History of Science 154

Science and Business in Modern America

Spring 2009

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The conjunction of science and business has been one of the most notable features of our economy and our culture over the past hundred years or so. The two enterprises have grown closer and each has significantly transformed the other. It is now hard to imagine what the scientific enterprise would be like without its commercial ties, and it is equally hard to imagine the conduct of business, especially, but not exclusively, at its innovative leading edges, without its scientific resources. These days, we hear quite a lot about **frictions** between science and business, and about **biases** induced in science through its commercial links. These are important and deserving of our attention, but the truth of the matter is that science and business have, in very many respects, just become folded together.

This course has two main aims: first, it is a historical survey of how these relations developed from the period ca. 1880 to the present; and second, it situates the developing links between science and business in strands of deep **cultural history**. What do these links mean for **the idea of science** and **the idea of business**? How should one think about twentieth-century developments in relation to ideas of proper knowledge and the good society that track back many centuries in Western culture? How have modern social scientists, historians, and other cultural commentators sought to make sense of science-business relations, and how have such relations figured in the development of certain types of social scientific and humanistic inquiry?

Assessment:

(i) There will be a short, take-home mid-term exam, counting for 40% of the final grade. The question for this five-page essay exam will be distributed at class on March 16th and it will be due on Monday, March 23rd.

(ii) There will be an essay of 10-12 pages, with a small selection of topics specified, due May 8th. This will count for 60% of the final grade.

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Reading materials:

Almost all reading materials will be available as pdfs on the course website. The one exception is Paul Rabinow's Making PCR, assigned for 20 April. I have not ordered this book for the Coop, as used paperback copies are freely available for as little as $4 from Amazon.com, etc. Try to obtain a copy as soon as possible and start reading.

A bound copy of all readings will also be deposited in Lamont.

There are sessions where the required reading seems more bulky than usual. On these occasions, I will point out which readings you should pay special attention to and which may be "skimmed" to get a general sense of things. That is, my intention is not to overload students with readings, and things will even out over the semester.

I have dealt with much of this material in a recent book: The Scientific Life: A Moral History of a Late Modern Vocation (Chicago: University of Chicago Press, 2008). In general, I try to avoid requiring students to read my own work, but anyone who is interested is free-- **definitely not expected**-– to take a look at that book, and especially chapters 4-8.

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2 February: Introduction

The relations between science and business are substantial **facts** about modern American intellectual and economic life, but they are also **topics** in cultural history. That is because the **Idea of Science** and the **Idea of Commercial Activity** have had an uneasy relationship over a long span of history. While some have celebrated an intimate connection between the two, others have viewed them as antithetical: science and business have been thought properly to exist in quite separate realms, and the consequences of attempts to bring them together are reckoned to include corrupting the very **idea of science.** This course aims to survey some of the concrete links between science and business over the past century or so of American history, while also looking at the science-business relationship in cultural historical terms. We will see how appreciations of that relationship bear upon ideas of **what science is**, **how it is produced, who the scientist is,** and **what the role of knowledge is in the production of commercial goods and services**. This session introduces students to overall course topics and reading materials, and outlines the cultural sensibilities that inform the course.

No required reading

9 February: Science *versus* Business: Some Classical Sensibilities

If our present-day sensibilities strongly link the very idea of science to its powerful utilitarian outcomes, dominant traditions in Western culture **contrasted** the quest for scientific knowledge and the desire to embody that knowledge in technologies. Science belonged to one world; technology and commerce belonged to another world. Purity of inquiry had a higher value than profit and power; science was about knowledge **for its own sake.** Here we are introduced, via the American physicist Henry Rowland, the American sociologist and economist Thorstein Veblen, and the German sociologist Max Weber, to the traditional idea-– strong among academic scientists–- of a necessary tension between science and practical goals, while Alexis de Tocqueville, a French visitor to the new American democracy, was struck by the very high value democratic citizens placed upon utilitarian outcomes.

