

**Integrated Liberal Studies / History of Science 202**  
**Western Culture: Science, Technology, Philosophy II**  
**The Making of Modern Science**

**Spring 2012**

3 Credits; N (Natural Sciences), ILS / H (Humanities), Hist. Sci.; E (Elementary).  
2 hours lecture (1:20 pm MW, 1520 Microbial Sciences Bldg), 1 hour discussion.  
Open to freshmen.

**Instructor**

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**TAs**

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Hist. Sci. 301-304  
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**Course Description:** Welcome to ILS / Hist. Sci. 202! This course continues ILS / Hist. Sci. 201, but may be taken independently. Here we explore the history of the sciences from the scientific revolution through to World War I, with the aim of understanding how science came to be so important in modern culture, and the varied ways in which it has shaped the intellectual, cultural and material environment in which we now live. In many respects this period provided what we can think of as a critical infrastructure that is still visible in our educational system and the disciplinary framework of the sciences, as well as in several key controversies that currently challenge the relations between science and society (like the debate surrounding the teaching of evolution in the US).

We meet three times a week, twice in one-hour lectures and once in a discussion section led by a TA. *Attendance is required in lectures and discussions.* Beginning with philosophical foundations and the development of new institutions like the scientific societies, we move on to study methods in practice across the different fields of mechanical philosophy, natural history, and the physical and life sciences. Students will be introduced to the work of Isaac Newton, Charles Darwin, and Albert Einstein, but they will also be brought to question the limits of understanding, the role of gender in knowledge formation, and how changing views of nature have delivered new perspectives on what it means to be human.

Tracing links between ideas, instruments and institutions across both disciplinary and national boundaries will provide critical insight into the changing relations among science and technology, science and religion, and science and the state. Thus, examining the historical significance of fundamental concepts like gravity, energy, and evolution will show just how deeply scientific and social values have been interwoven in Western culture. In turn, understanding how much such values have changed – and the historical process by which this occurred – will help us use a contextual understanding of science to raise the possibility of critiquing some of the assumptions underlying common views of nature and culture.

Note that this course conveys either **Natural Sciences** or **Humanities credit**, a difference that will be reflected in the discussion sections and examinations in ILS and History of Science respectively. The course is also on the Global Studies course list.

### **Book List (A Room of One's Own, 307 W. Johnson St.)**

Peter J. Bowler and Iwan Rhys Morus, *Making Modern Science: A Historical Survey* (Chicago: University of Chicago Press, 2005). Required.

Betty Jo Teeter Dobbs and Margaret C. Jacob, *Newton and the Culture of Newtonianism* (Amherst, NY: Humanity Books, 1995). Required.

**Course Reader** Available for \$28 from the **Social Science Copy Center**, 6120 Social Science Building. Required.

*Note: All reading materials are also available on reserve at the College Library.*

### **Assessment**

Assessment is through three take-home essay exams written on selected topics (75% of the total grade), and lecture attendance and participation in weekly discussion sections (25%). The participation grade will test your comprehension of both lectures and readings through the semester, and some informal writing will be required for discussion sections.

First Take-Home Exam (20%): Distributed Feb. 22; due March 5.

Second Take-Home Exam (25%): Distributed March 28; due April 16.

Final Take-Home Exam (30%): Distributed May 2; due 4:45 P.M. Sun. May 13.

### **Honors Assessment**

Honors students will work on a project, the details of which will be finalized early in the semester. It will be completed by Sunday May 13, and is worth 20% of the overall grade.

### **Participation and Performance**

If you have a conflict between an academic requirement and any religious observance, please notify me of the specific dates concerned within the first two weeks of the course and I will find an alternative means for you to fulfill the requirement. Such requests are confidential.

In compliance with the Americans with Disabilities Act, I will make every effort to honor requests for reasonable accommodations made by individuals with disabilities. (If you think you qualify for accommodation, please contact the McBurney Disability Resource Center [263-2741; <http://www.mcburney.wisc.edu/>] to establish your eligibility for services.) Requests for accommodation can be responded to more effectively if I receive them as far in advance as possible, preferably at the beginning of the semester. Such requests are confidential.

