

**Industrial Revolutions: a graduate seminar**  
**HSci 8930**  
**Seminar in History of Technology**

Jennifer K. Alexander  
325D Mechanical Engineering  
(612) 626-7309  
jalexand@me.umn.edu

**Overview:** This seminar will address the question: Was there an Industrial Revolution? Historians have been discussing the Industrial Revolution since Arnold Toynbee first used the term in 1884. Scholars have agreed that the period between roughly 1700 and 1850 was marked by an enormous increase in the production and transportation of goods (cotton cloth and pig iron are the most frequent examples), but they do not agree on the cultural, economic, and intellectual ramifications of these changes. They do not agree that such marked discontinuities do indeed amount to a revolution, nor are they agreed on the technological bases behind such changes. As historians continue to study the implications of the period of early industrialization they have, in light of more recent industrialization in central Europe, Asia, and Latin America, also begun to reassess the concept of industrial revolution itself. This reassessment includes renewed attention to the scientific and technical parameters within which such change took place.

We will begin by reading classic studies of the industrial revolution, from Toynbee, Phyllis Deane, and David Landes, looking next at how the roles of technology and science have been described in general. We then turn to specific examinations of industrialization, looking at how it was powered (prime movers), how technology interacted with science in the case of precision mechanics and scientific instrument making (applied science), and how educational and other institutions affected industrialization in particular localities. We consider the economic history of the industrial revolution in two ways, first, by examining evidence that economic growth was a central driver of British industrialization, and second, by looking at evidence growth was not necessary, and that revolutionary change was instead local and limited. We next move outward from a focus on Britain to consider international aspects of industrialization, including technology transfer, industrial espionage, and early industrialization elsewhere in Europe and the world. Other key issues in the industrial revolution have been the genesis and role of factories, to which we turn in week eleven, and the role and experience of working people under early industrialization, which we examine in weeks twelve and thirteen. Our final set of readings concerns demographic analyses of the industrial revolution, including the current debate over whether or not industrialization benefited worker health.

**Format:** The seminar is a discussion course, and students are expected to attend and participate in the weekly discussions.

**Reports:** Each student will prepare a report on, and lead discussion of, two of the scheduled readings topics during the semester. Reports should discuss the evolution of scholarship on the topic, survey principal works, summarize current thinking on the topic, and suggest what the other students in the class should read before the discussion. Each report should be in the range of 12 to 20 pages long. So that other students can prepare, reports must be submitted and distributed one week before the date of discussion. The instructor has samples of such reports, and students are welcome to see them.

We will begin with student reports in week IV, to give students time to prepare. The first three weeks we will discuss possible topics, and have readings in common.

**Summary paper:** Each student must write a short (5 to 8 pages long) paper answering the question: Was there an Industrial Revolution? Summary papers will be due in class during our final meeting of the term, and will form the basis of our concluding discussion.

**Grading:** Grading will be based on participation in discussion, on written reports, and on the summary paper.

**Schedule of Topics and List of Possible Readings:** Below is a list of possible readings; students will choose among them in conference with the instructor. The listed titles are intended to give students a preliminary idea of the variety of subtopics within each of the main divisions, and to help them choose the topics for which they will write reports. Students writing reports will assign the readings for their topics for that week. Students should expect to read the equivalent of two articles or book chapters each week that they are not doing a report; they are expected to do more intensive reading on the topics for which they are writing reports.

**Conference with Instructor:** Students are required to meet with the instructor for guidance on the selection of readings for each of their reports.

**Week I. Introduction and discussion of topics for reports**

**Week II. Discussion: Parameters of the industrial revolution**

**Also: Choosing of topics for reports**

**These readings are required.**

Julian Hoppit, "Understanding the Industrial Revolution," *The Historical Journal* 30 (1987): 211-224.