Required readings:

Alexis de Tocqueville, Democracy in America, 2 vols. (New York: Alfred A. Knopf, 1945; orig. publ. 1835), Vol. II, pp. 42-49.

Henry A. Rowland, “The Highest Aim of the Physicist,” Science n.s. 10, no. 258 (8 December 1899): 825-833.

Max Weber, “Science as a Vocation,” in idem, The Vocation Lectures, ed. David Owen, trans. Rodney Livingstone (Indianapolis: Hackett, 2004; orig. publ. 1918), pp. 1-31.

Thorstein Veblen, The Higher Learning in America: A Memorandum on the Conduct of Universities by Business Men (New York: Sagamore Press, 1957; orig. publ. 1918), pp. 1-42, 124-139.

16 February: Presidents’ Day Holiday: No Class

23 February: The Origins of American Industrial Research

The use of scientific knowledge in commercial and productive processes is no new thing, but the systematic institutionalization of scientific inquiry within commercial firms definitely was a novel development of the late nineteenth and early twentieth centuries, first in Germany and later in the United States and other countries. The employment of large numbers of academically-trained scientists in big technologically-advanced companies, doing something readily recognizable as scientific research, and regarded as valuable sources of product and process innovation–- all these were considered new and worthy of comment. How did one organize such a thing as an industrial research laboratory? What was the identity, and what were the motives and allegiances, of scientists working in industry? Was industrial science the same as, or fundamentally different from, its university equivalent? Was industrial science an admirable extension of academic science or was it a pathological form of science? Mees was one of the pioneers of American industrial science-– at the Eastman Kodak photographic company–- and one of its most reflective practitioners. Herbert Hoover, a trained chemical and mining engineer, wrote his brief celebration of the industrial value of pure scientific research as Secretary of Commerce, before he became President. David Hounshell offers a valuable historical survey of the American experience, and Michael Dennis’s paper is a provocative challenge to some standard ways of understanding science in industry.

Required readings:

C. E. Kenneth Mees, “The Organization of Industrial Scientific Research,” Science n.s. 43, no. 1118 (2 June 1916): 763-773.

William Allen Hamor, “The Research Couplet: Research in Pure Science and Industrial Research,” The Scientific Monthly 6, no. 4 (April 1918): 319-330.

Herbert Hoover, “The Vital Need for Greater Financial Support to Pure Science Research,” Mechanical Engineering 48 (January 1926): 6-7.

David A. Hounshell, “The Evolution of Industrial Research in the United States,” in Richard S. Rosenbloom and William J. Spencer, eds, Engines of Innovation: U.S. Industrial Research at the End of an Era (Cambridge, Mass.: Harvard University Press, 1996), pp. 13-85.

Michael Aaron Dennis, “Accounting for Research: New Histories of Corporate Laboratories and the Social History of American Science,” Social Studies of Science 17 (1987): 479-518.

2 March: Freedom and Control in Industrial Science

For those who regarded industrial science as a pathological form, one of the major indictments was its practitioners’ lack of **autonomy** compared to the individual freedom of academic science. The natural author of science, properly so called, was supposed to be the free-acting, autonomous individual, while science in industry was condemned as a team product, an unnatural and inferior creature of hierarchical command-and-control structures. Conversely, from within industry the organized team was sometimes celebrated as a more efficient and responsive form than the wasteful, and often aimless, inquiries of eccentric individuals. In reality, the situation was much more nuanced than this. J. D. Bernal was an influential English Marxist physical chemist, who really did think that science should be more responsive to the directing forces of social needs. Polanyi was a Hungarian-emigré chemist, who was appalled by Marxist tendencies towards centralized planning, and who sought to defend autonomous science from external control. Perhaps surprisingly, Mees and his colleague at Eastman Kodak substantially **agreed with** Polanyi about the wrongness of seeking to plan, direct, and control scientific inquiries, even in industry, while Warren Hagstrom is an American sociologist of science seeking to make sense of forms of organized science emerging in the Cold War, both in industry and academia.

