Editor: Stephen H. Cutcliffe **Nos. 139 & 140, 2004**
Managing Editor: Elaine Nelson **ISSN: 0275-8075**

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Syllabus
Ancient Engineering
Lawrence Technological University

Summer Session "A" May 12-June 23, 2004 Dr. Stephen Bertman, bertman@ltu.edu.
Class: M W, 1- 4:15 p.m.

Course Description

An exploration of the challenges and achievements of ancient engineers from prehistoric times to the era of classical civilization. The course will examine the role of the engineer in early societies, including those of ancient Egypt, Mesopotamia, Greece, Rome, India, and China.

Instructor

Dr. Stephen Bertman; Department of Humanities, Social Sciences, and Communication, will be available to give individual help to students on Mondays and Wednesdays immediately following the conclusion of each day's class.

Textbooks (all on reserve at the library)

L. Sprague deCamp, *The Ancient Engineers* (New York: Barnes & Noble, repr., 1993)
J.G. Landels, *Engineering in the Ancient World,* rev. ed. (Berkeley & Los Angeles: Univ. of California Press, 2000)
Henry Hodges, *Technology in the Ancient World,* 1970 (New York: Barnes & Noble, 1992) (recommended reading)

Basis for Grading

Midterm Examination (Wednesday, June 2): 40% (An essay format will be used.)
Final Examination (Wednesday, June 23): 40% (An essay format will be used.)
Attendance: 20%

Extra Credit: Extra credit will be awarded to a maximum of 10% for the completion of a special project. The project will consist of constructing a working model of an ancient technological device (for example, a Greek or Roman catapult). The model is to be accompanied by a text describing the history and operation of the original device as well as the materials and procedures used to construct the model. Students may work together in teams. The models are to be presented and demonstrated on the last day of class following the completion of our final exam. Useful information about designing such devices can be found in the books listed above and on the Internet. If you're interested, begin your research as soon as possible! Note: If you are planning on presenting an extra-credit project following our final examination, be sure to discuss it in advance with Dr. Bertman no later than Monday, June 21.

Helpful Hints:

Because summer session is so compressed, success in this course will require that you keep up with your readings, attend class consistently, take detailed notes, and allow adequate time for review. Attendance will be an especially critical factor in success because so much of the material in the course will be presented in the form of lectures illustrated by color slides. Be sure to complete each day's assigned readings *before* you come to class so what you see and hear in class will have the maximum meaning. Feel free to ask questions both during and after class. Your teacher is here to help you.

Useful Websites:

Ancient Engineering: http://www.fls.org.jm/users/worldeng/ancient/ancient.html
Prehistory: http://exn.ca/mysticplaces/stonehenge.asp
Mesopotamia: http://www.cmi.k12.il.us/Urbana/projects/AncientCiv/Meso/meso.html
Egypt: http://www.pbs.org/wgbh/nova/pyramid/
Greece: http://medusa.perseus.tufts.edu/
Rome: http://www.tigtail.org/TIG/TVM/E/Ancient/Roman/roman_engineering.html
India: http://www.harappa.com/har/har0.html
China: http://www.travelchinaguide.com/china_great_wall/

ASSIGNED READINGS

May 12: **Introduction to the Course; Prehistoric Engineering**
Topics: Progress and Our Debt to the Past; Engineering for Survival (fire-making and Stone-Age weaponry); from the Stone Age to Civilization; Stonehenge
Readings: None

May 17: **Egyptian Engineering I**
Topics: Egyptian values; the Gift of the Nile (methods of irrigation); Engineering Immortality (mummification and tombs)
Readings: DeCamp, "Preface" and Chapters 1 & 2

May 19: **Egyptian Engineering II**
Topics: Pyramids of Egypt (history, design, and theories of construction)
Readings: Hodges, Chapters 1 & 2 (recommended)

May 24: **Egyptian Engineering III**
Topics: Raising Obelisks; Ramses the Great and Abu Simbel's Rescue; Shipbuilding and Maritime Exploration
Readings: Hodges, Chapters 3, 4, & 5 (recommended)

May 26: **Mesopotamian and Indian Engineering**
Topics: Mesopotamian Values; Irrigation in Ancient Iraq; Engineering Immortality (Royal Graves of Ur); Ziggurats and the Hanging Gardens of Babylon; Urban Planning and Sanitation in the Indus Valley (Harappa and Mohenjo-Daro)
Readings: DeCamp, Chapter 3 (recommended: Hodges, pp. 251-255 [India])

May 31: Memorial Day (no class)

June 2: **Midterm Exam**; **Greek Engineering I**
Topics: Greek Values; the Heroic Age; Legendary Engineers (Daedalus, the Labyrinth, and Manned Flight; Ulysses, the Trojan War, and the Wooden Horse)
Readings: Hodges, Chapter 6 (recommended)

June 7: **Greek Engineering II**
Topics: Golden Age of Athens; Secrets of the Parthenon; Rebuilding the Parthenon in Nashville
Readings: DeCamp, Chapter 4

June 9: **Greek Engineering III**
Topics: Geniuses and Mechanical Marvels of the Hellenistic Age; Wonders of Ancient Alexandria
Readings: DeCamp, Chapter 5; Landels, Chapters 6, 8, 9 "Hero of Alexandria," and "Appendix"

June 14: **Roman Engineering I**
Topics: Roman Values; Walls, Roads, Bridges, and Aqueducts; the True Arch; Trajan's Column and Military Engineering
Readings: DeCamp, Chapter 6; Landels, Chapters 2, 3, and 9 ("Vitruvius," "Frontinus," and "Pliny")

June 16: **Roman Engineering II**
Topics: Engineering for Pleasure and Propaganda (Triumphal Arches; the Colosseum; the Baths of Caracalla and Diocletian); the Urban Ideal (discoveries at Ostia and Pompeii)
Readings: DeCamp, Chapter 7; Landels, Chapters 4 and 5; (recommended: Hodges, Chapter 7)

June 21: **Roman Engineering III and Chinese Engineering**
Topic*s*: Hadrian, Pantheon, and Hadrian's Wall in England; Tomb of the Emperor and the Great Wall of China; Marco Polo and Chinese Inventions
Readings: Landels, Chapters 1 and 7; (recommended: Hodges, pp. 255-270 [China])

June 23: **Final Examination; Presentation of Special Projects**

Ancient Engineering— Midterm Exam

Prepare persuasive answers to all of the study questions below. Two will be chosen at random as the questions for your midterm examination.

Be sure to bring one or two "blue books" with you on the day of the exam. Do not put your name on the front cover(s) since the booklets will be collected by your teacher before the exam and then randomly redistributed.

At the start of the exam, Dr. Bertman will roll a dice-cube. If an odd number comes up, you will write on the two "A" questions below; if an even number, the two "B" questions. You will have a maximum of an hour and a half (about 45 minutes per question) to write your answers. You may not use any notes or other aids at the time of the exam.

Wherever possible, back up your general statements with specific facts, and relate specific facts to general principles, so that your answers are as convincing as possible. In your answers, you should draw upon the information you gained from your readings and from your teacher's presentations about Prehistoric, Egyptian, and Mesopotamian engineering. You may choose to agree or disagree with the premise of a quotation, but if you do, be sure to do justice to both sides of the argument.

"A" Questions

1. Discuss the following quotation: "The chief goals of modern engineering are largely defined by the needs of a materialistic society, while the main objectives of ancient engineering were mostly determined by people's religion."
2. Discuss the following quotation: "Gravity posed a major challenge to ancient engineers, and their triumphs were mainly triumphs of verticality."

"B" Questions

1. Discuss the following quotation: "Though the feet of ancient engineers were firmly planted on the ground, their eyes were on the stars."
2. Compare and contrast the natural resources and engineering accomplishments of two ancient "hydraulic states": Egypt and Mesopotamia.

Ancient Engineering—Final Exam

Prepare persuasive answers to all of the study questions below. Two will be chosen at random as the questions for your final examination.

Be sure to bring one or two "blue books" with you on the day of the exam. Do not put your name on the front cover(s) since the booklets will be collected by your teacher before the exam and then randomly distributed.

At the start of the exam, Dr. Bertman will roll a dice-cube. If an odd number comes up, you will write on the two "A" questions below; if an even number, the two "B" questions. You will have a maximum of an hour and a half (about 45 minutes per question) to write your answers. You may not use any notes or other aids at the time of the exam.

Wherever possible, back up your general statements with specific facts, and relate specific facts to general principles, so that your answers are as convincing as possible. In your answers, you should draw upon the information you gained from your readings and from your teacher's presentations about Greek and Roman engineering.

"A" Questions

1. One of the hallmarks of ancient Greek civilization was intellectualism. How was this trait expressed through the contributions the Greeks made to engineering and invention?
2. What would you regard as the greatest contributions of Greek and Roman engineering to the history of human progress? Identify these contributions and discuss their significance.

"B" Questions

1. One of the hallmarks of ancient Roman civilization was practicality. How was this trait expressed through the contributions the Romans made to engineering and construction?
2. What individuals would you regard as the greatest of the ancient Greek and Roman engineers? Name them (in those cases where names survive) and discuss their achievements.