David Landes, "Introduction," *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present* (Cambridge: Cambridge University Press, 2<sup>nd</sup> ed., 2003)

Sidney Pollard, "The Industrial Revolution: An Overview," in Mikula Teich and Roy Porter, eds., *The Industrial Revolution in National Context: Europe and the USA* (Cambridge: Cambridge University Press, 1996)

### **Additional general treatments**

Arnold Toynbee, *Lectures on the industrial revolution of the 18th century in England : popular addresses, notes and other fragments* (New York, 1884)

Maxine Berg, ed., *Technological Revolutions in Europe: Historical Perspectives* (Cheltenham, Northampton, MA: Edward Elgar, 1998)

Phyllis Deane, *The First Industrial Revolution* (New York: Cambridge University Press, 1965)

Peter Mathias, *The Transformation of England* (London: Methuen, 1979)

Peter Mathias, ed., *The First Industrial Revolutions* (Oxford: Blackwell, 1990)

### **Week III. Technology and industrial revolution. Distribution of first student report, for use in Week IV.**

#### **These readings are required:**

Christine MacLeod, "Conceptions of invention," in Robert Fox, ed., *Technological Change: methods and themes in the history of technology* (Australia: Harwood Academic, 1996).

Patrick O'Brien, Trevor Griffiths, and Philip Hunt, "Technological change during the first industrial revolution: the paradigm case of textiles," in Fox, ed., *Technological Change*.

Chapter Two: "The Diffusion of Technology in Great Britain during the Industrial Revolution," and Chapter Three: "Science and Industry in the Late Eighteenth Century," in A.E. Musson and Eric Robinson, *Science and Technology in the Industrial Revolution* (Manchester: Univ. of Manchester Press, 1969/1989 with Jacob foreword)

**Additional readings of interest:**

Maxine Berg, Pat Hudson, and Michael Sonenscher, eds., *Manufacture in Town and Country Before the Factory* (Cambridge: Cambridge University Press, 1983).

Anthony F. C. Wallace, *Rockdale: The growth of an American village in the early Industrial Revolution* (New York: W.W. Norton, 1972, 1978)

Maxine Berg, *The Machinery Question* (Cambridge, 1980)

**Week IV. Science and industrial revolution: Presentation of first student report, based on readings chosen in conference with the instructor. We will continue with student reports in the succeeding weeks.**

**Possible readings:**

Larry Stewart and Margaret Jacob, *Practical Matter*

Margaret Jacob, *Scientific Culture and the Making of the Industrial West* (New York: Oxford Univ. Press, 1997)

D.S.L. Cardwell, "Steam Engine Theory in the 19<sup>th</sup> Century: From Duty to Thermal Efficiency, from Parkes to Sankey," *Transactions of the Newcomen Society* 65 (1993-94): 117-28

D.S. Cardwell, *From Watt to Clausius: The Rise of Thermodynamics in the Early Industrial Age* (Ithaca: Cornell University Press, 1971)

**Week V. Prime Movers**

**Possible readings:**

Terry Reynolds, *Stronger than One Hundred Men: A History of the Vertical Water Wheel* (Baltimore: Johns Hopkins, 1983)

John Shaw, *Water Power in Scotland, 1550-1870* (Edinburgh, Donald, 1984)

Arthur W. Skempton, ed., *John Smeaton, FRS* (London: Thomas Telford, 1981)

Ben Marsden, *Watt's Perfect Engine: Steam and the Age of Invention* (New York: Columbia University Press, 2002)

John Farey, *A Treatise on the steam engine, historical, practical, and descriptive* (London: Longman, Rees, Orme, Brown, and Green, 1827)

H.W. Dickinson, *A Short History of the Steam Engine* (New York: Macmillan, 1939)

Richard L. Hills, "James Watt, Mechanical Engineer," *History of Technology* 18 (1996): 59-79

Richard L. Hills, *Power in the Industrial Revolution* (Manchester, 1970)

Richard L. Hills, *Power from Steam: A History of the Stationary Steam Engine* (Cambridge and New York: Cambridge Univ. Press, 1989)

## **Week VI. Applied science: craft and mechanics**

### **Possible readings:**

Scott Mandelbrote, "Scientific lecturing and the Industrial Revolution," *History and Technology* 13 (1996): 73-81

Robert Fox, "Science, Practice and Innovation in the Age of Natural Dyes, 1750-1860," in Berg, ed., *Manufacture in Town and Country*