Required readings:

J. D. Bernal, The Social Function of Science (New York: Macmillan, 1939), pp. 309-330.

Michael Polanyi, "The Foundations of Freedom in Science [and following 'Discussion']," Pp. 124-143 in Physical Science and Human Values, ed. E. P. Wigner (Princeton, NJ: Princeton University Press, 1947).

C. E. Kenneth Mees and John A. Leermakers, "The Direction of Research," in idem, The Organization of Industrial Scientific Research, 2nd ed. (New York: McGraw-Hill, 1950), pp. 227-258.

Warren O. Hagstrom, "Traditional versus Modern Forms of Scientific Teamwork," Administrative Science Quarterly 9 (1964): 241-263.

9 March: Basic Science, Applied Science, and Material Outcomes

One of the key sensibilities informing ideas of the value of science in democratic society concerns its **utility**. Tocqueville noted in the 1830s that aristocrat societies supported the idea of science "for its own sake" while the new democratic culture strongly preferred knowledge which produced materially useful outcomes. But sometime during the late nineteenth century, or perhaps even later, a new sensibility emerged into common cultural currency, and this was the notion that there was a linear **causal** relationship between knowledge produced **for its own sake** (variously called **pure**, **basic**, or **fundamental**) and knowledge that could be **applied** to technological problems and that ultimately produced materially useful outcomes. What has been called **the Linear Argument** is the claim that Pure Science produces Applied Science which, in turn, produces new technology and economic growth. In this session, we explore the historically varying senses in which such an argument has been made and the historical circumstances that have shaped its rise to popularity. Vannevar Bush was one of the leaders of America’s scientific mobilization in the Second World War and his Science-– The Endless Frontier became a manifesto for State support of pure science on the grounds of its ultimate utility. Stokes’s book is a good introduction to the conceptual status and historical development of **the Linear Argument**.

Required readings:

Vannevar Bush, Science-- The Endless Frontier: A Report to the President on a Program for Postwar Scientific Research, National Science Foundation 40th Anniversary Edition (Washington, DC: National Science Foundation, 1990; orig. publ. 1945), pp. 1-40.

Donald E. Stokes, Pasteur’s Quadrant: Basic Science and Technological Innovation (Washington, DC: Brookings Institution Press, 1997), pp. 1-89.

16 March: Science and Industry: A Conflict of Values?

By the middle of the twentieth century, the links between science and business had grabbed the attention of American social scientists, concerned to describe the institutional conditions for producing scientific knowledge deserving of the name. Here, the leading commentator was the Harvard-trained sociologist Robert K. Merton, whose influential account of the unique and powerful scientific “norms” made the place of science within commercial structures deeply problematic. Some of Merton’s followers pursued the place of science in industry as a significant **problem**. Scientists in industry, it was said, were subject to “role conflict,” as the scientific norms into which they were socialized were incompatible with industrial structures and needs. It is remarkable how central the problem of science in industry was to the agenda of mid-century and Cold War sociology of science and of organizations. Excerpts from Kornhauser and Shepard illustrate the perception science-in-industry as a problem, while sociologists Barnes and Kaplan represent marginal voices skeptical of accounts of science and its supposed norms that informed the very idea of a necessary conflict between science and industry.

Required readings:

Robert K. Merton, “The Normative Structure of Science,” in idem, The Sociology of Science: Theoretical and Empirical Investigations, ed. Norman W. Storer (Chicago: University of Chicago Press, 1973; art. orig. publ. 1942), pp. 267-278

William Kornhauser, “Professional Controls in Industry,” in idem, Scientists in Industry: Conflict and Accommodation (Berkeley: University of California Press, 1963), pp. 43-82.

Herbert A. Shepard, “Nine Dilemmas in Industrial Research,” Administrative Science Quarterly 1 (1956): 295-309.

Barry Barnes, “Making Out in Industrial Research,” Science Studies 1 (1971): 157-175.