TECHNOLOGICAL CATASTROPHES
VAST 223
Birkbeck College / University of London

Class: TR 9:30-11:00 a.m. (Lecture/Discussion) William A. Best, jumboe81@yahoo.com
F 12:00- 1:00 p.m. (Guest Lectures, Weekly Newspaper Discussion)

Course Description:
The past several decades have seen many highly publicized accidents involving both advanced and new technologies. The most notable of these catastrophes include the Bhopal chemical leak, the space shuttle *Challenger* explosion, the Three Mile Island nuclear accident, the Chernobyl Power Plant explosion, and the Dalkon Shield IUD. Using these and other historical examples of catastrophic failures in technological systems (e.g. the *Titanic*) as case studies, this seminar will consider such questions as:

What is risk? Is there such a thing as "acceptable" risk? Who determines "acceptable risk"?
What are the important similarities and differences among technological catastrophes?
Are large-scale technological catastrophes avoidable?
Should society attempt to control the growth of "high-risk" technologies, and, if so, how is this accomplished?
To what extent are technological catastrophes the result of "unsafe" technologies?
What technological, social, political, cultural, economic, legal, and ethical issues do these case studies raise?
What lessons were learned and not learned from these catastrophes, and what does this say to us about the future of our "high risk, complex" technological world?

Course Requirements and Assessment:

1. Preparations, attendance, and regular participation in class discussions …….. 20%
   Note: This is a seminar/discussion course. It is imperative for your intellectual growth as well as that of others in the seminar that you prepare, attend, and participate. For this reason, attendance will be recorded and participation will be noted. Readings should be done before the period. More than 3 unexcused absences will result in a serious markdown of your final grades and/or refusal to sit for the final exam.
2. Written Work ……. 30%
   Note: You will submit two original essays during the semester based on the case studies we will cover. You are expected to choose your own topic and develop your own thesis. In addition, it is expected that you utilize a wide range of "outside" resources and exhibit a deeper and broader understanding of the course material than just 'rehashing' class notes and readings. Drafts will be discussed with the instructor periodically throughout the semester, and the final drafts will be turned in on the last day of the term. All essays must follow the standard *St. Martin's Handbook* format. Late essays will not be accepted. In addition, each student will compile an annotated notebook containing newspaper articles, editorials, and other source materials from current events.
3. Term Project: studying a "Catastrophe Waiting to Happen," a historical catastrophe, or a catastrophe that was not covered during the semester. In addition, each student will give a brief presentation to the class of their topic …….....25%
4. Final Examination……25%
   Note: The final examination will be a combination of both written and oral parts. A list of written questions from which the final will be chosen is included in this syllabus.

Course Outline & Readings:

Photocopies of all articles as well as copies of videos are kept on reserve (VaST 223) in Skillman Library. Books are available for purchase at the campus store, or you may purchase them online (Amazon.com). If you wish to browse before you purchase any book, they are all available from my personal collection for borrowing [short-term please!!].

In addition to the course readings, you are expected to keep current with the "Technology" journals in Skillman Library. They include: 1) *Technology Review* 2*) Technology & Culture* 3) *Issues in Science & Technology* 4) *Earth Island Journal* 5) *Environmental Ethics* 6) *IEEE Technology & Society Magazine.*

I. Introduction:Defining the Problem (periods 1-3)

Florman, S. (1981) "Living With Technology: Tradeoffs in Paradise," *Technology Review* (August/September): 1-12.

Herkert, J. (1994) "Ethical Risk Assessment: Valuing Public Perceptions," *IEEE Technology & Society* (Spring): 4-10.

Slovic, P. (1987) "Perception of Risk," *Science* (Vol. 236): 280-285.
Wilson, R. & Crouch E. (1987) "Risk Assessment and Comparisons: An Introduction," *Science* (Vol. 236): 267- 270.

Slovic, P. (et al) (1995) "Technological Stigma," *American Scientist* (Vol. 83): 220-223.

Haddad, J. (1985) "Technology & Human Values." Speech delivered 9-14-85 at Clarkson University.

Perrow, C. (1999) *Normal Accidents: Living With High-Risk Technologies.* Princeton University Press (Introduction), 3-15.

Tenner, E. (1996) *Why Things Bite Back: Technology and The Revenge of Unintended Consequences* Vintage Books (Chapter 1), "Ever Since Frankenstein," 3-32.

II. Nuclear Power and T.M.I. (periods 4-6)

Perrow, C. (1999) *Normal Accidents: Living with High-Risk Technologies.* Princeton University Press (Chapters 1 & 2): 16-63.

Pooley, E. (1996) "Blowing the Whistle on Nuclear Safety," *Time Magazine* (March 4): 47-54.

Pooley, E. (1997) "Nuclear Safety Fallout," *Time Magazine* (March 17): 34-36.

James, G. (1990) "Whistle-Blowing: Its Moral Justification,"*Ethical Issues in Engineering:* 263-78.

"The Report Of The President's Commission On The Accident At T.M.I."
www.nrc.gov

The China Syndrome (Video)

The American Experience: Meltdown at T.M.I. (Video)

Nuclear Notes (A Collection of Newspaper Articles and Editorials Dealing with Nuclear Power Issues)

III. *Challenger* (periods 7-10)

Cook, R. (1986) "The Rogers Commission Failed: Questions It Never Asked, Answers It Never Listened To," *The Washington Monthly* (November): 13-21.

Gladwell, M. (1986) "Blowup," *The New Yorker Magazine* (January 22): 32-36.

Nelkin, D (1995) "Science's Fall From Grace," *The Humanist* (September/October): 14-19.

Harris, C. (1995) "Explaining Disasters: The Case for Preventive Ethics," *IEEE Technology and Society Magazine* (Summer): 22-27.

Werhane, P. (1991) "Engineers and Management: The Challenge of the *Challenger* Incident," *Journal of Business Ethics* (Vol. 10): 605-616.

Boisjoly, R. (1989) "Roger Boisjoly and the *Challenger* Disaster. The Ethical Dimensions," *Journal of Business Ethics* (Vol. 8): 217-30.

McConnell, M. (1987) Challenger*: A Major Malfunction.* Doubleday Press, New York.

Vaughn, D. (1996) *The* Challenger *Launch Decision: Risky Technology, Culture and Deviance at NASA.* University of Chicago Press, Chicago, Illinois.

Note: The Vaughn book is quite long, so I recommend browsing, and using it extensively for essays.

A Major Malfunction: The Story Behind the Space Shuttle Challenger *Disaster* (Video)

Challenger *Notes* (A Collection of Newspaper Articles and Editorials Dealing with *Challenger*)

www.nasa.gov

IV. Bhopal (periods 11-14)

Shrivastana, P. (1987) *Bhopal: Anatomy of a Crisis.* Ballinger Press

Everest, L. (1987) *Behind the Poison Cloud: Inside Union Carbide's Bhopal Massacre.* Banner Press

Kurzman, D. (1987) *A Killing Wind: Inside Union Carbide and the Bhopal Catastrophe*

Note: You should read one of the above titles**.**

Donaldson, T. (1986) "The Ethics of Global Risk," *IEEE Technology and Society Magazine* (June): 35-8.

Khare, R.S. (1989) "The Bhopal Puzzle: A Failure of Modern Technology, Law and Values," *International Social Science Journal* (Vol. 120): 273-281.

Lepkowski, W. (1994) "Ten Years Later: Bhopal," *Chemical and Engineering News* (Dec.19): 8-18.

Bhopal: The Second Tragedy (Video)

Bhopal Notes (A collection of newspaper articles and editorials dealing with Bhopal)

www.osha.gov and www.epa.gov

V. Chernobyl (periods 15-18)

Hawkes, N. (et al) (1986) *Chernobyl: The End of the Nuclear Dream.* First Vintage Books

Medvedev, Z (1992) *The Legacy of Chernobyl.* W.W. Norton and Company

Gale, R.P. (1988) *Final Warning: The Legacy of Chernobyl.* Warner Books

Medvedev. G. (1991) *The Truth About Chernobyl.* Basic Books

Note: You must read the Hawkes book. The others will serve as wonderful resources for essays.

Sweet, W. (1989) "Chernobyl: What Really Happened," *Technology Review* (July): 43-52.

Ahearne, J. (1987) "Nuclear Power After Chernobyl," *Science* (Vol. 236): 673-679.

Sweet, W (1996) "Chernobyl's Stressful After-effects," *IEEE Spectrum* (November): 26-34.

French, W. (1986) "Technology and Ethics: Reflections after Chernobyl," *The Christian Century* (July 30 - August 6): 675-678.

Chernobyl Notes (A collection of newspaper articles and editorials dealing with Chernobyl)

Back to Chernobyl (Video)

Chernobyl: Legacy of a Meltdown (Video)

Dr. Vladimir Chernousenko: The Truth About Chernobyl (Video)

VI. The Dalkon Shield (periods 19-21)

Hawkins, M. (1997) *Unshielded: The Human Cost of The Dalkon Shield.* University of Toronto Press

Mintz, M. (1985) *At Any Cost: Corporate Greed, Women and the Dalkon Shield.* Pantheon Books

Perry, S. (1985) *Nightmare: Women and the Dalkon Shield.* Macmillan Press

Sobol, R. (1991) *Bending the Law: The Story of the Dalkon Shield Bankruptcy.* University of Chicago Press.

Note: You should read one of the above titles. The others will be wonderful resources for essays.

www.fda.gov

VII. *Titanic* (periods 22-24)

Lord, W. (1955) *A Night to Remember.* Bantam Books

Biel, S. (1997) *Down With the Old Canoe: A Cultural History of the* Titanic *Disaster.* W.W. Norton & Co.

