region on the globe, outside of Western Europe and North America, for which one could persuasively argue that the set of enlightenment values have taken root; on the contrary, in many if not most of those regions, such values are to this day widely disparaged and explicitly rejected.

What has resulted is the *hyper-development* of one side (the inventive) and the *under-development* of the other (the transformative). **[Slide 13]** And it is precisely in this disparity – as between the two sides of the enlightenment project – that I see a steadily increasing risk of catastrophic results.

On the side of the physical sciences, nations and peoples are being handed an ever more complete array of potent technologies. In the last decade we realized that the threat of weapons made with radioactive materials did not vanish with the passing of the Cold War; on the contrary, it now occupies the mad dreams of an ever-expanding complement of state and non-state actors.[1] A newer science, molecular biology, shows the way to the genetic engineering of biological warfare agents.[2] In terms of the scope of the scientific and technological apparatus needed to weaponize its products, today's molecular biology is far more user-friendly than nuclear physics ever will be; indeed, it is well on its way to becoming a backyard-garage type of operation. High-school

students in Canada and elsewhere play with DNA sequences, which can be ordered over the Internet and delivered by mail to your home (including viral sequences).[3] Finally, both genomic sequencing in general, and the accelerating study of brain function in particular, brings broad powers of manipulation right up to the threshold of the most personal and intimate aspects of a person's mind.[4] For me, all this brings to mind Einstein's remark, penned in 1917 amidst the mounting horrors of the First World War: **[Slide 14]** "All of our technological progress, civilization for that matter, is comparable to an axe in the hand of a pathological criminal."

If we were living in a global community where enlightened social values were everywhere unshakably entrenched, I for one would worry far less about the public availability of the scientific knowledge on which such new powers are based. (I might still be concerned about the sheer pace of such innovations and of our ability to keep abreast of them through adequate policy and regulatory responses.) But we do not live in such a world, nor are we likely to do so anytime soon. Rather, we live with the reality of the rejection of enlightenment values, in most nations of the world, and the recurring challenge to those values even within the societies of the most scientifically-advanced nations. Moreover, we live with bitter conflicts within and among peoples and with the constant threat of witnessing the deployment of weapons based on advanced sciences against ourselves and others. For me, this represents the central "crisis of modernity." I am not convinced that can manage the downside risks associated with this situation. Are you?

Part III:
The "Crisis" in the Enlightenment Project – and the Distribution of Responsibilities [Slide 15]

At the end of the second lecture I posed a series of questions, all related to my basic contention about the rupture between the two sides of the original enlightenment project, and the possible consequences of that rupture. You may say that these questions are posed in remembrance of a brilliant and thoughtful physicist, Max Born:

[Slides 16/17]

> [Your] words were a great comfort to me, for similar thoughts are going through my mind as well, in view of the evil which our once so beautiful science has brought upon the world.
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> One must then also decide to keep one's knowledge to oneself,... for otherwise others are still going to misuse the results for evil purposes, and I feel that one would then never be free of responsibility.

* * *

Tonight I just want to focus on the "practical" questions from that list – phrased, admittedly, in somewhat provocative language:

1. Do senior scientists – including leaders such as Nobel Prize-winners – have an ethical and social duty to consider (along with the rest of us) their collective responsibility for the consequences of their research? **[Slide 18]**

2. If so, in what concrete and practical ways can we ensure that an ongoing dialogue about such ethical and social duties of scientists will indeed take place?

Let me illustrate an event that prompts me to ask myself these questions. Here is the account – from February of 2004 – in the *New York Times* with news about the forthcoming paper in *Science* in which South Korean scientists announce they have cloned human embryos and extracted embryonic stem cells:[5]

> "Of course," Dr. Woo Suk Hwang said, "we acknowledge that there will be controversy. But as scientists, we think it is our *obligation* to do this."
>
> **[Slide 19]**
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> "Now you have the demonstration that everyone was waiting for," Dr. Jose B. Cibelli of Michigan State University said. "Whether this approach will be applicable to making babies, I don't know. And I hope I never find out."

This is, of course, the research that was later shown to have been faked. But I'm interested in the scientists' commentary. Note especially the first sentence in the quoted passage, with its reference to the "obligation" to take this step: The idea is that the human agents are not "free" to decide whether or not to do so; rather, it is the "project" itself which dictates what we must do. Presumably, it will continue to dictate to us where we must go along this path, wherever it takes us. Note also that Dr. Cibelli just wanted to get the sensitive issues "off the table" as quickly as possible. My question is: When are the rest of us going to get a chance to talk about this?

