**Princeton University
Science, Technology and Environmental Policy (STEP) Program
Woodrow Wilson School of Public and International Affairs
Graduate Program, Spring 1999**

**SCIENCE, TECHNOLOGY AND ENVIRONMENTAL POLICY**

**(WWS-588**[[http://www.wws.princeton.edu/wws588/](https://www.princeton.edu/~mauzeral/syllabi/%3Cfont%20face%3D%22Arial%2C%20Helvetica%2C%20sans-serif%22%20size%3D%222%22%3Ehttp%3A/www.wws.princeton.edu/wws588/%3C/font%3E)]**Spring Term, 1999)
Lectures:**Tuesday and Thursday, 1:30-2:20 PM; Bowl 1, Robertson Hall
**Seminar/ Discussion:**one 2-hour session per week, to be scheduled

**Professor Denise L. Mauzerall
office: 5 Ivy Lane, Room 301
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e-mail:**mauzeral@princeton.edu **www:**[http://www.wws.princeton.edu/~step/step.info/mauzerall.html](https://www.princeton.edu/~mauzeral/syllabi/%3CB%3E%3Cfont%20face%3D%22Arial%2C%20Helvetica%2C%20sans-serif%22%20size%3D%222%22%3Ehttp%3A/www.wws.princeton.edu/~step/step.info/mauzerall.html) **Secretary: Jackie Schatz, 258-4821,**jacki@wws.princeton.edu

**Description:** Analyses the special problems encountered by democratic policy making in scientific, technical and environmental areas of public policy: the often hidden value assumptions concealed behind technical debates; the frequent existence of options which may be better than those being debated; insights available from "back-of-the-envelope" calculations; the role of Government in fostering and regulating technological change; the roles of non-governmental organizations ranging from the National Academy of Sciences to individual "public citizens"; accessibility of critical information and analyses; the uses, misuses, rights and responsibilities of technical experts. Case studies of current policy debates concerning: nuclear-weapons, climate change, alternative energy futures, cancer risks, genetic engineering, and the information technologies. Two lectures each week, one weekly 2-hour section. No prerequisites.

This year, this course will take advantage of a considerable overlap in subject material with the undergraduate course, WWS-304, "Science, Technology and Public Policy", taught by Professor Frank von Hippel. Graduate students are requested to attend the undergraduate lectures. They will, however, have additional readings, assignments, and a weekly two hour session led by Professor Denise Mauzerall (to be scheduled at the first meeting of WWS 304 / WWS 588, but most likely occurring on Wednesday evenings from 7-9 pm).

**Requirements:**

Course paper (40 % of grade), a maximum of 25 double-spaced pages, focussing on a specific science, technology or environment related policy problem. The paper should draw on primary literature, be clear, concise and cogently argued, present both sides in a science, technology or environment related debate, and draw a conclusion as to what is the preferred policy choice. The topic should be discussed with Mauzerall during the second or third week, an outline and not-necessarily-complete draft (which will not be graded) should be submitted for detailed comments in class on Wednesday March 31, and a 10-minute oral presentation will be scheduled shortly thereafter. The final paper will be due on Wednesday May 12, 1999.

Section participation (15%). The course is organized so that the last WWS 304/ WWS 588 lecture of a topic is ordinarily on a Tuesday. The WWS 588 section will occur between that lecture and the lecture on Thursday. This section will be used to expand on lectures, for discussion, presentations and debates. Students are encouraged to e-mail Mauzerall by the night before the evening session with questions relating to the unit that has just been covered that they would like to discuss.

Policy Memos (15%). Three 2-page memos, one approximately every four weeks, on a topic related to one of the course topics treated during that period. The memo should recommend a particular policy to an appropriate policy maker and should include the reasoning behind that recommendation. At least one of these policy memos should be built around "back-of-the-envelope" estimates of your own design. You will be given written feedback on a draft and then graded on your memos after they have been revised in response to the comments. Drafts are due by Feb 18, March 25 and April 15. Revised final versions are due, March 4, April 8 and April 29.

Problem Sets (5%). There will be three assigned problem sets illustrating the usefulness of back-of-the-envelope estimations for topics where the material is amenable to this approach. Problem sets will not be graded but are to be handed in. Similar problems will appear on the final exam.

Final (25%). The final will be approximately equally divided between factual questions (30%),opinion questions (35%), and back-of-the-envelope estimates similar to those in the assigned problem sets (35%).