Norman Kaplan, “Organization: Will It Choke or Promote the Growth of Science?” in The Management of Scientists, ed. Karl Hill (Boston: Beacon Press, 1971), pp. 103-127.

23 March: Spring Recess: No Class

30 March: Scientists in Industry: Cold War and Organization Men

The tension between individuality and conformity was one of the leading themes of American culture in the post-War period, and, especially, in the 1950s. Conformity might be critically associated with the leveling sameness of Main Street or of Levittown, or celebrated in the name of American **community**. And individuality might be critically linked to the “cosmopolitan’s” rejection of authentically “American values,” or celebrated as the birth-right of democratic citizens and a bulwark against the dead hand of Communist control. These tensions were also expressed in commentary on the nature of social solidarity and of valued innovation in American industry. Was science an essentially individual activity, and, if it was, was corporate culture, by seeking to organize and control it, killing the Goose that Laid the Golden Egg? William Whyte, who for many years had been a journalist for Fortune magazine, wrote one of the iconic texts of 1950s America, Organization Man, central chapters of which vigorously defend scientific individuality against the conformist tendencies of American business. Whyte may well have had a hand in the 1948 Fortune survey of American scientists, and the celebrated management thinker Peter Drucker wrote two pieces for the Harvard Business Review, separated by about a decade, in which he addressed the proper nature of control that commercial organizations ought to exercise over their professional employees, including scientists.

Required readings:

William H. Whyte, Jr., The Organization Man (Garden City, NY: Doubleday Anchor, 1956), pp. 3-14, 205-230.

Fortune Editorial Staff, "The Scientists," Fortune 38, no. 4 (October 1948): 106-112, 166, 168, 170, 173-174, 176.

Peter F. Drucker, "Management and the Professional Employee," Harvard Business Review 30, no. 3 (May-June 1952): 84-90.

Peter F. Drucker, "Twelve Fables of Research Management," Harvard Business Review 41, no. 1 (January-February 1963): 103-114.

6 April: Academic Science, Intellectual Property, and Business

Observers of academic and industrial science commonly recognize that the translation of new ideas into technological artifacts is mediated by institutions. Well before the Bayh-Dole Act of 1980 allowed universities to patent the results of federally funded research, universities and businesses entered into intellectual property agreements and worked together to bring new products to the market. For more than a century, this practice has sparked controversy, as questions about university patents have been drawn into broader debates about the role of the university and of academic science. This week we examine some early instances of university patents, as well as the current state of university-industry relations. At the same time, we will reflect on how these activities are-– and were-– interpreted by both critics and advocates. What kinds of problems do university patents solve and what problems do they create? How have commentators reconciled the university's economic necessities with its purported institutional ideals? Is it right to say that an interest in intellectual property is fundamentally changing the character of the university? Historian Rima Apple examines an early instance academic entrepreneurialism, and illustrates the promise and pitfalls of university patents at the beginning of the century. Metlay considers the way that conceptions and criticisms of university patents changed-– or did not-– between the beginning and the end of the twentieth century. And Daniel Greenberg, long-time observer of the politics of science funding, provides a textured account of current relations between universities and industry.

Required readings:

Rima D. Apple, “Patenting University Research: Henry Steenbock and the Wisconsin Alumni Research Foundation,” Isis 80 (1989): 375-394.

Grischa Metlay, “Reconsidering Renormalization: Stability and Change in 20th-Century Views on University Patents,” Social Studies of Science 36 (2006): 565-597.

Daniel S. Greenberg, Science for Sale: The Perils, Rewards, and Delusions of Campus Capitalism (Chicago: University of Chicago Press, 2007), pp. 11-99.

