SS3820

MOLECULAR COORDINATES

A MACHINE FOR THINKING THROUGH THE SOCIETAL IMPLICATIONS OF EMERGENT NANOTECHNOLOGIES

SPRING 2008

CHEMSCI 19-104A

M, W 2-3pm

Professor Michael G Bennett
Office: Academic Office, 216
Office Hours: M, 10a-11a
Phone: x72413
Email: mbennett

"I say!" murmured Horton. "I've never heard tell
Of a small speck of dust that is able to yell . . ."
Seuss

a

This course is designed to enable you to analyze dynamics and relationships germane to the domestic emergence of nanotechnological and nanoscientific research and development from approximately 1980-2003, and, in turn, the enmeshed ethical, societal, legal, martial, political and imaginary implications they suggest.

b

Our course is intensely empirically grounded. We will digest a broad, diverse sampling of the literatures coordinating the nanotechnological —think of these as our data— and our course's natural emphasis will be close and critical readings of these texts. The reading load is sizeable. If you are averse or out-and-out opposed to digesting large quantities weekly, for the duration of the semester, and on pains of scoring poorly, you should think on this requirement, and consider our grading calculus below. Please attend class prepared to discuss in detail and depth the texts noted under the appropriate date on the Reading Calendar below (i.e., in week 3 (01.28 & 01.30), on Monday come to class prepared to discuss all the readings listed for that week.).

In addition to the texts we will access electronically, there are three required texts you should purchase:

1. Drexler, K. E. (1986). Engines of Creation: The Coming Era of Nanotechnology. New York: Anchor Books. (Hereinafter "Drexler (1986)")
2. Stephenson, N. (1995). The Diamond Age; or, A Young Lady's Illustrated Primer. New York: Bantam Books. (Hereinafter "Stephenson (1995)")
3. Sargent, T. (2006). The Dance of Molecules: How Nanotechnology is Changing Our Lives. New York: Thunder's Mouth Press. (Hereinafter "Sargent (2006)").

c

Familiarity with the family of texts enables in-class discussions that, more often than not, will consume the bulk of our time together. We will break the class body into four groups (4-5 students each) who will be for a week at a time primarily responsible for catalyzing class discussions and fielding questions from other students and from me. During the weeks in which it is "on-call," a group should (i) **prepare and**, by the Sunday evening before the week begins, (ii) **distribute to the class at large** a synoptic overview of important points, questions and critiques of the reading assigned for the week.

d

Scoring and final marks are based on the following point distribution:

25 points —**Group Participation** (including critical readings' summaries pace paragraph "c" above)
25 points —**Individual Attendance & Individual Class Participation**
50 points —**Individual Written Assignments**

---

100 points —**Total**

Participation and attendance are self-explanatory. The written assignments will comprise three short essays of approximately 800 words. **The first essay is due 02.11** and should discuss the value of "nanohype" as concept for understanding the nanotechnoscientific community's emergence. **The second essay is due 03.17** and should discuss (i) Stephenson (1995) within the context of Delany (1969) or Suvin (1974). In **the third essay**, which **is due 04.07**, discuss what you consider to be the most significance ethical, legal and/or political implication of "nanotechnology." The essays must be typed, double spaced, inclusive of a consistent citation system and a reference list.

e

Readings should be completed by the dates with which they are associated below. With minimal deviation, our reading-based discussions should unfold as follows:

Week 1: Introduction
01.14 & 01.17
Orientation
Michael Berry's (1991) "The Creator."

Week 2: Personas & Nominal Demarcations
Group 1
01.21 (MLK Recess) & 01.23
Michael Berry's (1991) "The Creator."
Ed Regis (2004) "The Incredible Shrinking Man," Wired 12.10.
Lawrence Lessig (2004) "Stamping Out Good Science," Wired 12.07.
Editors (2004), "The Nanotech Schism," The New Atlantis, no. 4, Winter.
Rice, News & Media Relations (2005), "Nanotech Pioneer, Nobel Laureate Richard Smalley Dead at 63."
Rudy Baum (2003), "Nanotechnology: Drexler and Smalley Make the Case For and Against 'Molecular Assemblers," Chemical and Engineering News.