**Reading and Study Materials.**A volume of photocopied material, *Science, Technology and Public Policy, Course Readings* will be available for purchase at Pequod (6 Nassau St). This contains chapters from books and articles from journals such as *Science* magazine (www.sciencemag.org) and *Scientific American*(www.sciam.com).*Citizen Scientist* will also be available for purchase for the author's discount price ($3.00) at 5 Ivy Lane. *Remaking Eden: Cloning and Beyond in a Brave New World* by Lee M. Silver will be available in the University Bookstore. Multiple copies of these books and other assigned reading materials will also be available in the WWS library. Study questions and supplementary materials for most lectures will be handed out and/or posted on the WWS-588 world-wide-web home page. (1/14/99)

Lecture Dates Topics

Feb. 2 I. INTRODUCTION: TECHNOLOGY,

GOVERNMENT AND VALUES

Feb. 4, 9 II POLICY-MAKING FOR TECHNOLOGY

Feb. 11, 16 III. NUCLEAR WEAPONS --THE FIRST

GLOBAL PROBLEM

Feb. 18, 23 (meet with Mauzerall to decide IV. THE GREENHOUSE PROBLEM,

Feb. 25 on term paper topic) ALTERNATIVE-ENERGY FUTURES &

March 2 INSIGHTS FROM BACK-OF-THE-ENVELOPE

ESTIMATES

March 4, 9 V. RISK ASSESSMENT AND REGULATION

March 11 VI. FREEDOM OF INFORMATION

------------------------Break week----------------------------

March 23 VII."PUBLIC-INTEREST SCIENCE"

March 25, 30 (draft term papers due 3/31) VIII.DISSENT AND THE ORGANIZATION

April 1, 6 IX.R&D -- FOR WHAT?

April 8, 13 X. TECHNOLOGY & DEVELOPMENT

April 15, 20 XI. INFORMATION TECHNOLOGY, DEMOCRACY AND PRIVACY

April 22, 27 XII. GENETIC SCREENING AND THE

DESIGNER CHILD?

April 29 XIII. WRAP-UP

May 12 Last date for papers to be handed in

To be scheduled Final exam

I. **Introduction: Technology, Government and Values**

Natural science teaches us how the world works. Technology uses this understanding to enhance human capabilities. How we use these insights and powers depends on values.

(**\***Indicates reading is in photocopied volume of Course readings; www means look on the Web. Additional readings will be distributed in class.)

\* "The First Technological Revolution and Its Lessons," Peter F. Drucker, in *Technology and Culture,*Melvin Kranzberg and William H. Davenport, eds. (New York: New American Library, 1972) pp. 41-49.

\* "Palchinsky's Travels: A Russian Engineer's Adventures Among Gigantic Projects and Small Minds" by Loren R. Graham, *Technology Review*, November/December 1993, pp. 22-31.

\* "Scientifically Illiterate vs. Politically Clueless" by Gregory E. van der Vink, *Science 276* (23 May 1997), p. 1175.

\* " Taxes Well Spent" by Mark Shields, *Washington Post*, August 4, 1997, A19.

\* "Spanish Waters, Amish Farming" in *Democracy and Technology,*by Richard E. Sclove (NewYork: The Guilford Press, 1995), pp. 3-9.

\* "Do Artifacts have Politics?" (pp. 19-39) in *The Whale and the Reactor* by Langdon Winner (University of Chicago Press, 1986)

II. **Policy-Making for Technology**

Historically, policy-making technology in the U.S. has occurred mainly at the federal level, with Congress, specialized Executive agencies, the courts, the media and "public-interest" groups all playing their usual roles. In addition, because specialized knowledge is involved, specific organizations have been set up to provide the Executive branch and Congress with expert advice: the White House Office of Science and Technology Policy, the quasi-independent National Research Council (NRC), which is operated by the National Academies of Science and Engineering and the Institute of Medicine; and (until abolished by Congress in 1995) the Congressional Office of Technology Assessment.

\* "Introduction" (pp. 3-9) and "The Supersonic Transport: A Case History in the Politics of Technology" (pp. 10-29) in *Advice and Dissent: Scientists in the Political Arena* by Joel Primack and Frank von Hippel (Basic Books, 1974; New American Library 1976).