If any problems arise, either academic or personal, that might jeopardize your performance in the course, you must try to inform me of the problem at the next available office hour, or by leaving a message with the Department of the History of Science (262-1406).

## Syllabus

Items from the two books on our Book List are referred to by name (eg. **Bowler and Morus**, pp. 23-25). The other material is in the Course Reader. The readings listed are core material and ideally should be read before the relevant lecture.

### Part 1: The New Sciences

#### 1. Introductions (*Jan. 23*)

#### 2. Francis Bacon and the Reconstruction of Science (*Jan. 25*)

**Bowler and Morus**, pp. 23-25.

David S. Landes, "Clocks and the Wealth of Nations," *Daedalus* (Spring 2003): 20-26.

Francis Bacon, *The New Organon* (1620), in *The New Organon and Related Writings* ed. Fulton H. Anderson (New York: Liberal Arts Press, 1960), pp. 33-49 and 93-103.

*Discussion Section: Introductions (discussing Science, Society, History and Time)*

#### 3. René Descartes on Method and Matter (*Jan. 30*)

**Bowler and Morus**, pp. 33-45.

René Descartes, *Discourse on Method* (1637), as excerpted in Ralph M. Eaton, ed. *Descartes: Selections* (New Haven and London: Yale University Press, 1996), pp. 1-37.

#### 4. The New Academies and Societies (*Feb. 1*)

"The Introduction," *Philosophical Transactions* 1 (1665-1666): 1-2.

Robert Boyle, "A Letter of the Honorable Robert Boyle Concerning the Vegetable Nature of Amber Greece, according to an Extract Taken Out of a Dutch East Indian Journal," *Philosophical Transactions* 8 (1673): 6113-15.

**Bowler and Morus**, pp. 322-326 (and, for a thematic overview, 319-322).

Steven Shapin, "The House of Experiment in Seventeenth-Century England," *Isis* 79 (1988): 373-404.

*Discussion Section: Framing the Scientific Revolution*

#### 5. Isaac Newton and the New Natural Philosophy (*Feb. 6*)

**Dobbs and Jacob**, pp. 1-34.

Isaac Newton, "A New Theory About Light and Colours," (1672), and Queries 28 and 29 from *Optics* (4<sup>th</sup> ed., 1730) as excerpted in William Francis Magie, ed. *A Source Book in Physics* (Cambridge, MA: Harvard University Press, 1963), pp. 298-308.

#### 6. Newton's Mechanics: Matter, Motion and Force (*Feb. 8*)

**Dobbs and Jacob**, pp. 34-60.

Isaac Newton, *Principia Mathematica Philosophiae Naturalis* (1687), as excerpted in Magie, *A Source Book*, pp. 30-46.

*Discussion Section: Newton and the Royal Society*

## 7. Newton and Newtonianism (Feb. 13)

**Bowler and Morus**, pp. 46-52.

Mary Terrall, "Gendered Spaces, Gendered Audiences: Inside and Outside the Paris Academy of Sciences," *Configurations* 3.2 (1995): 207-232.

## Part 2: From the Enlightenment Experiment to Industrial Revolution

## 8. Electricity and the Theater of Experiment: Franklin's Calculus and the Taming of Lightning (Feb. 15)

**Dobbs and Jacob**, pp. 61-110.

I. Bernard Cohen, *Benjamin Franklin's Science* (Cambridge, MA and London: Harvard University Press, 1990), "Benjamin Franklin's Scientific Style," pp. 14-30.

Letter 3 from Benjamin Franklin to Peter Collinson, Sept. 1, 1747, as reprinted in I. Bernard Cohen, ed. *Benjamin Franklin's Experiments: A New Edition of Franklin's Experiments and Observations on Electricity* (Cambridge, MA: Harvard University Press, 1941), pp. 179-186.

### Discussion Section: Newton, Newtonianism and the Enlightenment

## 9. The Enlightenment Balance, Revolution, and Chemistry (Feb. 20)

Anthony Elliott and Charles Lemert, *The New Individualism: The Emotional Costs of Globalization*, rev. ed. (London and New York: Routledge, 2009), pp. 43-53.