Kuntz, T. (ed) (1998) *The* Titanic *Disaster Hearings: The Official Transcript of the 1912 Senate Investigation.* Pocket Books, Simon & Schuster

Wreck Commissioners Court Staff (1999) *Formal Investigation into the Loss of the* Titanic *1912* (Uncovered Editions). The Stationery Office, London

Titanic*: Death of a Dream (Part 1 & Part 2)* (Video)

Note: The Kuntz & the Stationery Office books are to be used as reference materials for essays.

VIII. Catastrophes Waiting to Happen or Those That Already Have. What Does the Future Hold? (periods 25-28)

Mesthene, E. (1968) "How Technology Will Shape the Future," *Science* (July 12): 135-43.

Tenner, E. (1996) *Why Things Bite Back: Technology and The Revenge of Unintended Consequences.* Vintage Books, (Chapter 12), "Another Look Back and a Look Ahead"

Perrow, C. (2000) *Normal Accidents: Living With High-Risk Technologies* Princeton University Press, (Chapter 9), "Living With High-Risk Systems," 304-352.

Perrow, C. (2000) *Normal Accidents: Living With High-Risk Technologies.* Princeton University Press, "Afterward," 353-387.

Roush, W. (1993) "Learning From Technological Disasters,"*Technology Review (*Aug./Sept.*):* 50-9.

Possible Term Projects

Accidental Nuclear War, Air Traffic Control Safety, Human Induced Climate Change, Solid Waste Disposal, Nuclear Waste Disposal, Genetic Engineering, Power Utility Networks and Brownouts, Thalidomide and DES, Prosthetic Heart Valves, Domestic Bridge and Dam Infrastructure, Silicon Breast Implants, Hanford Nuclear Reservation, The Hindenburg Airship Disaster, The Knox Mine Disaster, Love Canal, Ford Pinto, Hyatt Regency Collapse, Ford/ Firestone, Exxon Valdez and Other Notable Oil Spills, Woburn Water Case (*A Civil Action*), PGE Contamination (Erin Brockovich), Historical Bridge Failures

Note: These topics represent the instructor's recommendations, if you have no other choice in mind.

Final Exam Questions

Is it better for society to develop ways to COPE with technological catastrophes than attempt to PREVENT technological catastrophes? If so, how do we accomplish this?

Is society well-served by attributing blame and punitive sentences, or has this merely turned defendants into scapegoats thus preventing a true understanding of the catastrophe and its societal implications?

Is society's feeling about the value of life realistically expressed through everyday decisions about how much we spend to reduce risk?

Should society expend all available resources on the reduction of risk in order to achieve a risk-free world?

To what extent are catastrophes a result of a quick shift from scientific, technological inquiry to an economic, commercial venture?

Do you agree with the following? "People should be informed about unusual dangers to which they might be subjected, and given the chance to consent or not consent to the dangers." Why or why not?

Do you agree with the following? "Technocrats are developing large scale technological systems that disenfranchise the average citizen, erode civil liberties, and produce specialized ignorance for some and generalized ignorance for all." Why or why not? What does this say about our increasingly high-risk technological world?

Explain the change in journalistic perception of technology since never in our history have we had a shortage of catastrophes, but never before have they been front page news.

Should corporate executives be held personally or criminally responsible if technologies result in death? Would this help reduce the number of technological catastrophes?

Do you agree with the following? "While multinational corporations are expected to obey the laws of the nations in which they operate, they have no moral obligation to assure that their manufacturing processes and products are safer than required by the laws and regulatory practices of these nations. If developing countries wish to utilize complex high-risk technologies, it is their own responsibility to determine which risks are acceptable." Why or why not?

Have the technologies discussed this semester led to a greater degree of "techno-pessimism"? If so, is this bad?

Suggest effective criteria to reduce the risk of Bhopal-type accidents from technology transfer to the developing world by U.S. corporations.

Which of the technologies highlighted this semester (nuclear power, space, chemicals, or medicine) is most likely to produce the next technological catastrophe? Why?

Compare and contrast the responses of the Indian, the Soviet, and the U.S. governments and regulatory agencies to the respective catastrophes (Bhopal, Chernobyl, *Challenger*, Dalkon Shield). In your opinion, could they have done a better job?

Which of the case studies that were considered this semester will have the most enduring effect? Why?

Do you agree or disagree that human error <u>can</u> be removed from the world of complex technological systems? Support your argument.

Syllabus
Engineering, Policy, and Development
EGR 330/Picker Engineering Program
Smith College

Class**:** TR 9:00-10:20 a.m. Instructor: Professor Donna Riley
Prerequisites: Junior Standing in Engineering or instructor's permission

Texts: Reserve Readings (electronic)
Shiva, Vandana. *Stolen Harvest*. HD9000.5.S454 2000
Hazeltine and Bull. *Appropriate Technology: Tools, Choices, and Implications.* T49.5 . H4 1999 (H&B)
Rodney, Walter. *How Europe Underdeveloped Africa.* HC502 .R633 1974

Evaluation Project: 50%
- Initial Research – 10%
- Design & Testing – 10%
- Prototype Construction – 10%
- Final Report – 10%
- Community Involvement – 10%

Homework: 20%
Participation: 10%
Final Exam (Self-scheduled): 20%

Objectives: Students receiving a passing grade in the course will be able to:
1. Design and build appropriate technology systems
2. Apply knowledge of community based design in a real-world situation
3. Critically analyze issues related to the use of technology in developing countries and local communities
4. Demonstrate an understanding of the limitations of technology in addressing problems of development

Course Schedule: Readings, Questions, and Assignments

Jan. 27: Introduction

Jan. 29: Technology and Development

Readings: Kofi Anan's Astonishing Facts, *New York Times*, Sept. 27, 1998, 16.
Roy, Arundhati. *Power Politics*, pp.1-3.
Agunga, R. *Development Aid in Historical Perspective in Developing the Third World: A Communication Approach*. Commack, N.Y.: Nova Science Publishers, 1999, pp. 57-86.

Questions: What is Roy's idea of development? How does it relate to Anan's fact sheet?
What does Anan's fact sheet imply about technology? About economic systems? About governmental policy?
Name five conditions that exist in developing countries, per Agunga, and provide explanations for the existence of each.

Feb. 3: Capitalism and Colonialism

Readings: Weber, Max. "The Spirit of Capitalism and the Iron Cage," – excerpt from *Protestant Ethic and the Spirit of Capitalism in Social Theory: The Multicultural and Classic Readings*. Charles Lemert, ed., 2nd ed. Westview Press, pp. 99-104.
Rodney, Walter. *How Europe Underdeveloped Africa*. Howard University Press, 1982, pp. 205-281.

Assignment: Visit Nuestras Raices & El Jardin

Questions: What are Rodney's priorities in How Europe Underdeveloped Africa?
What does he accomplish, and what does he take for granted?
Where is technology in the process of colonialism and industrialization?
How does Weber's analysis of capitalism explain globalization and development? How does it fit with Rodney's? With your own?

Feb. 5: **Why Projects Fail**

Readings: Hammer, M. Why Projects Fail. *Ceres*, 26(1), 1994, pp. 32-35.
Agunga, R. The Blame-Assignment Syndrome. *Development Aid in Historical Perspective in Developing the Third World: A Communication Approach*. Commack, N.Y.: Nova Science Publishers, 1999, pp. 87-110.
Hall, Stephen S. Science Triumphs, Market Fails. *Technology Review*, Jan/Feb 1999, 78.

Questions: Why do development projects fail? Who is responsible for these failures?
Discuss the pros and cons of different actors in development projects.

Feb. 10: **History of Development**

Readings: Agunga, R. *Development Aid in Historical Perspective in Developing the Third World: A Communication Approach*. Commack, N.Y.: Nova Science Publishers, 1999, pp. 111-136.

Assignment 1: Should aid be given? Why or why not? OR Reflect on pitfalls to avoid in Holyoke project based on why projects have failed in the past.

Questions: How do foreign assistance policies change over time and from country to country? Should aid be given? Why or why not?

Feb. 12: **Three Economic Development Models**

Readings: Yunus, Muhammad. Alleviating Poverty through Technology. *Science*, 282, Oct. 16, 1998.
Albee, A. and Gamage, N. *Our Money our Movement: Building a Poor People's Credit Union*. London: Intermediate Technology Publications, Ltd., 1996.
Stevens, J. Martin Makes a Middle Class, *San Francisco Chronicle*, Sunday, December 8, 2002.

Questions: What are the key differences between microbanking, credit collectives, and entrepreneurial approaches to economic development? What role does technology play in each?

Feb. 17: **Discuss Project 1**

Readings: Denevers. *Air Pollution Control Engineering.* U.S.: McGraw-Hill, 1999, Ch. 1.

Assignment: VISIT NUESTRAS RAICES- measurement

Question: What are the primary ways of controlling or preventing air pollution?

Feb. 19: **Appropriate Technology**

Readings: H&B, *Appropriate Technology: Tools, Choices, and Implications.* T49.5 . H4 1999, Chapters 1-2.
Kammen and Dove. The Virtues of Mundane Science. *Environment*, 39 (6) 1997, pp. 11-15, 38-40.

Questions: What is appropriate technology? What are its promises and limitations?
Why do engineers favor large-scale systems, and how does that impact development?

Feb. 24: **Critically Evaluating Appropriate Technology**

Readings: McGowan, P. The Political Economy of Intermediate and Appropriate Technology. *Appropriate Technology: Choice and Development*. Durham, N.C.: Duke Press, 1984, pp. 31-47.
DeSebastian, L. Appropriate Technology in Developing Countries: Some Political and Economic Considerations. *Mobilizing Technology for World Development.* Jairam Ramesh and Chales Weiss, Jr., eds. New York: Praeger Publications, 1979, pp. 66-73.