\* "Emerging Importance" (pp. 1-17) in *The Brain Bank of America* by Philip Boffy (McGraw-Hill, 1975). A discussion of the role of the National Research Council, the "think tank" of the National Academies of Science and Engineering, in the development of federal policies for technology.

\* "Is the NRC [National Research Council] Ready for Reform?" by Andrew Lawler, *Science 276*, May 9, 1997, pp. 900-904.

\* "Rationalizing Politics" (pp. 1-12) in *The Fifth Branch: Science Advisors as Policy Makers,*by Sheila Jasanoff (Harvard University Press, 1990).

\* "An Outsider's Inside View of the Challenger Inquiry" by Richard P. Feynmann, *Physics Today,* February 1988, pp. 26-37.

\* "Town Meetings on Technology" by Richard Sclove, *Technology Review* , July 1996, pp. 24-31.

III. **Nuclear Weapons -- The First Global Problem**

Nuclear weapons have dramatically reduced the willingness of major industrialized nations to go to war. They have also made it possible to destroy civilization by accident. On balance, the governments of the nuclear-weapon states seem confident in their abilities to avoid such accidents. However, they are not sanguine about the results if additional countries -- or even terrorist groups -- get their fingers on the trigger. Non-nuclear-weapon states want nuclear disarmament too. (M.V. Ramana will give a guest lecture on Feb. 16.)

*Hiroshima* by John Hersey (1946), chapters 1-4

\*"Taking Nuclear Missiles Off Hair-trigger Alert@ by Bruce Blair, Harold Feiveson, and Frank von Hippel,*"Scientific American* ," November 1997, pp. 74-81.

@Cure for Russia=s Nuclear >Headache= Proves to be Painful Crisis B Spotty Data Hobble Bid to Secure Bomb Material,@ David Hoffman,*Washington Post*, December 26, 1997, A1.

@ Idled Arms Experts In Russia Pose Threat, Many Take Talents to Developing States@ by David Hoffman, *Washington Post* , December 28, 1998, A1.

\*"Nuclear Status" (pp. 10-11); "Nuclear Weapons -- A Primer" (p. 317); "Manufacturing Nuclear Weapons" (pp. 319-322); "International Atomic Energy Agency Safeguards" (pp. 295-299); "Nuclear Suppliers Organizations" (pp. 307-309) in *Tracking Nuclear Proliferation: A Guide in Maps and Charts, 1998*, Rodney W. Jones et al (Washington, D.C.: Carnegie Endowment for International Peace, 1998).

\*"Iraq's Shop-till-you-drop Nuclear Program" by David Albright and Mark Hibbs, *Bulletin of the Atomic Scientists*, April 1992, pp. 27-37.

\*"The Indian Nuclear Bomb: Long in the Making" by M.V. Ramana, *Précis IX,*#3 (Fall 1998), pp. 1, 21-25.

\*"Effects of a Nuclear Blast Over Bombay" by M.V. Ramana, *Medicine & Global Survival 5, #2*, October 1998, pp. 74-77.

\*"The Politics of South Asias Nuclear Crisis" by Zia Mian, *Medicine & Global Survival 5, #2*, October 1998, pp. 78-85.

\*"Working for Non-proliferation Control in Argentina and Brazil" by David Albright and William Higinbotham in *F.A.S. Public Interest Report*, April 1990, pp. 1-3.

\*"Working in the White House on Nuclear Nonproliferation and Arms Control" by Frank von Hippel, *Federation of American Scientists Public Interest Report*, March/April 1995, pp. 1, 3-8.

IV.**The Greenhouse Problem, Alternative-Energy Futures &**

**Insights from Back-of-the-Envelope Calculations**

(Denise Mauzerall will give lectures on Thursday, Feb. 18 and Tuesday, Feb. 23.)

**The Precedent: Protecting The Stratospheric Ozone Layer**

The 1985 Vienna Convention on Protection of the Ozone Layer and the subsequent implementing Montreal Protocol on Substances that deplete the Ozone Layer were the first successful steps toward an international policy to protect the global atmosphere. What can we learn from the way in which policy makers dealt with the uncertainties of estimates of both the severity of the problem and the costs of its mitigation? How can we apply what we�ve learned to other global atmospheric pollution problems?

\*"Politics of the Ozone Layer" by David D. Doniger, *Issues in Science and Technology*, Spring 1988, pp. 86-92.

