Memory Practices in the Sciences (review)

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necessary to develop new dyes. Firms with many dyes had production and marketing advantages over competitors with few. That the yet ununified German states had no patent laws enabled a competitive industry to arise, initially copying and improving upon Perkin's inventions. The patent law eventually adopted protected processes but not products, enabling the competitive environment in Germany to continue while encouraging the development of research and development into new chemical processes. Murmann would have done well to include more detail on the origins of this novel patent approach, which supported the dominance of the national industry but not individual firms.

Evolutionary theory has gained a foothold in economics by relaxing the unrealistic classical assumption that firms know how to maximize profits. Evolutionary theory's substitution of random behavior for omniscience, which lets markets determine which firms come closer to the ideal, is a valuable modification to a technical theory. Any observer of modern public policy sees how firms attempt (and sometimes succeed) in altering their regulatory and economic environment and how government actions can sometimes drastically alter the structure of firms in an industry. Whether terming these alterations "coevolution" provides any better insight into the mechanisms by which they occur is debatable. In some types of market competition, firm survival is certainly an issue, and the idea of evolutionary pressure is a natural fit, although the extent to which it implies that intelligence and foresight are unimportant in the fortunes of individual firms is unclear. Murmann characterizes all trial and error as evolutionary—including the process by which dye firms created huge numbers of molecules and then winnowed the results to those most promising.

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Memory Practices in the Sciences. By Geoffrey C. Bowker (Cambridge, Mass., MIT Press, 2005) 312 pp. $34.95

Bowker has written an ambitious and intriguing book—in his words, "a reading of the ways in which information technology in all its forms has become imbricated in the nature and production of knowledge over the past two hundred years" (2). However, it is more a work of cultural geography than narrative history, concerned with the way in which time and space are constructed and represented through scientific practice. Bowker calls science "one of very few modern institutions that claim a perfect memory of the past," adding, "This book is about the work that goes into creating this avowedly perfect memory" (4).

Creating this perfect memory necessarily involves developing a social and technical set of operations and infrastructures, which Bowker terms "memory practices" (7). With respect to science, memory practices result in the production and reproduction of what Bowker calls the generalized "archive"—not just a system for storing, naming, standardizing, and classifying data, but an interlocking (and often hidden) set of claims about how the world works, about how to construct and remember facts that support these claims, and about how to use these claims and remembered facts to generate new knowledge. Bowker suggests that every archive is a "jussive" construction about what *can* be said about the world and not just a catalog of neutral facts *about* the world. It is a system designed with a particular worldview in mind, which in turn affects the reproduction (or replacement) of that very worldview.

Bowker develops this thesis by tracing the practices of knowledge production through three eras: "uniformitarian" geology in the 1830s, computer-inspired cybernetics in the 1960s, and database-driven biodiversity research in the present day. But for all of Bowker's attention to temporality, he is not himself writing a history of the disciplines that he investigates; he makes no attempt to arrange or explain chronologically the various claims, projects, funding sources, institution-building efforts, reproductive structures, critical challenges, or successes and failures within geology, cybernetics, or biodiversity. Rather, Bowker deconstructs claims and texts, looking for the key spatial and temporal metaphors that connect to the new information technologies and practices in each period—statistics and accounting for geology, automation and computerization for cybernetics, and networking and visualization for biodiversity.

This technique works poorly for the first two eras, about which Bowker is often unnecessarily cryptic, literary, and playful—so much so that he may bewilder or alienate readers. Moreover, he often exceeds the limits of what his sources can tell him. For instance, he claims that nineteenth-century geology was mainly "a cosmology inspired by factory production developed in the early nineteenth century in Britain and France" where "disordered human events were being made orderly" (43), and that in the twentieth century, "the problems cyberneticians were tackling (managing large systems necessary to keeping complex systems stable) were problems that were central to the new capitalist order" (76). Besides a longer treatment of historical context and development, along the lines of Stephen Kern's *The Culture of Time and Space: 1880–1918* (New York, 1986), such arguments demand a richer theory of the spatial-temporal connections between culture, capital, and technology, such as in Neil Smith's *Uneven Development: Nature, Capital, and the Production of Space* (New York, 1991).

Bowker's discussion of the development of database technology and its application to biodiversity research, however, is required reading for scholars of both science studies and information studies, and for historians interested in the recent development of "technoscientific" efforts on a global scale. In this context, Bowker's political-economic and disciplinary concerns finally emerge directly; he convincingly argues that "the work of producing these databases is inherently political and philosophical and about our relationship with our past despite their acclaimed practicality in the present." He reminds us that in the virtual world of biodiversity data, "exclusion from databases has drastic consequences" in the material world of funding and attention, since "you can only protect through policy interventions that which can be named, that which can be shown to have been important in the past" (127).

What Bowker really seems to want is for the next generation of science-studies researchers to focus on the "data set" as a unit of analysis—on par with the research paper or the research animal—possessing its own agency over the development of scientific findings and scientific theories. "We need to open a discourse—where there is no effective discourse now—about the varying temporalities, spatialities, and materialities that we might represent in our databases," Bowker writes (184). His book, though not perfect, has achieved this aim well.

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Models: The Third Dimension of Science. Edited by Soraya de Chadarevian and Nick Hopwood (Stanford, Stanford University Press, 2004) 488 pp. $65.00 cloth $24.95 paper

This book concerns three-dimensional (3-D) models produced in the sciences of Europe and North America between the mid-eighteenth and mid-twentieth centuries. Sixteen articles by a distinguished list of museum researchers and historians, philosophers, and sociologists of science examine a stunning variety of models and their uses: wooden ships and extinct monsters rebuilt in bricks and mortar, casts of diseases, displays of stuffed animals and perspex models of a Keynesian economy, monuments in cork and mathematics in plaster, wax embryos and plastic molecules, and many others. Although all of these models embodied and displayed knowledge, their manner of doing so varied enormously over time and circumstance. The term "model" persisted throughout the period covered in this volume, but its meaning evolved greatly.

Recent studies of representation in scientific practice have shown how scientific tools and instruments and the engravings, traces, and printouts that they produce are fundamental to the scientists' tasks of convincing colleagues, training students, and winning public support. Yet these studies have been almost entirely concerned with the two-dimensional (2-D) flat surface, and have neglected 3-D. This volume restores models to their rightful place among the basic materials of knowledge production. Several essays emphasize the varieties of structural details that could not be conceived any other way. Hopwood shows, for example, how late nineteenth-century wax embryological models, which could be seen from all sides and even "dissected" with hot wires, were more important than printed works, since they made