Week 3: Conceptualizations
Group 2
01.28 & 01.30
Richard Feynman (1959), "There's Plenty of Room at the Bottom."
Richard Feynman (1983), "Infinitesimal Machinery."
Drexler (1986: Forward; Part One).
Eric K. Drexler (1988) "Originally Published in 1988"
Sargent (2006: Prologue; Introduction).

Week 4: Conceptualizations
Group 3
02.04 & 02.06
Rand (2006), "Global Technology Revolution 2020-Executive Summary: Bio/Nano/Materials/Information Trends, Drivers, Barriers, and Social Implications."
Coenen & Rader (2004), "Of Visions, Dreams and Nightmares: The Debate on Converging Technologies."
David Berube (2006: Introduction)
George M. Whitesides and Mila Boncheva (2002), "Beyond Molecules: Self-Assembly of Mesoscopic and Macroscopic Components."
Drexler (1992), Preface, Chapters 1 & 9.

Week 5: Technology/Science
Group 4
02.11 & 02.13
Wang & Song (2006), "Piezoelectric Nanogenerators Based on Zinc Oxide Nanowire Arrays," *Science*.
Wilson (2002), "Quantum Information and Quantum Computing" and "Experimental Implementations of Quantum Computers."
Montemagno et al. (2004), Nanosyringe Array and Method, United States Patent #

6686299.
Evident Technologies (2008), "Quantum Dots Explained" (http://www.evidenttech.com/quantum-dots-explained.html).
Jovin (2003), "Quantum Dots Finally Come of Age," *Nature Biotechnology*.
Seydel (2003), "Quantum Dots Get Wet," *Science*.
Sayes et al. (2004), "The Differential Cytotoxicity of Water-Soluble Fullerenes," *Nano Letters*.
Ho et al. (2004), "Three-Dimensional Crystalline SiC Nanowire Flowers," *Nanotechnology*.
Karwa et al. (2006), "Selective Self-Assembly of Single Walled Carbon Nanotubes in Long Steel Tubing For Chemical Separations," *Journal of Materials Chemistry*.

Week 6: Law & Policy
Group 1
02.18 & 02.20
Fiedler & Reynolds (1994), "Legal Problems of Nanotechnology: An Overview," *Southern California Interdisciplinary Law Journal*.
Reynolds (2001), "Environmental Regulation of Nanotechnology: Some Preliminary Observations," *Environmental Law Reporter*.
President Clinton (2000), "Remarks at the California Institute of Technology, Pasadena, California (January 21)."
21st Century Nanotechnology Research and Development Act.
Bennett (2004), "Does Existing Law Fail to Address Nanotechnoscience?" *IEEE Technology and Society Magazine*.

Week 7: Law & Policy
Group 2
02.25 & 02.25
Sabety (2005), "Nanotechnology Innovation and the Patent Thicket: Which IP Policies Promote Growth?" *Albany Law Journal of Science and Technology*.
Barnaby (2004), "Tiny Ideas Coming of Age," *New York Times*.
Maloney (2005), "Patent Office Faces Backlog Crisis," *Design News*.
Moore (2005), "The Nanotech Patent Trap," *IEEE Spectrum*.
ETC Group (2005), "A Tiny Primer Nano-Scale Technologies and 'The Little Bang Theory'."
Berkeley Municipal Code, Chapter 15.12.040, Part I, and Chapter 15.12.050, Part C, 7 (https://www.cityofberkeley.info/bmc/berkeley_municipal_code/Title_15/12/index.html).
Elias (2006), "Berkeley to be the First City to Regulate Nanotechnology," *Associated Press*.