\*"Environmental Science Under Siege in the U.S. Congress" by George E. Brown, Jr, *Environment*, March 1996, pp. 12-29.

**The Greenhouse Problem.**Reducing our emissions of greenhouse gases challenges us to change the basic support systems of the industrialized world: our energy supply, energy use, and possibly agriculture.

\*"The Changing Climate," Stephen H. Schneider, *Scientific American*, September 1989, pp. 70-79.

\*"The Great Climate Debate," Robert M. White, *Scientific American*, July 1990, pp. 36-43.

\* "Greenhouse Forecasting Still Cloudy" by Richard A. Kerr, *Science 276*, May 16, 1997, pp. 1040-2.

\*"The Hottest Year, by a Hair" by Richard Kerr, *Science 279*, January 16, 1998, pp. 315-6.

\*"Warming�s Unpleasant Surprise: Shivering in the Greenhouse?" by Richard Kerr, *Science 281*, July 10, 1998, pp. 156, 158.

\*"Heating Up: Princeton scientists chart global warming and suggest ways to slow it, but there are no small fixes" by Royce Flippin, *Princeton Alumni Weekly*, Dec. 2, 1998, pp. 12-19.

\*"The Kyoto Negotiations on Climate Change: A Science Perspective" by Bert Bolin, *Science 279,* January 16, 1998, pp. 330-1.

\*"Coal vs. Goals: India�s Dilemma" by Kenneth J. Cooper, *Washington Post,* Oct. 16. 1997, A21.

\*"The Kyoto Protocol: too many gaps", *NYT*, September 10, 1998, and "The Kyoto Protocol: a painful response", *NYT,* November 5, 1998, ads by Mobil.

\*"Deadline Set to Form Rules for Reducing Gas Emissions" by William Stevens, *NYT,*Nov. 15, 98, p. 11.

\*"The Costs of Climate Protection: A Guide for the Perplexed"by Robert Repetto and Duncan Austin (World Resources Institute, 1997), pp. 5-16.

\*"Study Says Trading Permits Would be Economical" by John H. Cushman Jr.,*NYT,*Aug. 1, 1998.

\*"Acid Rain Control: Success on the Cheap" by Richard Kerr, *Science 282*, Nov. 6, 1998, pp. 1024-7.

**Alternative Energy Futures**(Robert H. Williams guest lecture, Tuesday, March 2). We have the opportunity to make our society much more energy efficient and shift away from fossil to renewable energy sources without great economic cost. But the unaided "invisible hand" of the market will not do it for us. (Problem Set.)

\*"Carbon Dioxide Emissions from Industrialized Countries" by Lee Schipper and Mike Ting, Lawrence Berkeley National Laboratory, Summer 1997, p. 6.

\* Figure from "Efficient Use of Electricity" by A.P. Fickett, C.W. Gellings and A.B. Lovins, *Scientific American*, September 1990, p. 74.

\*"New Energy Rules for Refrigerators: Efficiency, at a Cost" by Matthew Wald, *NYT*, April 24, 1997, p. 1.

\*"Basic Needs and Much More with One Kilowatt per Capita" by José Goldemberg, Thomas B. Johansson, Amulya K. Reddy and Robert H. Williams, *Ambio 14* (1985), pp. 190-200.

\* "A Technological Strategy for Making Fossil Fuels Environment and Climate Friendly" by Robert H. Williams, *World Energy Council Journal*, July 1998, pp. 59-67.

\*"Beyond Combustion" by Margaret M. Steinbugler and Robert H. Williams, *Forum for Applied Research and Public Policy 13, #4*, Winter 1998, pp. 102-106.

V. **Risk Assessment and Regulation**

The basic problems with risk assessment are how to deal with values and uncertainty (David Hassenzahl will give a guest lecture, March 4). (Problem set.)

\*"Clinton's Talented and Tenacious Regulators: Government is left with one oar to promote public purposes" by Robert Kuttner, *Washington Post*, June 2, 1997, A19.

\*"A Statistical Portrait of the FDA, *New York Times*, August 3, 1997, p. 24.

\*"Troubling Climate at FDA" by Peter Lurie and Sidney M. Wolfe, *Washington Post,*Dec. 30, 1998, A19

\*"2 Diet Drugs are Pulled Off Market" by John Schwartz, *Washinton Post*, September 16, 1997, A1,6.

