A second chapter that I found quite engaging was Steven Shapin's "Who Is an Industrial Scientist?" Shapin juxtaposes the mid-twentieth-century culture and practice of industrial science as portrayed by academic sociologists and industrial research managers. He shows convincingly that the normative strains which authors like Robert Merton and William Kornhauser saw as central facts of life for industrial scientists were almost certainly not the essence of industrial research. Instead, companies recognized the need to allow scientists space to do their exploratory work, and scientists understood that the companies for which they worked were driven by the need to show a profit. Shapin concludes his analysis by speculating that the scientizing professionalization project in which mid-twentieth-century sociologists were engaged very probably played a crucial role in their failure to come to an understanding of industrial science.

Surrounding these pieces by Edgerton, Hounshell, and Shapin are a host of interesting essays. Among them is Thomas Misa's discussion of the value of large, sweeping approaches to the history of science and technology and the necessity of collaboration to carry off such work. In addition, Jeff Hughes contributes a discussion of the possible public roles of historians, and there are several more focused historical studies such as Angela Creager's into the development of radioisotopes as research tools.

There is a lot of ground covered in the more than 400 pages of this volume, and I suspect that any reader of *Technology and Culture* will find something useful here.

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Models: The Third Dimension of Science.

Edited by Soraya de Chadarevian and Nick Hopwood. Stanford, Calif.: Stanford University Press, 2004. Pp. xvi+464. $70/$25.95.

When confronted with a virtual 3-D molecular model on a computer screen in 1965, one crystallographer objected that "he had to have his hands on something physical, so that he could understand it" (p. 418). Luddite or not, this reaction takes us to the heart of this collection's focus on three-dimensional models in science. Its introduction, thirteen essays, and two commentaries chart elements of the history of 3-D models in science, both their production and use, assessing their impact on how scientific practice, display, and consumption have developed since the eighteenth century. Though the essays vary in quality, the total package is worth the purchase

price. This is true not only because a few of the essays are masterful, especially those by Simon Schaffer, Christoph Meinel, Mary Morgan, and Marcel Boumans. The book also bears an important message, which James Griesemer lucidly discusses in his commentary. It underscores how much we miss by thinking of science as theoretical knowledge and various forms of inscription. The very physicality of 3-D models pushes us to recognize science as a sensibly tangible enterprise, a confluence of processes that take place in real space and time as well as in the mind.

Contributors to this book focus on their own areas of expertise to help flesh out the rich historical presence of 3-D models in a wide range of scientific fields. Three can be said to focus explicitly on topics of interest to historians of technology: Malcolm Baker discusses eighteenth-century models of inventions, Simon Schaffer analyzes ship models, and Eric Francoeur and Jérôme Segal look at the rise of interactive computer graphics. But all the essays have something to do with the techniques that go into constructing physical models, with models as technical artifacts and the way in which their presence mediates between production, deployment, and consumption. Further, they help us consider how we learn to construct things and interpret their active presence once they are in use. Additionally, a number of essays explore the relations between specific models and the culture in which they were produced and consumed. These are important issues for historians of technology.

The palpable presence of 3-D models requires us to define science as practice; theorizing is, then, a form of practice integrated within a larger, practical web. Based on the collective wisdom of the essayists, we can construct a taxonomy of scientific practice that includes (at least) the practices of making, displaying, representing, researching, teaching, and experiencing. The first category requires us to consider the role and heritage of artisanal knowledge and skill, which brings with it a complex history of relationships between producers and those who assert authority over their work. Displaying implicates aesthetics and didactics, but also the complex ways in which social relations and hierarchies are worked out, especially in the historical context of establishing borders around claims of serious science and popularization.

A model can be an original object to be copied or modified. It can also represent something else in any number of ways. It can be larger or smaller (which can bring physical problems of scale with it, as in the case of heat-producing models), mechanical, heuristic, dramatic, or analogical. Further, 3-D models can be represented by two-dimensional portrayals. Each of these possibilities brings with it a host of consequences for the employment of skills as well as what is perceived and learned.

Models can be used to further research or to teach. Their physicality and manipulability open up both the researcher and the student to a more sensate form of cognition. The act of manipulating (the parts of) an object

allows for a kind of physical analogizing that brings connections to the fore which might otherwise go undetected. It can engage a number of senses simultaneously and allows for the comparison of various visual perspectives. When used pedagogically, 3-D models not only enable students to develop the skills of manipulation and tactile interpretation, they bring along lessons about how one ought to think about nature. Is nature a puzzle to be solved, a dramatic or sublime scene worthy of our awe, open to our exploitation, or a mystery that is fathomable only to the elite few? And for those on the receiving end of such lessons, do models invite insight, credulity, entertainment, or passivity?

Once constructed, models can travel across space and through time. Their meanings, consequently, are liable to change—a point that requires us to historicize scientific practice, to see it as something whose meaning and significance is tied to the context in which it is situated. The essays in this book do an admirable job of illustrating this point. The best of them reveal just how the models they investigate mediate between scientific content and context, linking scientific practice to the broader field of sociocultural practice in which it takes place.

LISSA ROBERTS

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The Tale of the Scale: An Odyssey of Invention.

By Solly Angel. New York: Oxford University Press, 2004. Pp. 304. $28.

For any student of innovation processes, Solly Angel's highly readable odyssey—*The Tale of the Scale*—is a worthy case study. There is something genuinely Homeric about the tale, with all of the recurrent symbolic elements of myth playing out yet again. Man has an idea—a vision, really—of a svelte, inch-thick scale for weighing one's self, is gripped by said idea, and tirelessly pursues its development through thick and thin and characters of all shades in pursuit of the proverbial golden fleece. Although Angel succeeds in prototyping the product, he fails in efforts to bring it to market. Like Homer, he ultimately returns home, wiser, and of course with a wonderful story.

I found *The Tale of the Scale* all the more intriguing because I have long been an admirer of Angel's previous work with architect Christopher Alexander in developing the remarkable Pattern Language series of books on the built environment. Among many concepts, "pattern language" underscores the importance of context for the success of the details, that there is