Week 8: Science Fiction
Group 3
03.03 & 03.05
Delany (1969), "About Five Thousand One Hundred Seventy-Five Words," *Extrapolation: A Science-Fiction Newsletter*.
Delany (1999), "Future Shock," *Village Voice*.

Suvin (1974), Radical Rhapsody and Romantic Recoil in the Age of Anticipation: A Chapter in the History of SF," *Science Fiction Studies*.
Lopez (2004), "Bridging the Gaps: Science Fiction in Nanotechnology," *HYLE*.
Berne & Schummer (2005), Teaching Societal and Ethical Implications of Nanotechnology To Engineering Students Through Science Fiction, *Bulletin of Science, Technology and Society*.
Ju (2004), "Dangers Compared To Science Fiction," *The Ithaca Journal*.
Itzkoff (2006), "It's All Geek to Me," *New York Times* (March 5).

Week 9: Spring Break
03.10 & 03.12
Relax, enjoy yourself . . . then read ahead.

Week 10: Science Fiction
Group 4
03.17 & 03.19
Drexler (1986: Part 2)
Stephenson (1995)

Week 11: Ethics
Group 1
03.24 & 03.26
Joy (2000), "Why the Future Doesn't Need Us," Wired.
Rehmann-Sutter (N/A), "Ethical Implications of Nanosciences."
Mulhall (2002: Introduction).
Pullin (2002), "Goo and Evil," Innovation.
Winner (2003), "Testimony to the Committee on Science of the U.S. House of Representatives on the Societal Implications of Nanotechnology."
Grunwald (2005), "Nanotechnology —A New Field of Ethical Inquiry?" Science and Engineering Ethics.
Berne (2006: Forward, Chapter 2)
Sargent (2006: Epilogue).
Keiper (2007), "Nanoethics as Discipline?" *The New Atlantis* (Spring) (http://www.thenewatlantis.com/index.html).
The New Atlantis (2007), "Correspondence: Debating Nanoethics" (Spring) (http://www.thenewatlantis.com/index.html).

Week 12: Economics
Group 2
03.31 & 04.02
Drexler (1986: Part 2)
Merrill Lynch (2001), "The Next Small Thing: An Introduction to Nanotechnology."
Uldrich (2003: Chapter 3).

Week 13: Militarisms
Group 3

04.07 & 04.09
Department of Defense (2005), "Defense Nanotechnology Research and Development Programs."
Altmann (2006: Chapter 4).
Drexler (1986: Part 3)

Week 14: Synthesis
Group 4
04.14 & 04.16
Sargent (2006: Chapters 1-3, 7-9, Epilogue)

Week 15: Convergence—The Big Picture?
04.21 & 04.23
Bernal (1929), "The World, The Flesh and The Devil: An Enquiry Into the Future of the Three Enemies of the Rational Soul." cscs.umich.edu/~crshalizi/Bernal/ .
Dyson (1972), "The World, The Flesh and The Devil."

f

A non-exhaustive list of questions to keep foregrounded in your mind during the semester should include the following:

What is "nanotechnology"?

How many definitions exist scattered among our assigned readings? What of definitions beyond our readings? Which are most compelling to you and why? (Keep a running tally to share at semester's end.)

Why should society (whatever that is) be the least bit concerned with nanotechnology? How should society respond to nanotechnological developments, concepts, promises and thought collectives? What role (if any) should various lay elements of society play in responding to such developments? Should nanotechnological development be a purely technocratic affair?

What function(s) does science fiction (sf) —as genre, as irradiating epithet— play in the nanotechnological arena?

Are juridical laws appropriate in domains of technical activities during their larval phase?

How much sway should commercial and economic forces be allowed to exercise over nanotechnological matters?

Who are the mascots of nanotechnology? Whose personas, like scientific service marks, have come to represent, front and shield nanotechnology?

How, if at all, should possible futures and their inhabitants be taken into consideration when thinking through and performing nanotechnology-related activities?

Should a democracy's research and development differ from those of socialist, communist or fascist regimes?

What other questions should augment this list?