\*"Risk Analysis and Management" by Granger Morgan, *Scientific American*, July 1993, pp. 32-35, 38, 40, 41

\*"Perception of Risk" by Paul Slovic, *Science 236* , April 17, 1987, pp. 280-285.

\* "Much Ado About Alar" by Joseph D. Rosen, *Issues in Science and Technology*, Fall 1990, pp. 85-90.

\*"Could We -- and Should We -- Reduce the Worst Risks First?" by Adam M. Finkel in *Worst Things First?: The Debate Over Risk-based National Environmental Priorities,*" Adam M. Finkel and Dominic Golding, eds (Washington, D.C.: Resources for the Future, 1994), pp. 3-13.

\* "The Bitter Pill," Carl Djerassi, *Science 245*, 28 July 1989, pp. 356-361.

\*"Risk, Scientific Testimony and the Burden of Proof: Science on Trial" by Kenneth R. Foster, *Minerva 35* (1997), pp. 73-81.

"Evaluating the 'Small' Probability of a Catastrophic Accident from the Marine Transportation of Liquified Natural Gas" by William B. Fairley in *Statistics and Public Policy*, William B. Fairley and Frederick Mosteller (eds.) (Addison-Wesley Publishing Co., 1977), pp. 331-353.

**Low-Dose Risks**

\* "How Cancer Arises" by Robert A. Weinberg, *Scientific American*, September 1996, pp. 62-70.

\* "What Causes Cancer" by Dimitrios Trichopoulos, Frederick P. Li and David J. Hunter, *Scientific American*, September 1996, pp. 80-87.

\*"A Molecular Approach to Cancer Risk" by Richard Stone, *Science 268*, April 21, 1995, pp. 356-7.

\*"3 Versions of Ex-Lax Are Recalled After F.D.A. Proposes Ban on Ingredient" by Sheryl Gay Stolberg, *New York Times*, August 30, 1997, p. 8

\*"The Global Tobacco Epidemic" by Carl E. Bartecchi, Tomas D. MacKenzie and Robert W. Schrier, *Scientific American*, May 1995, pp. 44-51.

\*"The Tobacco Companies Lied," *New York Times*, April 7, 1997.

\*"Haze Begins to Clear Over Hazards of Passive Smoke" by John Schwartz, *Washington Post*, September 29, 1997, A3.

\*"Showdown Over Clean Air Science" by Jocelyn Kaiser, *Science 277* (25 July 1997), pp. 466-469.

\*"Clearing the air" An epidemiologist takes on the worst air pollution problems of our time" by Renée Skelton, *Amicus*, Summer 1997, pp. 27-30.

"Chernobyl: Estimating the Long-Term Health Effects" (pp. 226-235) in *Citizen Scientist*

\*"U.S. Atomic Tests in 50�s Exposed Millions to Risk" by Matthew Wald, *NYT*, July 29, 1997.

\*"Cassini Spacecraft Nears Liftoff, but Critics Object to its Risks", *NYT*, October 12, 1997, p. 20.

VI. **Freedom of Information**

"Knowledge will forever govern ignorance. And a People who mean to be their own governors must arm themselves with the power knowledge gives. A popular government without popular information, or the means of acquiring it, is but the prologue to a farce or tragedy, or perhaps both." -- James Madison, 1822

\* "The Perils of Government Secrecy" by Steven Aftergood, *Issues in Science and Technology*, Summer 1992, pp. 81-88.

\* "Torricelli Admits Violating House Secrecy Oath," Dana Priest, *Washington Post*, April 8, 1995, A7;

\* "Are Secrecy Oaths a License to Lie?" by Daniel Ellsberg (April 8, 1995), 5 pp.

\* "A Secret Disclosed Imperils the Career of State Dept. Aide" by Tim Weiner, *New York Times,*November 16, 1996.

\* "C.I.A. Chief Disciplines Official for Disclosure" by Tim Weiner, *New York Times,*December 6, 1996, A20.

\*"Panel Votes to Let Agency Staff Pass More Secrets to Capitol Hill" by Walter Pincus, *Washington Post*, June 6, 1997, A2.

\*"Senate Passes Intelligence Budget, Still a Secret" by Tim Weiner, *NYT*, June 20, 1997, A16.

\* "Government is Overzealous on Secrecy, Panel Advises" by. R.W. Apple Jr., *New York Times*, March 5, 1997

\*"The Federal Freedom of Information Act"

\*"The National Environmental Policy Act of 1969, as Amended," Title 1.