Questions: What does deSebastian affirm about the role of government, foreign capital, and the international division of labor in technology development?
Map the relationship of technology and development highlighted in McGowan

Assignment 2: Air Pollution Problems

Feb. 26: **Technology and Values, Social Context**

Readings: Winner, L. Do Artifacts have Politics? From *The Whale and the Reactor.* Chicago: University of Chicago Press, 1986, pp. 19-39.
Sclove, Richard. Spanish Waters, Amish Farming. In *Democracy and Technology,* 1995.
H&B, *Appropriate Technology: Tools, Choices, and Implications.* T49.5 . H4 1999, Chapter 13.

Questions: What are the relationships between technology, politics, and society as discussed by Winner and Sclove? What are the implications for engineering development projects? Compare Winner's discussion of technology and social/economic order with Weber's.

Mar. 2: **Cooking Technologies**

Readings: Wharton, D. Designing with Users: Developing the Lorena Stove, Guatemala. In *Experiences in Appropriate Technology*, Robert J. Mitchell, ed. Ottawa: The Canadian Hunger Foundation, 1980, pp. 21-34 (with Edwards).
H&B, *Appropriate Technology: Tools, Choices, and Implications.* T49.5 . H4 1999, Chapter 6 (cooking technologies).

Questions: Why is the Lorena stove such an effective technology? How much of its success is attributable to social factors? To technological factors?

Assignment 3: Do U.S.-trained engineers have a role in developing countries? What is the role of technology in development? What is our role in Holyoke?

Mar. 4: **Indigenous Technologies**

Readings: Thomasson, G.C. Kpelle Steelmaking: An Indigenous High Technology in Liberia. In *The Cultural Dimension of Development: Indigenous Knowledge Systems*, D. M. Warrne, J.L. Slikkerveer, and D. Brokensha, eds. London: Intermediate Technology Publications, 1995.
Rhyner-Pozak, K. Strengthening Houses and Local Organization, Guatemala. In *Experiences in Appropriate Technology*, Robert J. Mitchell, Ed. Ottawa: The Canadian Hunger Foundation, 1980, pp.113-120.
McCann, M. Hazards in Cottage Industries in Developing Countries. *American Journal of Industrial Medicine,* 30, 1996, pp. 125-129.

Questions: What makes a technology "indigenous"? Are indigenous technologies necessarily in competition with non-indigenous technologies? Why or why not?
What are some principles by which a culture might choose whether or not to employ indigenous vs. non-indigenous technologies to accomplish a given outcome?

Mar. 9: **Assistive Technologies**

Readings: Pfaelzer P. and Krizack, M. Wheelchair Riders in Control: WWI's Model of Technology Transfer. Available: http://whirlwind.sfsu.edu/general_info/news_articles/technology_transfer_model.html
Selections from Werner, D. *Nothing About Us Without Us: Developing Innovative Technologies for, by, and with Disabled Persons*. Palo Alto, Calif.: Health Wrights, 1998.

Questions: Discuss the role of community-based design in the development of assistive technologies.

Mar. 11: **Presentation to Community**

Assignment: PRESENTATION AT NUESTRAS RAICES
Initial Report Due – Problem Definition, Solution, Criteria, Options, Evaluation methods.

Spring Break

Mar. 23: **Water supply: Quantifying Water needs**

Readings: Hazeltine, B. *Field Guide of Appropriate Technology.* U.S.: Elsevier Science and Technology Books, 2003, pp. 731-759.
Gleick, P.H. *The World's Water, 2000-2001*. Washington: Island Press, 2000, pp. 165-174.

Questions: What are the main features of different technologies for water supply, treatment, and distribution?
Discuss the different kinds of wells that can be constructed, and when each is used. What are some important considerations in sitting and constructing wells, given past experience?

Mar. 25: **Water filtration**

Readings: Colwell, R. et al. Reduction of Cholera in Bangladeshi Villages by Simple Filtration. Proceedings of the National Academy of Sciences, January 14, 2003.
Hazeltine, *Field Guide, pp.* 760-768.

Questions: Is Colwell's solution an appropriate technology?
What is the difference between rapid and slow sand filtration?
Discuss the principal physical and biochemical processes involved in slow sand filtration. What is a schmutzdecke and what does it do?

Assignment 4: Cookstove problems, Reflection on best practices from collaborative design – what factors are important for your project?

Mar. 30: **Sanitation**

Readings: Hazeltine, *Field Guide,* pp. 769-796.
INSTRAW. Women Water and Sanitation. In *Women and the Environment: A Reader*. S. Sontheimer, ed. New York: Motherly Review Press, 1991.

Questions: What is women's role in water and sanitation? How do cultural issues factor in to sanitation design? Compare and contrast the different means of sanitation discussed by Hazeltine and Bull. Under what circumstances is each used?

Apr. 1: **Catchment & Transport**

Readings: Hazeltine, *Field Guide,* pp.796-809.
Lambton, A.K.S. The Origin, Diffusion and Functioning of the Qanat. In *Qanat, Kariz and Khattara: Traditional Water Systems in the Middle East and North Africa*. P. Beaumont, M. Bonine, and K. McLachlan, eds. Cambridgeshire: Middle East & North African Studies Press, Ltd.
Gleick, P.H. *The World's Water, 2000-2001*, 2000, pp. 63-92.

Questions: Why is irrigation increasingly important? How do each of the irrigation systems described by Hazeltine and Lambton work? Draw a picture of a Qanat to illustrate its function.

Apr. 6: **Energy Needs**

Readings: H&B, *Appropriate Technology,* Chapters 3, 6.
Goldemberg et al. Basic Needs and Much More with One Kilowatt Per Capita. *Ambio*, 14(4-5), pp. 190-200.
Kats, G. Achieving Sustainability in Energy Use in Developing Countries. In *Making Development Sustainable:Redefining Institutions,Policy, and Economics*. J. Holmberg, ed. Washington: Island Press, 1992, pp. 258-288.
Wilson, S. Pedal Power. In *Introduction to Appropriate Technology*. Congdon, R.J., ed. Emmaus, Pa.: Rodale Press, 1977, pp. 80-101.

Questions: What are the energy needs of individuals in developed and developing nations, and how could they be different? What are Kats's recommendations for achieving sustainability in energy use? What are yours? What are the promises and limitations of human-powered machines as part of a plan for sustainable energy use?

Assignment: Progress Report: evaluation of progress.

Apr. 8: **Human Power**

Readings: H&B, *Appropriate Technology*, Chapters 5, 7- 8, 12.

Questions: Compare solar, wind, and waste-to-energy technologies described by Hazeltine and Bull. Are all of them appropriate? What conditions (physical, cultural, economic, political, etc.) are ideal for each technology?

Apr. 13: **Hydropower** (Guest Lecture, Aryn Bowman, guest)

Readings: H&B, *Appropriate Technology*, Chapter 4.
Gleick, P.H. *The World's Water, 1998-1999.* Washington: Island Press, 1998, pp. 69-104.
Bowman, Aryn. The Tehri Dam: To Take Away the Lives of the Living. Smith College. May 2003.

Apr. 15: **Agriculture**

Readings: Pretty, J.Guijt, I., Scoones, I, and Thompson, J. Regenerating Agriculture: The Agroecology of Low-external Input and Community-based Development. In *Making Development Sustainable: Redefining Institutions, Policy, and Economics*. J. Holmberg, ed. Washington: Island Press, 1992, pp. 91-123.

Questions: Compare and contrast HEI and LEI agriculture.
What are some innovative approaches for sustainable agriculture?

Apr. 20: **Aquaculture**

Readings: Shiva, Vandana. *Stolen Harvest*. HD9000.5.S454 2000, Chapters 1-3.
What does Shiva mean by "the hijacking of the global food supply" and "soy imperialism?" What are three examples of each that she uses to support her argument? How does her analysis of agriculture and aquaculture fit with our examination of appropriate and inappropriate technology? Where do the themes fit and where do they diverge?

Apr. 22: **GM Foods**

Readings: Mann, Charles. Biotech goes Wild. *Technology Review*, 102 (4), July/Aug. 1999, pp. 36-43.
Shiva, *Stolen Harvest,* Chapters 4-7.

Questions: Can you reconcile Mann and Shiva's versions of biotechnology in agriculture?

Apr. 27: **Presentations**

Assignment: Presentations at Nuestras Raices

Apr. 29: **Wrap-up**

Assignment: Project Due

Readings That Help

This section of the *Newsletter* is meant to guide the reader to books or articles that someone recommended to me because they are useful, provocative, or enjoyable—at best, all three. Suggestions of other materials to be reviewed would be most welcome, with or without comments, but I hope you feel free to comment on my opinions as well.

Barrett Hazeltine
Division of Engineering, Brown University

Cadbury, Deborah. *Dreams of Iron and Steel: Seven Wonders of the Nineteenth Century, from the Building of the London Sewers to the Panama Canal.* New York: Fourth Estate, Harper Collins, 2004. Pp. xix + 300. Hardcover, $25.95.

