

innovator in his studies of weather prediction, offering a critical approach to the Norwegian school of meteorology. Karl von Frisch (an Exner via his mother) also performed in Brunnwinkl many of the experiments on honeybee communication that would earn him a share of the 1973 Nobel Prize in Physiology or Medicine. Towards the end, Coen's account loses some of its traction – von Frisch's account is not best characterized as statistical (indeed, this would prove one of the stumbling blocks in his later debate with Adrian Wenner), and his work under National Socialism deserves more nuanced consideration. But these issues are somewhat peripheral to Coen's concerns.

At its core, her book offers a compelling critique of Carl Schorske's still-influential *Fin-de-Siècle Vienna: Politics and Culture* (New York, 1980). Liberals, Coen shows, did not retreat into the private sphere as an escape from public life. Instead, the Exners' semi-private summer colony offered a space in which to hone the skills and dispositions that were best suited to their public lives. She urges us 'to rethink the linked dichotomies at the heart of Schorske's thesis between reason and uncertainty, publicity and privacy' (p. 3).

At times, the explanatory burden placed on this family seems great indeed, and one wishes that liberalism itself had been nudged a bit more into the role of *explanandum*. But overall, the book is an eloquent testament to the gains that can be made when a skilful historian treats interdisciplinarity not just as a methodological tool, but as an object of study in its own right. As such, Coen's study of the Exners achieves a truly cross-disciplinary reach. Her account is impressively erudite, ambitious and elegantly executed, and should be of enduring consequence to historians of science, family and gender, pedagogy and modern Europe.

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ANGELA N. H. CREAGER, ELIZABETH LUNBECK and M. NORTON WISE (eds.), **Science without Laws: Model Systems, Cases, Exemplary Narratives**. Durham, NC and London: Duke University Press, 2007. ISBN 978-0-8223-4068-3. £12.99 (paperback).

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*Science without Laws* developed out of a workshop in Princeton on model systems, from 1999 to 2001. The book was worth the wait, as it offers an interesting and eclectic set of essays. Baboons, pancake batter, even the Bible serve as exemplars in the non-lawful sciences discussed here – sciences, that is, which strive for generality but lack universal laws. The eleven essays, arranged into three sections – 'Biology', 'Simulations' and 'Human sciences' – are written by researchers in a variety of fields, but do not require expertise in any of the disciplines. The workshop organizers defined 'model' as 'an object or process selected for intensive research as an exemplar of a widely observed feature of life' (p. 213). Though models are perhaps more familiar in biology and geology, the section on the human sciences makes the case for the prisoner's dilemma as the *E. coli* of economics, rituals as the 'cultural *Drosophila*' of anthropology, and sexual fantasies as model cases for psychoanalysis.

Simplification of nature is a theme unifying several of these essays: differences in nature and diversity within categories must be limited for models to achieve the degree of generality that scientists strive for. In a brief but provocative paper, Rachel Ankeny argues that model organisms, such as the worm *C. elegans*, are 'idealized entities' that serve as index cases for case-based reasoning (p. 53). Index cases are like medical case descriptions, which require a sacrifice of natural complexity to emphasize similarities between the index case and future cases. In each of the book's sections, the authors show that nature must be simplified for models to achieve any generality. Game theorists assume that people are utility maximizers. Molecular biologists assume that biochemical mechanisms are conserved between species. Anthropologists assume that there is a human nature that we can learn by studying rituals. Sometimes nature is indeed

magnificently simple, as Marcel Weber describes in the case of *Drosophila*. Sometimes we have to push nature towards simplicity – for example, the need to breed genetically homogenous lab mice. In other domains, nature is radically diverse.

Jane Hubbard celebrates model organisms for their scientific utility. Similarly, Weber argues that model organisms are useful for philosophers: scientists' use of models can provide insight into philosophical problems in biology, such as the relationship between the classical gene concept and the molecular gene concept. A valuable addition to the first section of this book would have been a critical paper that illustrated epistemic problems with models in biology.

A rich, fascinating paper by Naomi Oreskes demonstrates a transition in the use of geological models. Nineteenth- and early twentieth-century physical models of geological systems attempted to *describe* causes acting in the past or present. Since the 1960s, political forces initiated a shift in the epistemological ambitions of earth scientists: with the use of computer simulations, *prediction* became a primary goal of geologists. The concomitant meaning of 'model' in geology shifted from a small-scale physical replica of a geological process to computer simulations based on abstract mathematical models, though both 'shared the ambition to access the inaccessible' (p. 94). Mary Morgan suggests that the prisoner's dilemma – a classic game used in game theory – is another example of models as simulations. Game theory became a pervasive tool, again in the 1960s, for studying economies and conflict between superpowers. The prisoner's dilemma led to trouble for two key assumptions of economists – that humans are self-interested utility maximizers and that the invisible hand of markets produces maximally good solutions – because when individuals act rationally in the prisoner's dilemma, they are led to a mutually worse outcome than if they had collaborated. Such trouble meant that the role of the prisoner's dilemma for economists shifted from strict simulations to narratives.