\*"Environmental Impact Assessment" (pp. 188-194) in *Technology, Environment, and Human Values* by Ian G. Barbour (New York: Praeger, 1980).

VII. **"Public-Interest" Science**

How does the public get its science advice? How does that affect public policy? What is the role of academia?

\* "The Battle over Persistent Pesticides: From Rachel Carson to the Environmental Defense Fund" (pp. 128-142) and "When Outsiders Can be Effective" (pp. 239-248) in *Advice and Dissent: Scientists in the Political Arena* by Frank von Hippel and Joel Primack.

*Environmental Defense Fund 1998 Annual Report*. See http://www.edf.org/pubs/AnnualReport/1998/b\_hist.html.

\* "Analysts and Activists" by Frank von Hippel, *Melampus* (Fall 1991), pp. 3-4.

"Peer Review of Public Policy" in *Citizen Scientist*, pp. 16-29

\* "Public Interest Science in the University: The Stanford Workshops on Political and Social Issues" (pp. 196-207) in *Advice and Dissent: Scientists in the Political Arena* by Frank von Hippel and Joel Primack.

\*"Putting Science to Work in Communities" by Richard E. Sclove, *The Chronicle of Higher Education*, March 31, 1995, B1-2.

\*"Changing the World on a Shoestring" by David Bornstein, *The Atlantic Monthly*, Jan. 1998, 4 pp.

On Reserve in the WWS Undergraduate Office (Rm. 438): *Jobs (and Internships) You Can Live With*(Washington, D.C.: Student Pugwash USA [http://www.spusa.org/pugwash/], 1996, 5th edition) lists science and technology jobs and internships in public-interest groups and government. See also*Princeton Project 55 Public Interest Internship Program* at http://alumni.princeton.edu:80/~class55/Project55/PIP.html

VIII. **Dissent and the Organization**

In our specialized society, we depend on experts to inform us accurately of possible dangers and opportunities of which non-specialists are unaware. But most experts are employed by large organizations with their own vested interests. (Daniel Ellsberg will give a guest lecture, Tuesday, March 30.)

\* "An Anatomy of Whistle Blowing" by Ralph Nader in Whistle Blowing, edited by Ralph Nader, Peter Petkas and Kate Blackwell (New York: Grossman, 1972), pp. 3-11.

\*"Missile-blower" by Daniel Golden, *The Boston Globe Magazine*, 19 July 1992, pp. 10-11, 16-26.

\*"Uranium Miners Inherit Dispute's Sad Legacy," Keith Schneider, *New York Times*, 9 January, 1990, pp. A1, A20.

\*"President Lyndon Johnson: The War Within" by Richard N. Goodwin in *The New York Times Magazine*, 21 August 1988, pp. 34-38, 42, 48.

\*"Dr Williams" in *Smoke Screen: The Truth Behind the Tobacco Industry Cover-up* by Philip Hilts (Addison-Wesley, 1996), pp. 128-143.

\* "Ex-Tobacco Official Enjoys the Aftermath of the Deal" by David Stout in *New York Times*, June 21, 1997, p. 9.

"The Advisor's Dilemma" in *Citizen Scientist*, pp. 30-39.

"Due Process for Dissent" in *Citizen Scientist*, pp. 40-51.

\* "The Role of Law in Protecting Scientific and Technical Dissent" by Alfred Feliu, *IEEE Technology and Society Magazine,* June 1985, pp. 3-9.

IX.**R&D -- for What?**

Historically, about one half of U.S. R&D has been supported by government (mostly the DoD) and half by industry. The post-Cold War period is a time of major questioning of the federal government's role in funding applied R&D. A more competitive marketplace and the rapid increase in the rate of information diffusion have also resulted in major cuts in industry investments in long-lead-time R&D. At the same time, there is little discussion of how research could strengthen the abilities of all levels of government to deal with educational, social, environmental and other problems. (Robert Margolis will give one of these lectures.)

\*"Call it a war" (pp. 1-5) and "The endless frontier" (pp. 218-235) in *Endless Frontier: Vannevar Bush, Engineer of the American Century* (The Free Press, 1997)

\*"The End of the Age of Physics" (pp. 1-15) in *Frontiers of Illusion: Science, Technology, and the Politics of Progress*by Daniel Sarewitz (Temple University Press, Philadelphia, 1996)

\*"Renewing the Compact Between Science and Government" (pp. 90-110) by Donald Stokes in *Pasteur�s Quadrant: Basic Science and Technological Innovation* (Brookings Institution Press, 1997)

\*"Government Support for Commercial R&D" (pp. 17-36) in *The Technology Pork Barrel*, Linda R. Cohen and Roger G. Noll, eds. (Washington, D.C.: Brookings Institution, 1991).