The seven wonders described, in the order presented, are: the *Great Eastern*, the Bell Rock Lighthouse, the Brooklyn Bridge, the London Sewers, the Transcontinental Railroad, the Panama Canal, and the Hoover Dam. Cadbury focuses on the engineers creating these wonders, beginning with Isambard Kingdom Brunel, who did both the basic design and all the detailed design for the monster ship the *Great Eastern*. One indication of how engineering has changed is that early engineers could really hold the entire design in their minds, as the senior and junior Roeblings did for the Brooklyn Bridge, while large contemporary projects are products of teams. Although the point is not made, one suspects that the hero of the Boulder Dam construction, Frank Crowe, probably had less control of his project than, say, Joseph Bazalgette, who built the London sewers. Another indication of change is the terrible work conditions on early projects, reflecting the appalling economic conditions of working people in general. When a workingman was drowned in building a lighthouse at the entrance to the Firth of Forth, the family's loss and pain was mitigated because a job had become open for his younger brother. Even in 1931 men worked on the Boulder Dam in 120-degree heat, in tunnels with trucks spewing carbon monoxide. For workers digging the foundations of the Brooklyn Bridge the bends were a constant threat, and many of the mostly Chinese workers building the transcontinental railroad through the Sierra Nevada Mountains lost their lives in blasting accidents. The book is based on a series of television shows produced for the BBC, and the writing is never dull. The relatively few references to the technology involved made sense, but I would have liked more—at least more detailed diagrams. The stories are inspiring, although one is taken aback at the callous disregard for working people in fulfilling the dreams of the driven engineers. This book is recommended highly for those wanting to know the glories of traditional engineering.

Le Couteur, Penny, & Jay Burreson. *Napoleon's Buttons: 17 Molecules that Changed History*. New York: Tarcher/Penguin, 2003. Pp. 375 Paperback, $14.95.

One reason Napoleon's army suffered such a devastating defeat in attacking Moscow may have been the tin molecules in the buttons of the overcoats—tin disintegrates at low temperatures. Without clothing fastenings the soldiers and officers froze. Another reason for the debacle may have been the molecule causing ergot fungus poisoning of the soldiers' flour—the same poisoning may have been involved in the Salem witch-hunts. A third molecule likely sharing blame is the one causing malaria. The seventeen stories of how particular chemicals changed world history are complemented by an accessible discussion of the chemical structure of the molecules in question. A slight variation in structure results in entirely distinct chemical properties. In some cases the properties, taste for example, could be predicted from the structure. I would have welcomed more discussion relating structure to properties—an instructor could do this. Some of the more engrossing stories deal with the spice trade, with scurvy, and with addictive drugs—morphine, nicotine, and caffeine. People went to remarkable efforts to gain access to the active ingredient of nutmeg, *isoeugenol.* Nutmeg was thought to protect against the plague; perhaps isoeugenol repelled fleas. The Dutch ceded Manhattan to England in exchange for a small island in present day Indonesia where nutmeg trees grew. Lack of the ascorbic acid molecule made the long sea voyages to collect spices nearly impossible—

scurvy destroyed the sailors. A major accomplishment of Captain Cook was to insist that his crews eat vegetables—sauerkraut if fresh produce was not available. Cook also insisted on cleanliness on his ship. The demand for opium, tobacco, and coffee arises from three distinct alkaloid molecules, but the effect on the ecology of lands where the plants are grown has generally been similar and not positive, although such high value crops may be the best way for impoverished people to earn cash. One comes away from the book sensing that basically everything important depends on chemistry. One also senses that molecular structure is the organizing principle for chemistry and that such structure can be understood. This is a fascinating book for anyone and an excellent gift for an aspiring scientist. More books like this are needed.

Malenschein, Jane. *Whose View of Life? Embryos, Cloning, and Stem Cells.* Cambridge, Mass.: Harvard University Press, 2003. Pp. xiii + 342. Hardcover. $27.95.

The unifying question in this well-written book is what kind of research should be permitted using human embryos. Medical advances from embryo research, particularly stem cell research, could greatly improve the lives of some. Embryos will be destroyed in this research, so the tradeoff is between the rights of the embryo and the medical benefits of the research. The embryo possesses life, but its life is not the same as human life. Who decides between the embryo and the research and how? Most of the book is a clear and reasoned account of the science needed to understand the tradeoff. The rest is an equally reasoned discussion of how such decisions should be made in a democracy—President George W. Bush said he drew on prayer to make his decision. Will other ways lead to better results for more people? The chair of President Bush's Council on Bioethics believes if he finds something "repugnant" then it is morally wrong. Is such the best criterion in a democracy? The science begins with Aristotle, who, like early Catholic interpreters, believed the fetus was not yet a human. More scientific knowledge did not clear up the issue. By the beginning of the twentieth century, cells, nuclei, and embryo development through cell division was known. About the same time bits of frog embryos were transplanted onto another frog—the resulting hybrid might have an eye on its back. Better understanding of inheritance, based on Mendel, led to eugenics and its crimes; in 1927 in the state of Virginia a woman was sterilized basically because she did poorly on an IQ test. In 1952, the nucleus from a frog cell was transplanted into a cell from which its own nucleus had been removed—such made cloning possible. Recombinant DNA, splicing bits of DNA into pieces of DNA from other organisms, was done in 1973 and hotly debated then and now. Louise Brown was born in 1978 after a fertilized egg was transferred into her mother. Public response was generally positive, perhaps because the responsible physicians waited until the birth to announce the procedure. In 1988 the expensive human genome project, to study the detailed structure of human DNA, began. Private companies, seeking patent protection for genes, gene fragments, and many DNA fragments, paid a big part of the cost. Dolly, the cloned sheep, was born in 1996. Newspaper handling of the story did not contribute to a reasoned understanding, perhaps because the article was rushed—this was a big story, clamoring to be released. In any case, cloning has given bioethicists an opportunity. The final pertinent scientific development, stem cell research, may not be an important development at all because of federal laws. The promise of stem cell research is that stem cells "seem to have an almost magical power to become what we want them to be." A problem with stem cells is that they come from contested sources—donated fetuses, which may be discarded. The powerful anti-abortion lobby objects strongly. This short summary does not do justice to the book, in particular to the policy issues and decisions carefully dissected. An exceptionally well-done combination of science and policy, dealing with an issue that appears will be important for a long time.

Manning, Richard. *Against the Grain: How Agriculture Has Hijacked Civilization.* New York: North Point Press, 2004. Pp. viii + 232. Hardcover, $24.00.

"This is a book not just about agriculture but about the fundamental dehumanization that occurred with agriculture." Present-day agriculture is big business, with a focus on inputs and outputs, not food. Without government subsidies the business would not be viable. A commodity farmer cited gets 40% of his income some years from government

subsidies–much of that money ends up with big corporations like ADM. Subsidies have lead to a glut of wheat and corn; a major concern of the USDA is reducing the glut. Until the food stamp program was instituted people receiving food aid had to use their coupons for wheat and other commodities first before receiving other coupons for fruit and vegetables. At present excess grain is sent to impoverished countries, depressing the market for local crops. Modern agri-business uses machines rather than people—Nebraska now has 10,000 deserted farmhouses. Commercial wheat and corn farms tend to plant only a single variety of seed; perhaps the best-known historical example of the result of monoculture was the Irish potato famine. Commercial farms, especially in developing countries also tend to use much fertilizer, with predictable implications for downstream water. Of course, converting land to farming destroys habitat for wild animals and thus deprives humans of an aesthetic experience. Manning is just as concerned with the sensual/spiritual implications of decoupling food from its origin; fast food is demeaning compared with, say, selecting the perfect piece of fruit at an outdoor market and eating it with companions; food has power to bond people together. So why did hunter-gatherers turn to agriculture? The biblical writers knew farming was work–Adam and Eve were turned out of the Garden of Eden, where the hunting and gathering was good, to toil on a farm. Evidently, agriculture began when nomadic people settled down, near rivers where food was plentiful, and experimented with selecting the best seeds for planting. Agriculture did allow reserves of food to be built up as protection against bad times. Ancient farmers had more children than hunter-gatherers, but the general health of the hunter-gatherers was better—perhaps because there were fewer of them or they lived in smaller communities. A great many clearly told stories, nearly all about the implications of technological change on people, make up the book. Government policies played a big role in how these implications worked out; two examples are present U.S. farm support programs and the English refusal to assist starving people in Ireland. Manning is equally eloquent about the importance of richer sensual experiences—taste, odor, color—and how these are being lost as he is about economic matters.

Schlichting, Kurt *Grand Central Terminal: Railroads, Engineering, and Architecture in New York City*. Baltimore: The Johns Hopkins University Press, 2001. Pp. xiii + 243. Hardcover, $28.00.

Grand Central Terminal became the magnificent building it is partly because the Vanderbilts, who controlled the New York Central Railroad, insisted on a building of which they would be proud. Yearly charges–interest and taxes–plus operation expenses came to be about 80% of the railroad's passenger revenue. In 1998 the building was restored and serves, on the one hand, as the "city's great public square" and, on the other hand, as a commuter station for New York and Connecticut residents. Commuters from Long Island and New Jersey and long distance rail travelers use Pennsylvania Station, now "tucked beneath Madison Square Garden." The story begins with Commodore Vanderbilt, a successful ship owner who, at age 67, gained control of the New York Central Railroad. The Central had a geographical advantage over other trunk lines to Chicago and the West because of a gap in the Appalachian Mountains in upstate New York–the Erie Canal went through the same gap. A train wreck in the tunnel to Vanderbilt's first terminal lead to a law banning steam locomotives on Manhattan. Electric locomotives had advantages but making full use of these would require redesign of the terminal. In any case, the existing terminal did not have the capacity to handle the increasing number of passengers. The Chief Engineer for the New York Central, William Wilgus, proposed a new terminal with two layers of tracks, financed partly by air rights for buildings above the tracks. Wilgus supervised the monumental task of excavating and electrification, maintaining rail service during the whole time. He was also good enough to leave his papers to the New York Public Library. The railroad chose Beaux-Arts architecture, just as the Vanderbilts did for their Newport mansions. The terminal actually has a steel framework–the columns and masonry are cladding. The site plan included attractive and matching buildings on the new Park Avenue, above the buried tracks, consistent with the City Beautiful movement. Schlichting blames onerous government regulations on railroads and public subsidies of highways and airports for part of the railroads' decline; in any case, Grand Central Terminal was nearly destroyed in 1969 to pay bills for the Penn Central. Citizen outrage saved the building and the new owner, Metro-North, re-

stored it to its original glory, even adding a matching stairway on the east side of the concourse. As the subtitle implies, this history of the Terminal gracefully combines railroading, engineering, and architecture, as well as city planning, notes on the Vanderbilt family, and contrasts between their lives and those of working people living a few blocks away–on the other side of the Central's tracks. Special commendation should be given for the pictures of the terminal and of the city.