Robert Fox, "An uneasy courtship: rhetoric and reality in the relations between academic chemistry and industrial chemistry, 1770-1914," in Fox, *Science, Industry, and the Social Order in Post-Revolutionary France* (Aldershot, Hampshire, Great Britain; Brookfield, VT: Variorun, 1996)

Phillip Lervig, "Sadi Carnot and the Steam Engine: Nicolas Clement's lectures on Industrial Chemistry," *British Journal for the History of Science* 18 (1985): 147-196

Daryl Hafter, *European Women and Preindustrial Craft* (Bloomington, IN: Indiana University Press, 1995)

J.A. Bennett, "The mechanics' philosophy and the mechanical philosophy," *History of Science* 24 (1986): 1-28

Jenny Wetton, "John Benjamin Dancer: Manchester Instrument Maker," *Bulletin of the Scientific Instrument Society* 29 (1991): 4-8

J.E. Burnett and A.D. Morrison-Low, '*Vulgar and mechanick*': *The scientific instrument trade in Ireland, 1650-1921* (Dublin: Royal Dublin Society, 1989)

Allan Chapman, "Scientific instruments and industrial innovation: The achievement of Jesse Ramsden," in R.G.W. Anderson, ed., *Making Instruments Count* (Aldershot, Eng.: Variorum, 1993), 418-430

## **Week VII. Institutions and the industrial revolution**

### **Possible readings:**

Maxine Berg and Kristine Bruland, "Culture, Institutions, and Technological Transitions," in Berg, ed., *Technological Revolutions in Europe: Historical Perspectives* (Cheltenham, Eng.; Northampton, MA: Edward Elgar, 1998)

James Edmonson, *From Mecanicien to Ingenieur: Technical Education and the Machine Building Industry in Nineteenth-Century France* (New York: Garland, 1987)

C.R. Day, "The making of mechanical engineers in France: The Ecoles d'arts et metiers, 1803-1914," *French Historical Studies* 1978, 10: 439-460.

C.R. Day, *Education for the industrial world : the Ecole d'arts et metiers and the rise of French industrial engineering* (Cambridge, MA; London : MIT Press, 1987)

Jacques Payen, "The Role of the *Conservatoire National des Arts et Metiers* in the Development of Technical Education up to the Middle of the 19th Century," *History and Technology* 5 (1988): 95-138.

Robert Fox, "Education for a new age: The Conservatoire des Arts et Métiers, 1815-1830," in Fox, *Science, Industry, and the Social Order in Post-Revolutionary France* (Aldershot, UK; Brookfield, VT: Variorum, 1996) 23-28

Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824-1865* (Baltimore and London: Johns Hopkins University Press, 1974)

Robert E. Schofield, *The Lunar Society of Birmingham* (Oxford: Clarendon Press, 1963)

Peter M. Jones, "Living the Enlightenment and the French Revolution: James Watt, Mathew Boulton, and their Sons," *Historical Journal* 42 (March 1999): 157-182

J.B. Morrell, "Bourgeois Scientific Societies and Industrial Innovation," *Journal of European Economic History* 24 (1994): 311-332

R.A. Buchanan, *The Engineers: A History of the Engineering Profession in Britain 1750-1914* (London: Jessica Kingsley, 1989)

### **Week VIII. Economics of industrialization I: Britain and growth**

#### **Possible readings:**

David Landes, *Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the present* (Cambridge: Cambridge University Press, 1969, 2003)

Joel Mokyr, *The British Industrial Revolution: An Economic Perspective* (Boulder, CO: Westview, 1993)

Joel Mokyr, ed., *The Economics of the Industrial Revolution* (London: George Allen and Unwin, 1985)

D. Cannadine, "The Present and the Past in the English Industrial Revolution 1880-1980," *Past and Present* 103 (May 1984): 131-172

T.S. Ashton, *The Industrial Revolution 1760-1830* (Oxford: Oxford University Press, 1968)

W.W. Rostow, *How It All Began: Origins of the Modern Economy* (London, Methuen, 1975)

Patrick Karl O'Brien, "Path Dependency, or, Why Britain Became an Industrialized and Urbanized Economy Long Before France," *Economic History Review* 49 (1996): 213-49