John Forrester playfully argues that a psychoanalytic case history is a script that serves as a model for psychoanalysis. Forrester describes an example script: a Hollywood actress neglects her daughter ('Belle') in favour of acting (and sex with famous men); Belle later sees a psychoanalyst interested in theories of sexuality, and their interaction reads like a script; Belle's daydreams, of rape and voyeurism, constitute a script that she plays for the analyst; the analyst develops a theory of scripts. The layers of self-reflexivity in Forrester's paper are pronounced. His description of the analyst's voyeuristic case history of Belle's voyeuristic dreams is itself an act of voyeurism: we read of sexual fetishes, long quotes describing Belle's sadomasochistic daydreams, and erotic descriptions of Belle (she is 'dressed deliciously', 'edible' and 'ripe'). The editors of this book suggest that the examination of models in diverse disciplines can provide a fresh way to consider the relationship between the natural sciences and the social and human sciences. Popperian demarcation might be passé, but it is difficult to read Forrester's essay on this leading psychoanalyst and not wonder how psychoanalysis could possibly achieve any degree of generality.

Much political theory relies on thought experiments; Josiah Ober suggests that such thought experiments 'typically tend toward either the bland or the bizarre' (p. 229). Instead, Ober argues that we should develop contemporary political theory by 'experimenting' with rich historical descriptions; his example is ancient Athenian democracy. One might say the same about historical versus philosophical accounts of science – the tension between normative philosophy of science (based on bland or bizarre thought experiments) and rich descriptive accounts of science is familiar to readers of this journal.

The late Clifford Geertz, in an anthropological study of anthropologists, suggests that rituals are models, or 'cultural *Drosophila*', for the description and comparison of human groups. Ceremonial gift giving, rites of passage, elaborate funerals and feasts, magic and melodrama – though anthropologists have approached their diverse subjects with various frameworks (functionalism, structuralism, hermeneutics), the study and description of rituals has become an

'exemplary narrative'. Geertz notes that models are self-vindicating: 'the more a model is studied, and the more perspectives from which it is understood, the more it becomes a model system' (p. 214).

The book ends with a thoughtful synthesis by Mary Morgan, reflecting on the relationships between the collected essays. Consciously self-reflexive, these essays are model studies of model studies and exemplary narratives of exemplary narratives. The book itself is an exemplary collection of model essays for historians and philosophers interested in model systems, and will be an engaging read for anyone interested in the vicissitudes of practices and reasoning strategies in sciences without laws.

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DAVID EDGERTON, *Warfare State: Britain, 1920–1970*. Cambridge: Cambridge University Press, 2005. Pp. xv + 364. ISBN 0-521-67231-7. £45.00, \$75.00 (paperback).  
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In this book, the culmination of many years' work, David Edgerton sets out to write a new history of the British state, one that 'does not rest on existing historiography' (p. 8), but one that requires a massive revision of our current 'accounts of British science, technology, industry and warfare'. This new history will afford us, we are told, an insight into modern Britain that, he says, historians of both right and left have overlooked or misread. The emphasis given by historians to the emergence of the 'welfare state' has, he believes, contributed to an image of Britain in 'decline' during most of the twentieth century (and perhaps since). However, this image overlooks the emergence of a British 'warfare state', 'long before the Second World War'; one that was by no means 'a late, reluctant respondent to a new scientific revolution' (p. 13). Turning received wisdom on its head, Edgerton argues that the way Britain has dealt with science and the military has become a central feature of British national life. The ensuing text pursues the argument with a revisionist analysis of the history of military, industrial and academic research; investment in innovation; and economic growth (p. 14).

All this is a tall order, and the broader implications of Edgerton's thesis lie beyond the scope of a short review. But between the lines of his complex narrative, there seems both more and less than meets the eye. Few would deny that science and technology have always been central to the exercise of power – a theme familiar to Western readers since Homer sang of Minerva's role at the siege of Troy – or that Britain, as the first industrializing nation, inevitably called upon the applied sciences to produce the means of modern warfare. Whilst some historians may have promoted the wishful, if well-intentioned, view that 'the sciences were never at war', these are the exception. What is debatable, perhaps, is the question of relative speed, discipline and direction, and whether and when Britain enjoyed a comparative advantage. But the fact itself is not in dispute. On at least one level, therefore, Edgerton may be knocking on an open door. In which case, he offers not so much an 'alternative' account, as a telling reminder of a relationship that many Britons would prefer to overlook, and some, to do without.

Such reflections meet the beginning of the book, but more follows, as in eight chapters Edgerton charts the history of the military–industrial complex in the interwar and postwar years, and introduces the 'new men' who came to exemplify its leadership in Britain. In passing, he delivers a powerful critique of the mythical 'white hot' revolution of Wilson's Labour government, and untangles the vexed history of defence technology spending through the 1970s. At times, however, a contrarian approach seems to get the better of the argument. It is, for example, one thing to say that Britain is an interventionist state, led by (defence) supply departments (p. 296); indeed, it would be a brave historian who would deny the importance of defence spending to the wider economy. But it is quite another thing to criticize economists for emphasizing the positive role