Sinclair, Bruce, editor. *Technology and the African-American Experience: Needs and Opportunities for Study*. Cambridge, Mass.: MIT Press, 2004. Pp. ix + 237. Hardcover, $35.00.

This collection of articles brings "together two subjects strongly connected but long segregated from each other"—the history of race and the history of technology. A sampling of the subjects gives a flavor of the book: the continuity of rice cultivation in the southern United States with that in West Africa, African-American inventors from 1619 to 1930, portrayals of African-Americans in the funny papers, industrial education for African-Americans in Philadelphia and at Tuskegee and Hampton Institutes, chanteys sung by African-Americans in the Atlantic menhaden fishery, hair as a catalyst for a discussion of race and technology. This article on hair first describes an x-ray machine to burn off unwanted hair and goes on to ask how certain tools have influenced national racial policies. The lead article by the editor lists some of the ways technology and race have interacted. A paradox of the slave owning South was a proclamation of the inability of slaves to master technology coupled with an increasing dependence on the skills of African-American artisans. Jobs became segregated either because white workers, as in a Ford plant, refused to do disagreeable jobs or because white craft workers, electricians for example, feared losing their claim to expertise. African-Americans have not fared well at the Patent Office; by law a slave's invention belonged to the master, and even later the expense and political knowledge required to get a patent put African-Americans at a disadvantage. The technology of photography allowed African-Americans to participate fully, while radio broadcasts, created by white people, almost never did. Technology affected African-Americans in their role as consumers differently than it affected white people—the automobile was an escape from the humiliation of segregated public transportation. In several places, the question why historians have not made major connections between race and technology is asked. One answer is in how the historical fields developed. There are many provocative ideas here for the professional historian and much of interest to the general reader—highly recommended to both sets of readers.

Sullivan, Robert. *Rats: Observations on the History and Habitat of the City's Most Unwanted Inhabitants.* New York: Bloomsbury, 2004. Pp. 242. Hardcover, $23.95.

Sullivan, a journalist, spent close to a year observing rats in an alley in lower Manhattan. He also learned much about the history of New York and of rats worldwide. A particular rat with a corkscrew tail became nearly an obsession, as a particular whale was for Captain Ahab. A remark by a driver of a garbage truck who had also noticed this rat came as reassurance: "He's big, boy. I've seen him *walk* upstairs." Rat lore, urban legends, abound; one such, evidently true, is of a woman attacked, in 1979, on the street by a large pack of rats. In 1959 in Coney Island, a three-month old baby died from rat bites—rats were attracted to the food on the child's face. When rats were observed on Park Avenue, the *Times* reported they were refugees from Harlem; in fact, any rat expert knows the creatures would never travel that far. Rats cohabit with humans because of the food we make available; closed metal garbage cans would eliminate the attraction, but plastic bags, easily pierced by a rat, weigh less and are favored by landlords. The reason for the near universal disdain people have for rats is not entirely clear, but the disdain itself seems clear—the book does not even include a picture of a rat. Fleas living in the fur of live rats carry bubonic plague, and people in the Middle Ages associated rats with the plague, without understanding the connection. The last case of plague in New York (in 2002) involved a couple from New Mexico—the diagnosis was not immediate, probably because none of the medical staff in the city had seen plague victims. Earlier the plague in San Francisco was a disaster for Chinese immigrants, partly because of the disease itself and partly because of the prejudice unleashed. Rats played a big part in rent strikes in New York City; a

now nearly forgotten activist named Jesse Gray urged tenants to bring rats to civil court and City Hall, and they did, to good effect. The success of the strike inspired other grassroots organizations in the city and the country. The alley where Sullivan observed shows up on city records in the 1740s; one of the residents owned a farm up-town that was sold to John Jacob Astor and became Times Square. Close by was Golden Hill, where the first skirmish, also now nearly forgotten, of the American Revolution took place. The juxtaposition is apt. Rats, like people, are tough and opportunistic.

Weber, Steven. *The Success of Open Source.* Cambridge, Mass.: Harvard University Press, 2004. Pp. viii + 312. Hardcover, $29.95.

How is it possible that open source software development–where any potential user has free access to the code–has become so successful? Nearly 40% of large American companies use Linux in some form; over 65% of all active web sites use Apache–both Linux and Apache are the result of open source development. A second question is whether the open source model is applicable in other contexts than software development; what are the characteristics of tasks where it works? Part of the reason open source works must involve the motivations of the people writing code; these motivations include the artistry of writing good code, combating a joint enemy–usually assumed to be Microsoft, and reputation. The motivation argument is extended using ideas of non-excludability and non-rivalness. Another part of the reason open source works is based on the organization of the effort–coordination and governance. Mechanisms for coordination include disincentives to "forking"–leaving the mainstream, cultural norms, leadership practices–responsiveness to those led, modularization–breaking the effort into small pieces, and the manifestos expressed in the licenses for the code. The issue in governance is maintaining the integrity of the code; the ultimate arbiter for Linux is its inventor, Linus Torvalds. Open source efforts have used different governance structures and various business models. The best-known open source company, Red Hat, offers support and a recognized brand. One implication of open source is rethinking the notion of property. Another implication is demonstrating that an effective alternative to hierarchical organizations exists–the network that created Linux is entirely different from the hierarchy that created Windows. One more example of contrasting organizations is a network of terrorist cells versus a hierarchy within a national government. An important question is how these two kinds of organizations can fruitfully interact. Weber, at times, uses terms and ideas that may be unfamiliar outside of professional social science, but the thrust of his argument seemed clear to me. This book is well worth reading, both for its explanation of open source and for the provocative insights about organizations and about managing technology.

Wilhelm, Anthony G. *Digital Nation*. Cambridge, Mass.: MIT Press, 2004. Pp. xiv + 161. Hardcover, $27.95.

Without access to the Internet and information technology in general, a person in the contemporary United States has trouble finding a job, securing government services, applying to college, transferring medical records–even learning about health care. In a disadvantaged area of Alabama recently the state employment agency put up billboards promoting employment and training centers; the only address given was a Web site. Government offices have been closed or hours reduced as licensing and registration services have been shifted online. The result is disenfranchisement of the digitally illiterate–analogous to the causes of the Civil Rights movement. Even if jobs can be found without submitting a resume online, people without computer training are at a disadvantage; the majority of newly filled jobs for non-college graduates require the use of computers; the percentage is higher for college graduates. Despite the protestations of the Chairman of the FCC, the situation does not seem to be getting better. Penetration of the Internet into households is slowing down, even decreasing; it is now about sixty percent, and only one in four of America's poorest households was online in 2001–at the bottom of the pyramid people may be trading Internet service for cell phones. Reliance on market forces to connect everyone seems to be a delusion. Many of the relevant programs established during the Clinton administration have been retrenched during the present administration. Libraries, which lower-income people and minorities use much more often than their more affluent peers for computer based job-related and educational purposes, have

been especially hard hit. Computer access is even more important as media companies are consolidating and thus reducing the diversity of points-of-view generally available. Digitally savvy citizens can compensate for this homogenization through the Internet but people unable to logon see limited perspectives. Recent government efforts to make information technology widely available have focused on hardware, perhaps because of commercial reasons, but the need, according to Wilhelm, appears to be in training teachers and staff to use the hardware effectively. Exemplary programs to impart computer literacy to everyone exist in Germany and Finland, as well as in various cities in the United States–the problem is solvable and worth solving. Ensuring universal computer access will improve government efficiency, facilitate electronic health care, and reduce traffic congestion through telecommuting. A prescription for moving to an inclusive digital nation is included; such looks difficult to me. A passionate, troubling book about how technological change can increase the gap between the haves and the have-nots.

Wilson, David Gordon, with contributions from Jim Papadopoulos. *Bicycling Science.* Third Edition. Cambridge, Mass.: MIT Press, 2004. Pp. vii + 477. Hardcover, $55.00.