### **Week IX Economics of industrialization II: the limited revolutions thesis**

#### **Possible readings:**

Peter Temin, "Two Views of the British Industrial Revolution," *Journal of Economic History* 57 (1997): 63-83

C. Knick Harley, "British industrialization before 1841: evidence of slower growth during the industrial revolution," *Journal of Economic History* 42 (1982): 267-289

Maxine Berg and Pat Hudson, "Growth and Change: A comment on the Crafts-Harley View of the Industrial Revolution," *Economic History Review* new series 47 (1994): 147-149

N. Crafts, "Forging Ahead and Falling Behind: The Rise and Relative Decline of the First Industrial Nation," *Journal of Economic Perspectives* 12 (1998): 193-210

John Smail, "The Sources of Innovation in the Woolen and Worsted Industry of Eighteenth Century Yorkshire," *Business History* 41 (1999): 1-15

## **Week X. Technology transfer and international comparisons**

### **Possible readings:**

John Harris, "Law, espionage, and the transfer of technology from eighteenth century Britain," in Robert Fox, ed., *Technological Change: Methods and Themes in the History of Technology* (Australia: Harwood Academic, 1996), 123-136

Mikula Teich and Roy Porter, eds., *The Industrial Revolution in National Context: Europe and the USA* (Cambridge: Cambridge University Press, 1996)

Ian Inkster, "Discoveries, inventions, and industrial revolutions: On the varying contribution of technologies and institutions from an international historical perspective," *History of Technology* 18 (1996): 39-58

Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca: Cornell University Press, 1989)

Daniel R. Headrick, *The Tools of Empire: Technology and European imperialism in the 19<sup>th</sup> century* (New York: Oxford Univ. Press, 1981)

Woodruff D. Smith, "Complications of the Commonplace: Tea, Sugar, and Imperialism," *Journal of Interdisciplinary History* 23 (1992): 259-78

J. R. Ward, "The Industrial Revolution and British Imperialism, 1750-1850," *Economic History Review* 47 (1994): 44-65

Chris Evans and Goran Ryden, "Kinship and the Transmission of Skill: Bar Iron Making in Britain and Sweden 1500-1800," in Maxine Berg, ed., *Technological Revolutions in Europe: Historical Perspectives* (Northampton, MA, 1998)



Kristine Bruland, "Skills, Learning, and the International Diffusion of Technology: A Perspective on Scandinavian Industrialisation," in Berg, ed., *Technological Revolutions in Europe: Historical Perspectives* (Northampton, MA: 1998)

T. H. Ashton and C.H.E. Philpin, eds., *The Brenner Debate: Agrarian Class Structure and Economic Development in Pre-Industrial Europe* (Cambridge: Cambridge University Press, 1985)

## **Week XI. Manufactures**

### **Possible readings:**

Charles Babbage, *On the Economy of Machinery and Manufactures* (Philadelphia: Carey and Lee, 1832)

Andrew Ure, *The Philosophy of Manufactures: or, An Exposition of the Scientific, Moral, and Commercial Economy of the Factory System* (London: Charles Knight, 1835)

Thomas Max Safley, *The Workplace Before the Factory: Artisans and Proletarians, 1500-1800* (Ithaca: Cornell University Press, 1993)

Simon Schaffer, "Babbage's Intelligence: Calculating Engines and the Factory System," *Critical Inquiry* 21 (1994): 203-27

Maxine Berg, Pat Hudson, and Michael Sonenscher, eds., *Manufacture in Town and Country Before the Factory* (Cambridge: Cambridge University Press, 1983).