\*"Industrial R&D: The New Priorities," *IEEE Spectrum*, September 1994, pp. 30-41.

\*"Study Finds Public Science is Pillar of Industry" by William Broad, *New York Times*, May 13, 1997, C1.

\*" Universities: At the Center of U.S. Research" by Richard C. Atkinson, *Science 276*, June 6, 1997, p. 1479.

\*"Evidence of Under-investment in Energy R&D in the United States and the Impact of Federal Policy" by Robert Margolis and Daniel Kammen (submitted to *Science*), 21 pp.

\*"Secession of the Successful" by Robert Reich, *New York Times Magazine*, 20 January 1991, pp. 17,18, 42-45.

X. **Technology and Development**

With the exception of politically-motivated major assistance packages to a few countries -- notably Israel and Egypt -- the U.S. Government is currently leaving bilateral investment in the development of other countries to private investment. However, the World Bank and International Monetary Fund play major roles in financing infrastructure and debt restructuring in the poorer countries, subject to their requirements of open markets. (Zia Mian will give a guest lecture on April 8.)

\*"Dwelling Place of the Angels" in *Mortgaging the Earth: The World Bank, Environmental Impoverishment, and the Crisis of Development* (Boston: Beacon Press, 1994), pp.1-24.

\*"Alleviating Poverty Through Technology" by Muhammad Yunus, *Science 282*, Oct. 16, 1998, pp. 409-10.

\*"Malaria Makes a Comeback and is More Deadly Than Ever" by Nicholas Kristof, *New York Times,* January 8, 1997, A1.

\*"For Third World, Water is Still a Deadly Drink" by Nicholas Kristof, *New York Times,* January 9, 1997, A1.

\*"Science Triumphs, Market Fails" by Stephen Hall, *Technology Review*, Jan/Feb. 1999, p. 78.

\*"The Economics of Life and Death" by Amartya Sen, *Scientific American*, May 1993, pp. 40-47.

\*"Population, Poverty and the Local Environment" by Partha S. Dasgupta, *Scientific American*, February 1995, pp. 40-45.

\*"The Virtues of Mundane Science" by Daniel Kammen and Michael Dove, *Environment* July/August 1997, pp. 11-15, 38-41.

\*"Technology Transfer: Implications for Women" by Mary B. Anderson in *Gender Roles in Development Projects*C. Overholt, M.B. Andersen, K. Cloud and J.E. Austin, eds. (West Hartford, CT: Kumarian Press, 1984), pp. 57-78.

"Reflections on the Republic of Korea's Acquisition of Technological Capability" by Larry E. Westphal, Linsu Kim and Carl J. Dahlman pp. 167-217. in*International Technology Transfer: Concepts and Measurement*, N. Rosenberg and C. Frischtak, eds. (1985).

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XI. **Information Technology and Privacy**

The information highway that is expected to grow from the Internet could provide new infrastructure for democracy. But whether that potential is realized depends in part on policy. Also, the ease of searching and matching information in huge databases has created new concerns about the future of privacy (Helen Nissenbaum will give guest lectures on April 15 and 20).

\*"Computers and the Year 2000: A Race for Security (and Against Time)" by Barnaby Feder and Andrew Pollack, *NYT*, Dec. 27, 1998.

"Accountability in a Computerized Society" by Helen Nissenbaum in *Science and Engineering Ethics*, Vol. 2, Issue 1, 1996.

\*"Keeping Secrets" by Maggie Scarf, *The New York Times Magazine,* June 16, 1996, pp. 38-40.

\*"HHS Proposes Standards for Medical File Privacy" by Amy Goldstein, *Washington Post*, September 12, 1997, p. A1,18.

\*"On Line, High-Tech Sleuths Find Private Facts" by Nina Bernstein,*NYT*, Sept. 15, 1997, p. 1, 20.

\*"Of Two Minds About Privacy" by Paul Wallich, *Scientific American*, June 1991, p. 27.