13 April: Science and Venture Capital

Scientists and engineers have visions of what their ideas of technologies may achieve, but they need financial resources to turn dreams into commercial realities. Entrepreneurial science is risky, and in the latter part of the twentieth century new forms of private finance-– known as Venture Capital-- emerged to cater for the particular sort of risk-environment confronted by emerging high-tech and biotech companies and to exploit the commercial opportunities that made exposure to high risk potentially very profitable. Etzkowitz gives a straightforward account of the historical emergence of venture capital in the MIT-Boston context; Mark Jones’s excellent Ph.D. thesis on the San Diego biotech industry has much worthwhile material on the interactions between biomedical entrepreneurs and venture capital, and the other sources here are windows onto concrete processes by which scientists and engineers seek to convince venture capitalists to invest.

Required readings:

Henry Etzkowitz, “The Invention of the Venture Capital Firm: American Research and Development (ARD),” in idem, MIT and the

Rise of Entrepreneurial Science (London: Routledge, 2002), pp. 89-101.

Mark Peter Jones. "Biotech's Perfect Climate: The Hybritech Story," Ph.D. thesis, University of California, San Diego, 2005, pp. 399-434.
Garage Technology Ventures, "Perfecting Your Pitch": http://www.garage.com/files/PerfectingYourPitch.pdf

Garage Technology Ventures, "Writing a Compelling Executive Summary": http://www.garage.com/files/Writing_Execsum.pdf

Mt Xia Technology Consulting Group, "Venture Capital Presentation Template": http://www.mtxia.com/css/Downloads/Documentation/vctemplate/vctemplate1.shtml

20 April: The Life of Entrepreneurial Bioscience

It was not until fairly recent times that the biological sciences-– with the exception of natural history-– were thought to have significant commercial potential: the first major biotech company-– Genentech–- was founded, with venture capital backing, in 1976. Before that, it was chemistry and physics that were considered to have a strong potential relationship with industry. Yet with the rise of biotech, and the promise of block-buster drug discovery, there emerged a new style of scientific life, new institutional configurations for doing science in industry, and between academia and industry, and new agendas and circumstances for biomedical research. Paul Rabinow is an anthropologist at Berkeley who has become a major figure in describing and interpreting the world of entrepreneurial biotech. Making PCR is about the discovery and commercialization of one of the indispensable tools of contemporary biomedical research-– the polymerase chain reaction. It is a gripping ethnographic story, full of vivid personalities, and aiming to convey something of the texture of science in entrepreneurial biotech.
Required reading:

Paul Rabinow, Making PCR: A Story of Biotechnology (Chicago: University of Chicago Press, 1996).

27 April: Is Commerce Corrupting Science?

For many people, the mere mention of science-industry relationships summons up the **problem** of “bias” and “corruption.” We started the course talking about deep cultural roots of the idea of conflict between science and business and we wind up by addressing how these relationships are thought of today. On the one hand, many of our contemporary academic structures strongly encourage ever more extensive links between university science and business; on the other, newspapers and digital media sound ever louder alarms over the alleged dangers of those links-– compromised objectivity, conflict with the Idea of a University, the abuse of graduate students and putting patients in university health facilities at risk. This is an area where Those Opposed dominate the public prints, so we will read some selections from influential critics (Krimsky, Healy, and Angell), but we will also pay attention to the forces and sentiments propelling science into closer ties with industry. Stossel’s piece is one of the very few celebrations of academic-industrial ties to appear in a major medical journal.

Required readings:

Sheldon Krimsky, Science in the Private Interest: Has the Lure of Profits Corrupted Biomedical Research? (Lanham, MD: Rowman & Littlefield, 2003), pp. 9-55, 73-89.

David Healy, “Conflicting Interests in Toronto: Anatomy of a Controversy at the Interface of Academia and Industry,” Perspectives in Biology and Medicine 45 (2002): 250-263.

Marcia Angell, “Drug Companies & Doctors: A Story of Corruption,” New York Review of Books 56, no. 1 (15 January 2009):
http://www.nybooks.com/articles/22237

Thomas P. Stossel, “Regulating Academic-Industrial Research Relationships-– Solving Problems or Stifling Progress? New England Journal of Medicine 353 (8 September 2005): 1060-1065.