**Bowler and Morus**, pp. 61-76.

## 10. *Frankenstein*: Chemistry, Electricity, and Life (Feb. 22)

Antoine-Laurent Lavoisier, *Elements of Chemistry in a New Systematic Order, Containing All the Modern Discoveries* (1789), trans. Robert Kerr (New York: Dover, [1790] 1965), pp. xiii-xxxvii and 1-7.

Mary Shelley, *Frankenstein, or, The Modern Prometheus* (New York: Doubleday, [1818] 1999), pp. 55-76.

Gale Stokes, "Why the West? The Unsettled Question of Europe's Ascendancy," *Lingua Franca* 11, no. 8 (2001): 30-38.

Note: First Take-Home Exam Distributed

### Discussion Section: Electricity; Airs and Gases and the New Chemistry

## 11. Linnaeus, Gender, and Natural History (Feb. 27)

Lisbet Koerner, "Carl Linnaeus in his Time and Place," in N. Jardine, J.A. Secord and E.C. Spary, eds. *Cultures of Natural History* (Cambridge: Cambridge University Press, 1996), pp. 145-162.

**Bowler and Morus**, Chap. 21, "Science and Gender," pp. 487-509.

## 12. Humboldt, Scientific Travel, and Global Physics (Feb. 29)

Michael Dettelbach, "Humboldtian Science," in Jardine, et al., eds. *Cultures of Natural History*, pp. 287-304.

### Discussion Section: Natural History, Classifying Creatures, Science and Gender

13. Science and the Industrial Revolution: Steam Engines (*March 5*)

Robert Friedel, *A Culture of Improvement* (Cambridge, MA: MIT Press, 2007), ch. 11, "Raising Fire," pp. 191-209.

**Bowler and Morus**, pp. 391-403.

Note: First Take-Home Exam Due

14. The Rise of Energy Physics: Conversion Processes and Concepts of Conservation and Dissipation (*March 7*)

Heinz Otto Sibum, "Working Experiments: Bodies, Machines and Heat Values," in Richard Staley, ed. *The Physics of Empire: Public Lectures* (Cambridge: Whipple Museum of the History of Science), 1994, pp. 29-56.

**Bowler and Morus**, pp. 79-95.

*Discussion Section: Science, the Industrial Revolution and Energy*

Part 3: The Age of Progress and the Rise of Evolution

15. Ideologies of Progress, Social and Biological: Lamarck and Cuvier at the Museum of Natural History (*March 12*)

Jean-Baptiste Lamarck, *Zoological Philosophy: An Exposition with Regard to the Natural History of Animals* (1809) trans. Hugh Elliot (Chicago and London: University of Chicago Press, 1984), pp. 106-127.

**Bowler and Morus**, pp. 129-138 (including Cuvier's response to Lamarck).

16. Museum, Garden, and Field; Time and Change in Geology (*March 14*)

Charles Lyell, *The Principles of Geology, Vol. I* ed. Martin J.S. Rudwick (Chicago and London: University of Chicago Press, [1830] 1990), pp. 1-4 and 75-91.

**Bowler and Morus**, Chap. 5, "The Age of the Earth," pp. 103-127.

*Discussion Section: Time, Change and Progress in the Life Sciences and Geology*

17. Charles Darwin's Search for a Vocation (*March 19*)

David Young, *The Discovery of Evolution* (Cambridge: Cambridge University Press, 2<sup>nd</sup> ed., 2007), pp. 102-129.

**Bowler and Morus**, pp. 137-149.

18. The Devil's Chaplain (*March 21*)

Film showing: "The Devil's Chaplain," (Timewatch, 1991).

Charles Darwin, *On the Origin of Species* (Cambridge, MA: Harvard University Press, 1964), pp. 1-6, 80-87, 126-130, 459-490.