\*"Europe and U.S. at Odds Over Protecting Privacy" by Edmund Andrews, *International Herald Tribune*, Oct. 24-25, 1998, pp. 1, 5.

\*"Information Technology and Dataveillance" by Roger Clarke in *Computerization and Controversy: Values and Choices*, Charles Dunlop and Rob Kling, eds. pp. 496-522.

\*"Information Privacy in Cyberspace Transactions" by Jerry Kang, *Stanford Law Review 50*, April 1998, pp. 1193-1211, 1220-45.

"The Machine Stops" by E.M. Forster, *Computers, Ethics and Social Values,*Deborah Johnson and Helen Nissenbaum, eds. (Prentice Hall, 1995), pp. 694-713.

XII. **Genetic Screening and the Designer Child**

Two recent break-throughs: the creation of embryos with the nuclei of other cells (cloning) and the "DNA chip," which will allow rapid screening of an embryo's (or your) entire genome, appear to have broken the final barriers to our ability to genetically engineer our descendants. Prof. Lee Silver of the Molecular Biology Department has just written a book on the science underlying the new technology and on his reasons for believing that society will not be able to control its uses. (He will give a guest lecture on on April 27.)

\*"Peasants of China Discover New Way to Weed Out Girls" by Nicholas D. Kristof, *New York Times*, July 21, 1993, p. A1, A6.

\*"Massively Parallel Genomics" by Stephen P.A. Fodor, *Science 277* (18 July 1997), pp. 393, 395.

\*"Single Gene Controls Fruit Fly Life-span" by Elizabeth Pennisi, *Science 282*, Oct. 30, 1998, p. 856.

\*"First Gene to be Linked with High Intelligence is Reported Found" by Nicholas Wade, *NYT*, May 14, 1998, A16.

\*"Human Gene for physical performance" by H.E. Montgomery *et al*, *Nature 393*, May 21, 1998, p. 221.

\*"First Gene for Social Behavior Identified in Whiskery Mice", Nicholas Wade, *NYT*, Sept.9, 1997, C4.

\*"Scientists Debate China�s Law on Sterilizing the Carriers of Genetic Defects" by Elizabeth Rosenthal, *NYT,*Aug. 16, 1998, p. 14.

\*"Genetic Tests in Workplace Can Be Privacy Breach, Appeals Court says" by Rick Weiss, *Washington Post,*Feb. 5, 1998, A8.

\*"From Science Fiction to Ethics Quandary", Gretchen Vogel, *Science 277*, Sept. 19, 1997, pp.1753-4.

\*"Clinics Selling Embryos Made For Adoption" by Gina Kolata, *NYT*, Nov. 23, 1997, p.34.

\*"Jewish leaders meet NIH chiefs on genetic stigmatization fears" by Meredith Wadman, *Nature 392*, April 30, 1998, p. 851.

\*"Genetic Testing Falls Short of Public Embrace" by Gina Kolata, *NYT*, March 27, 1998, A16.

\*" Iceland Oks Private Health Databank" by Martin Enserink, *Science 283*, Jan. 1, 1999, p. 13.

\*"F.B.I. Set to Open It�s DNA Database for Fighting Crime", Nicholas Wade, *NYT,*Oct. 12, 1998, p. 1.

\*"States Pass Laws to Regulate Uses of Genetic Testing" by Robert Pear, *NYT,*Oct. 18, 1997, A1,9.

\*"Clinton Asks Insurers to Ban Using Gene Screens" by James Bennet, *NYT*, July 15, 1997, A26.

"Out of Eugenics: The Historical Politics of the Human Genome" by Daniel J. Keveles (pp. 3-36); "A History of the Science and Technology Behind Gene Mapping and Sequencing" by Horace Freeland Judson (pp. 37-80) in *The Code of Codes: Scientific and Social Issues in the Human Genome Project*, Daniel J. Kevles and Leroy Hood editors (Cambridge, MA: Harvard University Press, 1992).

*Remaking Eden: Cloning and Beyond in a Brave New World* by Lee M. Silver (Avon Press, to be published, November 1997), Prologue, chapters 8, 9, 10, 17, 18, Epilogue

XIII. **Wrap-Up**.

\*"Technology and Wisdom" by Emmanuel G. Mesthene from*Technology and Social Change,* Emmanuel G. Mesthene, ed (Indinanapolis: Bobbs-Merrill, 1967), pp. 109-115