Francis Sejersted, "An Old Production Method Mobilizes for Self-Defense," in Maxine Berg, ed., *Technological Revolutions in Europe: Historical Perspectives* (Northampton, MA: 1998)

Maxine Berg, Pat Hudson, and Michael Sonenscher, eds. *Manufacture in Town and Country before the Factory* (Cambridge: Cambridge University Press, 1983)

## **Week XII. Labor in the industrial revolution I: Luddites and theories**

### **Possible readings:**

Eric Hobsbawm, "The Machine Breakers," in Hobsbawm, *Labouring Men* (London, 1968), 5-22

David F. Noble, *Progress Without People: In Defense of Luddism* (Charles Kerr, 1993)

Brian J. Bailey, *The Luddite Rebellion* (New York: New York University Press, 1998)

Adrian Randall, *Before the Luddites: Custom, Community, and Machinery in the English Woolen Industry, 1776-1809* (Cambridge: Cambridge University Press, 1991)

Adrian Randall, "The Philosophy of Luddism: The Case of the West of England Woolen Workers ca. 1790-1809," *Technology and Culture* 27 (1986): 1-17

Merritt Roe Smith, "Industry, Technology, and the 'Labor Question' in 19<sup>th</sup> Century America: Seeking Synthesis," *Technology and Culture* 32 (1991): 555-570

Peter Mathias, "Labour and the Process of Industrialization in the First Phases of British Industrialization," in *The Nature of Industrialization* (Blackwell, 1996), 3-47

Two classics that bear on the subject:

E.P. Thompson, *The Making of the English Working Class* (New York: Vintage 1966)

Max Weber, *The Protestant Ethic and the "Spirit" of Capitalism (and other writings)* (1930, 2001)

### **Week XIII. Labor in the industrial revolution II: Slaves, children, and women**

#### **Possible readings:**

Jan de Vries, "Between Purchasing Power and the World of Goods: Understanding the Household Economy in Early Modern Europe," in *Women's Work: The English Experience, 1650-1914*, ed. Pamela Sharpe (London: Arnold, 1998): 214-231

Clare Haru Crowston, *Fabricating Women: The Seamstresses of Old Regime France, 1675-1791* (Durham, N.C.: Duke University Press, 2001)

Neil McKendrick, "Home Demand and Economic Growth: A New View of the Role of Women and Children in the Industrial Revolution," in *Historical Perspectives: Studies in English Thought and Society*, ed. Neil McKendrick (London: Europa Publications, 1974)

David Eltis, "The Importance of Slavery and the Slave Trade to Industrializing Britain," *Journal of Economic History* 60 (2000): 123-44

Jennifer Tann, "Steam and Sugar: The Diffusion of the Stationary Steam Engine to the Caribbean Sugar Industry 1770-1840," *History of Technology* 19 (1997): 63-84

Clark Nardinelli, *Child Labor and the Industrial Revolution* (Bloomington, IN: Indiana University Press 1990)

Robert Gordon McIntosh, *Boys in the Pits: Child Labour in Coal Mining* (Montreal: McGill-Queen's University Press 2000)

M.J. Maynes, Birgitte Soland, and Christina Benninghaus, eds., *Secret Gardens and Satanic Mills* (Bloomington, IN: Indiana University Press, 2004)

M.J. Maynes, *Taking the hard road: life course in French and German workers' autobiographies in the era of industrialization* (Chapel Hill: University of North Carolina Press, 1995)

Stephen Nicholas and Deborah Oxley, "The living standards of women during the industrial revolution, 1795-1820," *Economic History Review*, second series, 46 (1993): 723-749

#### **Week XIV. Demographic questions**

##### **Possible readings:**

Robert William Fogel, *The Escape from Hunger and Premature Death, 1700-2100 : Europe, America, and the Third World* (Cambridge: Cambridge University Press, 2004)

J. Komlos, "Shrinking in a growing economy? The mystery of physical stature during the industrial revolution," *Journal of Economic History* 58 (1998): 779-802

Michel Oris, "Fertility and migration in the heart of the industrial revolution," *History of the Family* 1 (1996): 169-182

J.L. Simon, "Demographic causes and consequences of the industrial revolution," *Journal of European Economic History* 23 (1994): 141-158

J.P.D. Dunbabin, "The Demographic Causes of the Industrial Revolution: Some Qualifications" (a reply to Simon) *Journal of European Economic History* 24 (1995): 405-410

Charles H. Feinstein, "Pessimism Perpetuated: real wages and the standard of living in Britain during and after the industrial revolution," *Journal of Economic History* 58 (1998): 625-58

**Week XV. Was there an Industrial Revolution?**

Discussion, and summary papers due.