The point toward which I have been moving here is a simple one: There needs to be a sustained public dialogue about where we are going with all this, especially now that science is "up close and personal." And such dialogue is almost entirely absent in the public sphere. What we have instead is a kind of episodic, truncated series of "conversations" through intermediaries, lacking all continuity over time. (Recall from Lecture #1 my example of Carolyn Abraham's two *Globe and Mail* stories, in 2002 and 2005, about "fierce mice" – and the possibility that research on mice might be turned into technologies for producing soldiers lacking all normal inhibitions.) These types of fragmented "dialogues" are strictly one-day phenomena which appear in the news

without warning and vanish again immediately. Meanwhile, in the background, silently, the enormous engine of scientific discovery and technological application grinds away, moving from success to success. **[Slide 20]**

The journal *Nature Neuroscience* reported in 2006 that there are almost 350 scientific journals devoted to neuroscience research alone, and that something like 40,000 papers are published in this field each year.[6] After much looking around I found *one* article – one single short paper – in which a couple of prominent neuroscientists joined a few other specialists in bioethics and public policy to comment on the wider social, ethical and public policy issues associated with recent work in neurocognitive enhancement. Their four-page article, which appeared in May 2004, refers to a "need for more discussion of the issues" and concludes with this sentence: "With many of our college students already using stimulants to enhance executive [neurocognitive] function and the pharmaceutical industry soon to be offering an array of new memory-enhancing drugs, the time to begin this discussion is now."[7] Perhaps it will not surprise you to learn that, based on my own scans of the neuroscience literature in the years since 2004, no such discussion has been sustained within the technical literature.[8]

After noting that "the enhancement of normal neurocognitive function by pharmacological means is already a fact of life" for many people, the authors of the 2004 article note: "Many aspects of psychological function are potential targets for pharmacological enhancement, including memory, executive function, mood, appetite, libido, and sleep." Their list of social, ethical, and policy issues includes: drug safety; the possibility of coercion (e.g., in the penal system); and distributive justice, that is,

fairness (if, say, only the wealthy have access to the "brain-boosters.") But their discussion is most provocative when it gets to the issue they label "personhood and intangible values": "Enhancing psychological function by brain intervention is in some ways like improving a car's performance by making adjustments to the engine. **[Recall Slide 5]** But ... the two are very different, because modifying brains, unlike engines, affects persons." They conclude their very cursory consideration of ethical and social issues as follows: "Neither the benefits nor the dangers of neurocognitive enhancement are trivial." To be sure, there are centers of ongoing research and discussion, but it remains true, I think, that very few of the total complement of senior neuroscientists take part on a regular basis.[9]

If you look hard enough, you can find some other discussions by specialists about such issues on the web; but there isn't very much, all in all. But even if you did, this would fall into the category of private learning. There is no regular public forum, anywhere in the world, where citizens can participate in an in-depth dialogue on those issues which the experts themselves refer to as "non-trivial."

Sometimes when I raise the matter of truncated dialogue, to an audience which includes a few biologists, the response is: "Well, it'll be a long time before we get to that point, so why worry about it now?" Or, referring specifically to the most powerful types of interventions, namely, genetic manipulations: "Really, we may never be clever enough to be able to do that kind of thing, so why even talk about it now?" Of course, if we wait, the range of our options will have narrowed considerably, when such things do happen (as they surely will), and we will be left with managing the consequences,

whatever they may be. For what it's worth, our successors will pay a high price in the future for our failure to initiate sustained society-wide dialogues on these matters.

I would like you to accept, just for the sake of argument, that a "real" problem has been identified in the material I have presented. In short form, it can be stated thus: Managing the full set of possible consequences, resulting from the explosion of scientific knowledge in the past century, is not a trivial task. So how can it be done? That is the general question. A more specific question is: Do the scientists who are the creators of this knowledge have any special responsibilities in this regard? If we think about this in the broadest terms, there are at least two possible ways of responding to such questions:

1. Management of any such consequences is the responsibility of society's political institutions, specifically, its legal, policy and regulatory mechanisms; scientists may be interveners in this process, but they have neither special privileges nor special duties in this regard. Example: reproductive technologies and embryonic stem-cell research.

2. In addition to #1, senior scientists ought to be engaged with these issues in other forums on a regular basis, especially in seeking to anticipate the directions in which leading-edge research is headed and directing the attention of policy-makers to the corresponding social and ethical issues that are likely to emerge in the future. **[Slide 21]**

For an example of the first, one might look at Canada's experience with its federal Assisted Reproductive Technologies Act – but doing so would not inspire much confidence. It took over 15 years, from the time when the issues first surfaced, to get a piece of legislation passed, in 2004; three years later, we are still waiting for the regulations. So much time elapsed that the draft bill had to be revised, periodically, so as to incorporate newer technologies (such as animal cloning). In general, I think it is

fair to say, the response capacity of modern society's regulatory apparatus slows in direct proportion to the rate of increase in the production of new scientific knowledge.

Just as serious – perhaps even more so – is the failure of modern institutions to provide an ongoing venue for democratic dialogue about the larger implications of scientific research, such as neuroscience. For now I'd like to conclude with a kind of challenge. Directly across the street from the Harbour Centre campus is that beautiful renovated bank building, with lettering along the top of the façade reading, "The Morris J. Wosk Centre for Dialogue." **[Slide 22]** When might we expect the Wosk Centre to host its first dialogue on the social implications of research and applications in the neurosciences?

Tomorrow is Day One of this challenge. By the end of the day tomorrow, and at the close of each subsequent day, there will be in excess of 100 new scientific publications in the neurosciences. At the end of Day Thirty, there will be 3,300.