*Discussion Section: Darwin in Context: Collector, Observer, Naturalist*

19. Darwin's Theory of Evolution (*March 26*)

Craig Baxter (with the Darwin Correspondence Project as research collaborators), "Re: Design – Adaptation of the Correspondence of Charles Darwin, Asa Gray and others...", (2007), 40 pp., <http://www.darwinproject.ac.uk/content/view/89/74/>

20. The Reception of Darwin's Theory (*March 28*)

**Bowler and Morus**, pp. 149-162, 341-343 and 354-360.

Diane Paul, *Controlling Human Heredity: 1865 to the Present* (Amherst, NY: Humanities Press, 1995), pp. 22-30.

Note: Second Take-Home Exam Distributed

*Discussion Section: Debating Darwin*

***March 31-April 8, Spring Recess: No Class***

21. Evolution and the Social Order: The Question of Progress and the Science of Difference (*April 9*)

Francis Galton, *Hereditary Genius: An Inquiry into Its Laws and Consequences* (London: Macmillan, 1914; 1<sup>st</sup> ed. 1869), pp. 325-337.

22. The Development of the Human Sciences: Measuring Man and Mind (*April 11*)

**Bowler and Morus**, Chap. 13, "The Emergence of the Human Sciences," pp. 299-316.

Franz Boas, "Human Faculty as Determined by Race," (1894) in George E. Stocking, Jr., ed. *The Shaping of American Anthropology 1883-1911: A Franz Boas Reader* (New York: Basic Books, 1974), pp. 219-242.

Tim Ingold, "Culture on the Ground: The World Perceived through the Feet," in *Being Alive: Essays on Movement, Knowledge and Description* (London: Routledge, 2011), pp. 33-50.

*Discussion Section: The Human Sciences – Knowledge and Social Control*

**Part 4: The Laboratory Sciences and the Modern World**

23. Electricity and Magnetism: Telegraphy and Empire (*April 16*)

**Bowler and Morus**, pp. 403-414.

Bruce J. Hunt, "Doing Science in a Global Empire: Cable Telegraphy and Electrical Physics in Victorian Britain," in Bernard Lightman, ed. *Victorian Science in Context* (Chicago and London: The University of Chicago Press, 1997), pp. 312-333.

Note: Second Take-Home Exam Due

24. Standards and Networks: The Rise of the Teaching Laboratory (*April 18*)

James Clerk Maxwell, "Introductory Lecture on Experimental Physics," (1871) in *The Scientific Papers of James Clerk Maxwell*, ed. W.D. Niven (Cambridge: Cambridge Univ. Press, 1890), 241-255.

Graeme Gooday, "Precision Measurement and the Genesis of Physics Teaching Laboratories in Victorian Britain," *British Journal for the History of Science* 23 (1990), 25-51.

*Discussion Section: Standards and The Physics of Empire*

25. Science in the United States: Surveys and Standards (*April 23*)

Paul Lucier, "The Professional and the Scientist in Nineteenth-Century America," *Isis* 100 (2009): 699-732.

26. Rowland and Michelson: Pure and Practical Physics (*April 25*)

H.A. Rowland, "A Plea for Pure Science," *Science* 2 (1883): 242-250.

Edmund Russell, James Allison, Thomas Finger, John K. Brown, Brian Balogh, and W. Bernard Carlson, "The Nature of Power: Synthesizing the History of Technology and Environmental History," *Technology and Culture* 52 (2011): 246-259.

*Discussion Section: Science – and Scientists – in the United States*

27. Einstein's Early Career: Light and Matter, Time and Space circa 1905 (*April 30*)

John Stachel, "'What Song the Syrens Sang': How did Einstein Discover Special Relativity?" in John Stachel, *Einstein from 'B' to 'Z'* (Boston, Basel and Berlin: Birkhäuser, 2002), pp. 157-169.

Peter Galison, "Einstein's Clocks: The Place of Time," *Critical Inquiry* 26 (2000), 355-389.

28. Einstein's Relativity and its Reception (*May 2*)

Albert Einstein, "What is the Theory of Relativity?" (1919) in *The Collected Papers of Albert Einstein, Vol. 7: The Berlin Years: Writings, 1918-1921. English translation of Selected Texts*, (trans.) Alfred Engel, Consultant Engelbert Schucking (Princeton, NJ: Princeton University Press, 2002), pp. 100-104.