This is the third edition of a respected book. The cover note explains some of the additions: "This edition begins with a brief history of bicycles and bicycling… and includes information on … human-powered transportation including 'the ultimate human-powered vehicle'…." The bulk of the text is a careful exposition of the physics of bicycling and of the engineering design choices. Topics included are: Biological processes taking place in the muscles while pedaling, Aerodynamics, Rolling–tires and bearings, Braking, Steering and balancing, Power transmission, and Materials/stresses. Carbohydrate loading makes more fuel available to muscle fibers, but the factor limiting energy output is the buildup of lactate in the blood. The airflow past a moving bicyclist is sufficient to remove the heat generated by cycling–of course, a stationary bicyclist being tested will not have this advantage. The major limitation on cycling speed is aerodynamic; anything that reduces drag–tight clothing, a rider's position reducing frontal area–will improve performance, as will proper tire design and pressure. Aerodynamic drag can be reduced also by having the operator in an entirely different position, the so-called "recumbent" bicycle, which Wilson likes. The basic discussion of aerodynamics makes use of the Reynolds number. A model of tire rolling resistance is presented, but much theoretical work needs to be done. A solid tire would have less resistance than an inflated one on a smooth road but would transmit the effect of small bumps to the frame and possibly cause the bicycle to lose contact with the road. Frames usually fail through fatigue from repeated small stresses but must be strong enough to resist large stresses from accidents and swerving. Fortunately, most bicycles are not expected to last for many years, so metal fatigue is usually not the limiting factor. Exotic materials would allow lighter weight frames but are presently much too expensive. Some concerns with braking are behavior in wet weather and the maximum deceleration possible without sending the rider over the front handlebars are presented. A moving bicycle balances partly because the operator can steer the support points under the center of mass. Various moment diagrams are used to explain the stability of a moving bicycle and the torque needed to steer. A well-lubricated bicycle chain is very efficient in transmitting power to the rear wheels and can withstand the high torques of starting or swerving. The chapter on power transmission concludes with a discussion about how many gears are really useful–twelve perhaps. The last two chapters are less technical. One describes unusual human-powered machines–the first machine is a lawn mower, the last is a blimp. The other chapter discusses the future of human-powered devices; part is technical trends, part is a plea for a balanced government transportation policy that supports alternatives to motorcars.

The intended reader seems to be a rider/designer who wants to gain as much speed as possible without completely losing comfort. Another reader who would gain much from *Bicycling Science* is an engineering student who would see how various topics from mechanics, fluids, and materials courses are actually used in practice and would also see the interplay between theory and empirical measurements necessary in real design work. For engineering students this would be an exceptionally useful and inspiring book. Parts of the book would be equally valuable for non-technical students, including those who want to know what engineers really do.

BOOK REVIEW

Dyes Made in America 1915-1980: The Calco Chemical Company, American Cyanamid, and the Raritan River, Anthony S. Travis (Jerusalem: Sidney M. Edelstein Center for the History and Philosophy of Science, Technology and Medicine, Hebrew University/London: The Hexagon Press, 2004), Pp. xii + 582. $115. ISBN: 965-555-149-0.

Travis is an eminent historian of modern industrial chemistry—especially the manifold technologies arising out of the invention of synthetic dyes in 1856—whose work reflects a distinctive sensibility to the interplay of scientific, technological, commercial-managerial, and environmental issues. His earlier books include *The Rainbow Makers: The Origins of the Synthetic Dye Stuffs Industry in Western Europe* (Lehigh University Press, 1993); editor, with Ernst Homburg and Harm Schröter, *The Chemical Industry in Europe, 1850-1914: Growth, Professionalization, and Pollution* (Kluwer, 1998); and with Carsten Reinhardt, *Heinrich Caro and the Creation of Modern Chemical Industry* (Kluwer, 2000).

Dyes Made in America caps a decade of extraordinary productivity by Travis, reflecting a consistently high level of original research and publications that treat science, technology, and society issues in an integrated way. This book tells a complex and fascinating story that makes for a core STS study. It follows the evolution of what was, in effect, a vast business "machine" whose components were people, scientific and engineering knowledge, chemical manufacturing technologies, domestic and international markets and competition, executive strategies, managerial decisions, government policies, and last, but also least in the company's strategic planning and corporate goals, the social and natural environments that supported and suffered the machine's activity. The physical embodiment of this machine was a Bound Brook, New Jersey manufacturing facility that at its peak in the 1940s employed over 5,000 people, covered hundreds of acres, sucked 20 million gallons of water a day (and more) from the barely larger flow of the Raritan River into which its effluent was discharged, for decades untreated, and daily consumed tens of tons of sulphuric acid, and burned 700 tons of coal. The air pollution matched the water pollution.

The Bound Brook plant was born in 1915 as the Calco Chemical Company, newly created by a manufacturer of burlap wall covering to produce much needed dyestuffs previously imported from Germany but made unavailable by WWI. Very quickly, with the entry of the U.S. into that war, Calco leveraged its fledgling dye chemistry competence, and federal confiscation of relevant German patents, into a coal tar intermediates manufacturing business alongside colorant manufacturing and, from 1917, coal tar-based explosives manufacture. Over the ensuing decades, coal tar-based synthetic dye chemistry opened up new markets in pharmaceuticals (sulfa drugs are biologically active derivatives of synthetic dyes intermediates), plastics, and agricultural products, among many others. Concurrently, the Bound Brook plant itself grew explosively, adding people and capabilities in response to new markets, WWII, the Cold War, and of course intensified competition, at home and after WWII from a revived German chemical industry.

Like a time-lapse cutaway video of a machine in action, Travis shows us the interaction over sixty five years of basic research, process technology research, the transfer of research into production practices, the impact of managerial decisions on resource allocation, the impact of competition and financial pressures on strategic planning, the influence of personalities and personnel recruiting on these decisions, and, eventually, the reaction of nature and society to the functioning of this business machine. Along the way, what began in 1915 as the Calco Chemical Company became in 1929 a division of American Cyanamid, which, after selling and spinning off several divisions, was in 1994 acquired by American Home Products, which in 2002 morphed into the Wyeth Corporation. The demise in the 1980s of what had been for over fifty years a major U.S. chemical manufacturing facility, supplying diverse industries and profitably transforming chemical and chemical engineering knowledge into products, was the result of innovation "sclerosis" compounded by organizational problems, poor managerial decisions, and growing environmental accountability.

Dyes Made in America is physically formidable, and the chemistry woven into the text will gladden only the hearts of professionals, but the richness of Travis' story for STS studies trumps everything else. Travis had impressive access to archival materials, and he interviewed many people who played key roles in the "glory days" of Bound Brook and also experienced its decline. Excerpts from these interviews enrich the story, and Travis's style is unfailingly clear and straightforward: there is no aiming at literary effect or preaching as to what management ought to have done or should not have done. There is a tremendous amount of supporting factual material, and Part Two of the text is a 100-page detailed discussion of the environmental impact of the Bound Brook plant, in effect, an "exploded view" of the environmental elements of the overall history of the plant told in Part One. STS studies scholars, graduate students, and even advanced undergraduates working on a senior thesis would do well to give this book careful consideration.

This book is available at a price of $60 including postage through May 30, 2005 if ordered directly from the Edelstein Center. Address and further details from: alephj@cc.huji.ac.il

Steven L. Goldman
Lehigh University

OPEN FORUM
Utopian Visions and World's Fairs
Hagley Museum and Library
Wilmington, Delaware
April 15, 2005

Utopian Visions and World's Fairs is the theme of a spring symposium in the Hagley Museum and Library in Wilmington, Delaware on Friday April 15, beginning at 1:30 p.m. The symposium will run from 1:30 p.m. to 4:30 p.m., and will include four papers. Ryan J. Carey (Simon's Rock College) will explore how the 1905 Portland, Oregon Exposition ignored the role of labor when it celebrated the centennial of the Lewis and Clark expedition. Lisa Schrenk (Norwich University) will present the fantasies of progress presented at the 1933-1935 Chicago World's Fair that was held in the depths of the Great Depression. Erik Ellis (Arizona State University) looks at the complicated efforts to showcase the potential for space travel at the Seattle World's Fair of 1962. Finally, Natasha Zaretsky (Southern Illinois University) looks at the decision of the American Bicentennial Commission not to hold a centralized celebration of 200 years of American independence and to instead, encourage decentralized events emphasizing American folk traditions. Noted historian James Gilbert (University of Maryland) will offer a comment on the papers. For more information, e-mail clockman@Hagley.org or go to www.Hagley.org or call Carol Lockman at (302) 658-2400. ext. 243.

CALL FOR PAPERS

The Representation of Controversial Objects: New Methods of Displaying the Unruly and the Anomalous in Science and Technology Studies
Annual Meeting of the Society for Social Studies of Science
Pasadena Hilton, Pasadena, California
October 20-22, 2005

The program committee invites contributions that explore unruly objects in science and technology, including controversial, invisible, secret, or anomalous things. We are especially interested in showcasing new forms of representation, and welcome experimentation with theory, method, and conferencing modes.

Please submit abstracts through http://www.4sconference.org

Submission deadline: May 1, 2005

Program Chair: Marianne de Laet, e-mail: delaet@hmc.edu

Emergent Systems, Cognitive Environments
Society for Literature, Science, and the Arts
Chicago, Illinois
November 10-13, 2005

The theme for the nineteenth annual conference of the Society for Literature, Science, and the Arts will be *Emergent Systems, Cognitive Environments.* Papers are invited in all science-oriented topics, especially those related to emergence and cognition as these themes appear, variously, in science, literature, technology, and the arts. **The deadline for submission of papers is May 1, 2005.**

To emphasize the explicit inclusion of the arts, as indicated by the new organization name, SLSA, this year the organization is inviting artists to speak or perform in hour-long morning and evening plenary sessions. Scholars familiar with the work of each artist are also being invited to speak, and may form panel streams around the themes introduced in the sessions.

The conference will be held at the historic tower of the Intercontinental Hotel on Michigan Avenue in Chicago, in view of the Wrigley Building and the Chicago River. A reception will be held nearby at the University of Illinois at Chicago, in a venue overlooking a new landscape installation by Vito Acconci.