Faced with a science that tells us that we can, if we wish, transform the most sensitive and intimate traits that make up our lives and personalities, we should ask: Are we ready for this? Do we have the competence and the capacities, in our collection of social institutions, to manage such powers responsibly? And even if we think we do, what about the rest of the world? Science is universal; but enlightenment is not.

In many advanced societies today, scientists enjoy enormous advantages that are, in the end, bestowed on them by society: intellectual freedom, substantial financial

resources for research, and social prestige, to name a few. In return, they bestow on the rest of us both new insights into the workings of nature and the promise of great benefits, in terms of our health and material well-being. But they also transfer to us a host of substantial new risks which we must struggle to manage – risks associated with the whole range of consequences flowing from humanity's new powers, including the consequences of the misuse of those powers. They have a corresponding duty which flows from their role, a duty that cannot be dispensed with in a Pontius-Pilate-like gesture: "Here's the new stuff, do what you like with it, I've got to get back to my lab and prepare the next grant application."

My sole concluding proposition, at the end of this lecture series, is this: Those scientists have a duty to engage, along with the rest of us, in a serious, sustained, continuous – and, yes, very, very time-consuming – set of social dialogues on how to best manage the range of risks and benefits associated with the continual stream of new powers emanating from their laboratories. This is no one-off proposition. This is not the holding of an occasional conference and publishing the proceedings. This is a long, arduous road, made all the longer and more difficult by the fact that we have postponed starting the journey for so long. And there is no point in any of the rest of us setting off on the trek if we are not joined by a substantial number of the most successful, senior scientists in all branches of the physical sciences.

I must confess that I do not believe that very many senior scientists will actually take that road. I hope I'm wrong.

Part IV: [Slide 23]

What are our Options? An Exercise [Slides 24-30]

I. Consider four scenarios.

A. Two "Optimistic" Scenarios:

1. Nothing is done and gradually the problem takes care of itself.

2. Deliberate action is taken to redress the imbalance, it succeeds, and gradually "B" is strengthened around the world.

B. Two "Pessimistic" Scenarios:

1. The imbalance contributes to a general collapse of modern society – which takes science along with it.

2. There is a general collapse of modern society but the legacy of modern science is preserved for the future.

II. Perform a Little "Bayesian" Exercise.

1. Using the handout sheets, assign your own "subjective probability" to each of the four scenarios (A1, A2, B1, B2): How likely (probable) is it that each forecast will come true?

2. Your assignment of likelihood does not have to add up to 100% across the whole set (the scenarios are not necessarily mutually exclusive).

3. You may add one or more of your own scenarios and discard a similar number of the ones presented.

Use the following categories.

- Almost certain (90-100%)
- Quite likely (70-90%)
- More likely than not (50-70%)
- Even (50%)
- Possible (30-50%)
- Not very likely (10-30%)
- Almost impossible to imagine (0-10%)

Part V:
Reading: An Excerpt from *Hera, or Empathy*
[Slides 31/32]

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[1] See Michael Crowley, "The stuff Sam Nunn's nightmares are made of," *The New York Times Magazine,* 25 February 2007.

[2] E.g., The Sunshine Project, "Emerging Technologies: Genetic Engineering and Biological Weapons" (2003): http://www.sunshine-project.org/publications/bk/bk12.html; and a website maintained by UCLA's School of Public Health, "Epidemiologic Information on Bioterrorism": http://www.ph.ucla.edu/EPI/bioter/bioterrorism.html .

[3] Oliver Morton, http://www.wired.com/wired/archive/13.01/mit.html ("Life, Reinvented," *Wired*, Issue 13.01, January 2005); Jonathan B. Tucker and Raymond A. Zilinskas, "The Promise and Perils of Synthetic Biology," *The New Atlantis*, Number 12, Spring 2006, pp. 25-45: http://www.thenewatlantis.com/archive/12/tuckerzilinskas.htm; James Randerson, "Revealed: the lax laws that could allow assembly of deadly virus DNA; urgent calls for regulation after Guardian buys part of smallpox genome through mail order," *The Guardian*, 14 June 2006: http://www.guardian.co.uk/terrorism/story/0,,1797057,00.html

[4] For the most recent summary of neuroscience research, specifically in connection with legal processes, see Jeffrey Rosen, "The Brain on the Stand," *The New York Times Magazine,* 11 March 2007.

[5] Gina Kolata, "Cloning creates human embryos," *The New York Times*, 12 February 2004.

[6] "Putting the brain back together" (Editorial), *Nature Neuroscience* **9** (2006), 457.

[7] M. J. Farah *et al.* "Neurocognitive enhancement: what can we do and what should we do?" *Nature Reviews: Neuroscience,* **5** (2004), pp. 421-5. (Among the list of authors is the Nobel Prize winner, Eric Kandel.)

[8] Steven J. Marcus (ed.), *Neuroethics: Mapping the Field* (New York: Dana Press, 2004).

[9] See, e.g.: http://scbe.stanford.edu/research/programs/neuroethics.html ; http://www.neuroethicssociety.org/