Note: Final Take-Home Exam Distributed

*Discussion Section: Einstein and the Cultures of Time and Space*

29. Einstein and the Legacies of the Great War (*May 7*)

Bowler and Morus, pp. 463-468.

G.F. Nicolai, Albert Einstein, and F.W. Förster, "Manifesto to the Europeans," (1914) in *The Collected Papers of Albert Einstein, Vol. 6: The Berlin Years: Writings, 1914-1917. English translation of Selected Texts*, (trans.) Alfred Engel, Consultant Engelbert Schucking (Princeton, NJ: Princeton University Press, 1997), pp. 28-29.

30. Concluding Thoughts (*May 9*)

Lorraine Daston, "A Short History of Einstein's Paradise Beyond the Personal," in Peter L. Galison, Gerald Holton and Silvan S. Schweber, eds. *Einstein for the 21<sup>st</sup> Century: His Legacy in Science, Art, and Modern Culture* (Princeton and Oxford: Princeton Univ. Press, 2008), pp. 15-26.

*Discussion Section: Modern Science*

**Sunday May 13 Final Take-Home Examination Due (4:45 P.M.)**

## Grading Criteria for Essays

- A: For outstanding essays only. The thesis and argument are clear, thought-provoking, and based on correctly understood facts. Material used to support the argument synthesizes ideas from different parts of the course (readings, lectures, discussions from different weeks). The relationships drawn between facts and ideas are sophisticated, subtle, and/or original. The writing is grammatically correct and succinct, and the argument flows well from point to point. Not a word is wasted!
- AB: For very good essays that for some reason fall short of the criteria described above. The argument may be murky at one point; information may be presented that doesn't directly or clearly contribute to the argument; the writing style may be awkward occasionally, or flawed by one or two consistent (if minor) grammatical errors.
- B: The basic good grade. The essay may pursue a straightforward but not particularly deep or sophisticated argument; it is okay as far as it goes, but doesn't penetrate into the material very far. It may have a flash of brilliance that isn't brought to fruition, because it is counterbalanced by a weakness in argumentation, minor grammatical problems, and/or a significant misunderstanding of events or chronology.
- BC: The essay shows some of the basics of the ideal essay, but is weakened by a lack of serious thinking, or by writing problems. It may make superficial connections without offering sufficient evidence to make the connections plausible or persuasive, or it may have what is in principle a good argument supported by incorrect facts or chronology. Alternatively, it may provide a fairly solid argument with minor flaws, from which the reader is continually distracted by awkward or ungrammatical prose.
- C: A grade signifying some serious problem in essay writing. It may deliver facts without a recognizable thesis or argument; it may wander away from the point; or it may be a thoughtful attempt so weakened by writing problems (grammar, punctuation, word choice) that it is difficult for the reader to understand a crucial point you are trying to make.
- D: A marginal grade. There may be enough here to show that you have attended a few lectures and/or done some of the reading, but the essay indicates no attempt at synthesis or thinking on your own, or shows a serious misunderstanding of the nature of the material and/or the assignment. Also used for essays that are just barely coherent.
- F: For unacceptable essays. An essay may be judged unacceptable if it contains plagiarism; if it consists primarily of content inappropriate to the question or the material for this course; if it shows a complete misunderstanding of the course content; or if the writing fails to meet standard college-level requirements of basic communication in English.

Essays are expected to draw on readings, lectures, and discussions and will be predominantly based on these course materials, but may make sparing reference to other sources in order to back up an argument.

Plagiarism is grounds for automatic failure on an assignment. If you use three or more words in a row from another source the phrase must be placed in quotation marks and footnoted. Otherwise it is plagiarism. For more on plagiarism and how to avoid it, consult Diana Hacker, *A Pocket Style Manual*, or the UW-Madison Writing Center website at <http://www.writing.wisc.edu/>.

You should also keep a copy of your class essays for later reference.