Individuals may submit abstracts of 150 words, proposals for panels usually composed of 3-4 speakers, plus discussion in a 1-1/2 hour session, with specifications for any AV or Internet needs given at this time. In addition to standard formats, innovative proposals for papers, panels, round-table discussions, and any non-traditional formats, are encouraged. The circulation of papers among panelists before presentation is recommended. Sessions involving speakers and/or respondents that transcend disciplinary boundaries are particularly welcome.

Speakers must be 2005 members of SLSA. To join or to renew membership, please see https://www.press.jhu.edu/cgi-bin/associations/sls_membership.cgi or call Johns Hopkins University Press Journals at (800) 548-1784 (U.S. and Canada only, all others call (410) 516-6987). Mon.-Fri. 8:00 a.m. to 5:00 p.m. or fax: (410) 516-6968 or e-mail: jlorder@hupress.jhu.edu

Please submit abstracts and proposals via e-mail (in plain text, without attachments) to both the site chair, Joseph Tabbi jtabbi@uic.edu, and the program chair, Bruce Clarke bruce.clarke@ttu.edu. A mailing address for each participant should be included with all papers and proposals.

The Society for Literature, Science, and the Arts fosters the multi-disciplinary study of the relations among literature and language, the arts, science, medicine and technology.

Political Economy of Enterprise
Business History Conference
Toronto, Canada
June 8-10, 2006

The 2006 annual meeting of the Business History Conference (BHC) will take place June 8-10 in Toronto, Canada, at the Munk Centre for International Studies of the University of Toronto.

The theme for the conference will be **Political Economy of Enterprise.** Business, the political system, and government have influenced one another from time immemorial. This year's program theme invites us to reflect on those interactions. Which institutional frameworks have been more or less conducive to business enterprise? What has been the relationship of political leadership to business success and failure? How has government promoted business and innovation? How have regulation, taxation, and subsidies affected business? In what areas of business has government taken the most interest, and why? When does business corrupt government, and vice versa? How have globalization and multi-national corporations affected traditional business-government relations? What have been and are the effects on business enterprise of free trade areas such as NAFTA, of customs unions such as the EU, and of international organizations such at the WTO, the IMF, and the World Bank? The program committee invites proposals exploring such questions and the general theme of political economy of enterprise in a variety of historical contexts. Given that our meetings will be in Canada, we would like especially to encourage proposals for papers on Canadian business history and on the extent to which Canadian and U.S. scholarship on political economy differs. (In keeping with longstanding BHC policy, the committee will also entertain submissions not directly related to the conference theme).

Potential presenters may submit proposals either for individual papers or for entire panels. Individual paper proposals should include a one-page abstract and a one-page curriculum vitae (cv). The abstracts should summarize the argument of the paper, the sources on which it is based, and its relationship to existing scholarship. Each panel proposal should include a cover letter stating the rationale for the session, a one-page abstract and author's cv for each proposed paper (up to three), and a list of preferred chairs and commentators, with contact information.

Proposals also are invited *for* the **Herman E. Krooss Prize** for the best dissertation in business history. The Krooss Prize Committee welcomes submissions from recent Ph.D.s (2003-6) in history, economics, business administration, history of science and technology, law, and related fields. To participate in this competition, please indicate this in a cover letter, and include a one-page cv and one-page dissertation abstract. Semifinalists will be asked to submit copies of their dissertation after initial review of proposals. Finalists will present summaries of their dissertations at the Toronto meeting.

Doctoral candidates who would like to have their dissertations discussed can participate in special dissertations-in-progress sessions**.** Submit a cover letter to this effect, along with a one-page cv and one-page dissertation abstract, clearly indicating the submission is a dissertation abstract.

BHC also awards the **K. Austin Kerr Prize** for the best first paper by a Ph.D. candidate or recent Ph.D. (2003-6). If you wish to participate in this competition, please indicate this in your proposal. Proposals accepted for the Krooss Prize panel and the dissertations-in-progress sessions are not eligible for the Kerr Prize.

The deadline for receipt of all proposals is **15 October 2005.** Notification of acceptances wil1 be sent by January 2006. Presenters will be expected to submit abstracts of their papers for posting on the BHC website. In addition, presenters are encouraged to post electronic versions of their papers prior to the meeting, and to submit their papers for inclusion in our online proceedings publication, *Business and Economic History Online.* The BHC also offers graduate students who are presenting papers grants to offset some of the costs of attending the conference.

Please send all proposals to Dr. Roger Horowitz, Secretary-Treasurer, Business History Conference, P. O. Box 3630, Wilmington, DE. 19807, USA. Phone: (302) 658-2400; fax: (302) 655-3188; email: rh@ude1.edu.

The program committee: Mark Rose (chair), Florida Atlantic University; Rick Halpern, University of Toronto; Pamela Laird, University of Colorado-Denver; H. V. Nelles, McMaster University; Rowena Olegario, Vanderbilt University; and Richard Sylla (BHC president-elect, 2004-5), New York University.

Job Announcement
Cornell University
Department of Science & Technology Studies
Academic Year 2005-06

The Department of Science & Technology Studies invites applications for a one-year visiting professorship during the academic year 2005-06. The Department seeks applicants with research and teaching expertise in areas related to biology and society to teach two courses per semester during the academic year. We are particularly interested in applicants who can teach courses on the environment or public health and medicine. A Ph.D. in a relevant field—history of science, sociology, philosophy, science and technology studies, or history of medicine, is required.

Candidates should send a letter of application, curriculum vitae, evidence of teaching ability, a writing sample, and the names of two references to Biology & Society Search Committee, Department of Science & Technology Studies, 306 Rockefeller Hall, Cornell University, Ithaca, NY 14853. Application materials may be submitted electronically to Biology & Society Search Committee, c/o Debbie Van Galder, dmv1@cornell.edu

To ensure review of your application, please submit all materials as soon as possible, preferably **before May 15, 2005.**

Women and minorities are especially encouraged to apply. Cornell University is an affirmative action/equal opportunity employer.

FORTHCOMING MEETINGS AND CONFERENCES

April 15, 2005. *Utopian Visions and World's Fairs.* Symposium sponsored by the Hagley Museum and Library. Wilmington, Del. Contact: Carol Lockman, Phone: (302) 658-2400 ext. 243. or e-mail: clockman@Hagley.org
Or go to www.Hagley.org

May 18-21, 2005. *The Capitalization of Knowledge: Cognitive, Economic, Social and Cultural Aspects.* The Triple Helix 5th International Conference. Turin, Italy. Contact: Dr. Martin Meyer, e-mail: m.s.meyer@sussex.ac.uk, or martin.meyer@econ.kuleuven.ac.be or visit: www.triplehelix5.com

May 19-21, 2005. *Reinvention and Renewal.* Business History Conference, Annual Meeting. Minneapolis, Minn. Contact: Dr. Roger Horowitz, Business History Conference, P.O. Box 3630, Wilmington, Del. 19807. e-mail: rh@udel.edu Phone: (302) 658-2400. Fax: (302) 655-3188.

June 8-10, 2005. *Weapons and Wires: Social Implications of ICT and Global Security.* International Symposium on Technology and Society (ISTAS). Sponsored by the Society on Social Implications of Technology (SSIT) of the Institute of Electrical and Electronics Engineers (IEEE) and Loyola Marymount University. Loyola Marymount University, Los Angeles, Calif. For more information visit: www.gonzaga.edu/engineeringethics/ISTAS2005

July 24-30, 2005. The Twenty Second International Congress of History of Science. Bejing, China. For details: http://2005bj.ihns.ac.cn or http://2005bj.conference.ac.cn/

October 20-22, 2005. *The Representation of Controversial Objects: New Methods of Displaying the Unruly and the Anomalous in Science and Technology Studies.* Annual Meeting of the Society for Social Studies of Science. Pasadena Hilton, Pasadena, Calif. For more information visit: www.4sconference.org **For details, see page 20.**

October 28-29, 2005. *Producing Fashion.* The Center for the History of Business, Technology, and Society. Hagley Museum and Library. Wilmington, Del. Contact: Dr. Roger Horowitz, Hagley Museum and Library, P.O. Box 3630, Wilmington, DE 19807 or e-mail: rhorowitz@hagley.org or fax: (302) 655-3188.

November 3-6, 2005. Co-sponsored Meeting of the Society for the History of Technology and the History of Science Society. Minneapolis, Minn. For more information visit: http://www.shot.jhu.edu

November 10-13, 2005. *Emergent Systems, Cognitive Environments.* The Society for Literature, Science, and the Arts. Nineteenth Annual Conference. Chicago, Il. Contact: Johns Hopkins University Press Journals: (800) 548-1784 or e-mail: jlorder@jhupress.jhu.edu or visit www.press.jhu.edu **For details, see page 20.**

March 29-April 3, 2006. *A River Runs Through Them: Landscapes in Environmental History.* American Society of Environmental History. Annual Meeting. Radisson Hotel. St. Paul, Minn. Contact: John Anfinson, e-mail: John_Anfinson@nps.gov or visit the ASEH website: www.aseh.net

June 8-10, 2006. *Political Economy of Enterprise.* Business History Conference. Annual Meeting. Munk Centre for International Studies of the University of Toronto. Toronto, Canada. Contact: Dr: Dr. Roger Horowitz, Secretary-Treasurer, Business History Conference, P.O. Box 3630, Wilmington, Del. 19807, USA. Phone: (302) 658-2400 or fax: (302) 655-3188 or e-mail: rh@udel.edu **For details, see page 21.**