My favourite chapter came in the section on science and society, and focuses on *The Invisible Man*. McClean persuasively presents the novel as a study in the role of a scientific education and ways of knowing – a refreshing change from its protagonist's usual pairing with that degenerationist bogeyman Mr Hyde. Instead attention is given to the villagers' inability to comprehend the strange phenomena on their doorstep connected with the arrival of the bandaged Griffin. In McClean's reading, their failure to practise basic observational skills is used by Wells to highlight the need for a scientific education such as had been presented in Huxley's 'Science and culture' (1880) or in Karl Pearson's *Grammar of Science* (1892). I could not help but wonder if the analysis might have been made more complex by a reading of the novel alongside Wells's short story 'The country of the blind', in which observation turns out to be a distinctly un-useful skill. Contrary to the saying ('in the country of the blind, the one-eyed man is king'), even a two-eyed man turns out to be at the mercy of his sightless peers. Their world is entirely self-consistent and actually easier to navigate without sight: a question mark, perhaps, over the automatic ascendancy of scientifically enlightened cultures.

A chapter on *War of the Worlds* returns (frustratingly, without intertextual comparison) to the evolution-and-ethics debate of *The Time Machine*. McClean reads *War* as an intervention in the debate between Huxley and Spencer about whether individualism or cooperation was more necessary for (human) evolution. McClean's conclusion, that Wells rejected Spencer's individualism in favour of Huxley's cooperation, is given an unnerving edge in many other of Wells's stories, where cooperative biological groups (for example, the ants in 'Empire of the ants') exploit their superorganismic status to trounce humanity.

The division of scientific labour in society – a topic related to the scientific education of *The Invisible Man* – is revisited in McClean's analysis of *First Men in the Moon*. The author astutely characterizes this novel as a 'perverse articulation' (p. 147) of Wells's then-current thinking on the scientific ordering of society. This hints at one of the central problems of Wellsian scholarship, namely knowing whether or not to take him seriously. Near-identical social set-ups are apparently the objects of satire and then endorsement in *First Men* and *Anticipations* respectively.

In the book's final chapter, McClean has to grapple with Wells's infamous and incendiary eugenic statements. He does so calmly, treating them in the helpful contexts of contemporary debates on social well-being and Wells's personal reading of J. S. Mill. In his coverage of this and other intellectual debates, McClean occasionally slips towards what Quentin Skinner has called the 'mythology of coherence', attempting to find a perspective from which Wells's views may be demonstrated to have been consistent. Yet this perspective does not necessarily exist, and McClean's own interpretative framework of 'perverse articulation' could have been followed through more fully to useful effect in exiting this trap. Despite his latter-day reputation for didacticism, the distinctive quality of Wells's writing was that he was able to articulate a dynamic process of wrestling with the multiple implications of science, both the desirable and the rebarbative. Neither for his readers, nor even perhaps for himself, was there a clear and self-consistent set of answers. For this reason Wells remains a vital and engaging figure for historians of science, and one that can never be reduced to a literary articulation of scientific positions.

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Deborah Coen, **Vienna in the Age of Uncertainty: Science, Liberalism, and Private Life**. Chicago and London: University of Chicago Press, 2007. Pp. xi + 380. ISBN 978-0-226-11172-8. $45.00, £28.50 (hardback).
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Deborah Coen's excellent *Vienna in the Age of Uncertainty* invites us to view *fin de siècle* Vienna through the lens of the Exners, one of the city's most illustrious families. From the early

nineteenth century to the Second World War, three generations of Exners serve as well-chosen guides to this heady time and place. Members of the family rose to prominence in physics, physiology, meteorology, avant-garde art, law and medicine, boasting no fewer than ten university professors as well as a Nobel laureate.

Coen moves adroitly over demanding and varied intellectual terrain to reveal an approach to the world that was specifically tailored to the politics and cultural constellation of Habsburg Austria. During the growing unrest in the Austro-Hungarian Empire of the 1840s, the philosopher and patriarch Franz Exner left his university position in Prague for Vienna to help establish guidelines for educational reform. One of the lasting post-1848 legacies of Exner and his liberal colleagues was the introduction of instruction in probabilistic reasoning into the empire's secondary curriculum. They aimed to instruct future citizens to realize their freedoms while arming them against the forces that were seen to threaten liberalism and the stability of a vast and heterogeneous empire (including clerical dogmatism, splintering nationalism and Hegelian determinism). Exner and his wife Charlotte died young, but their five children and grandchildren would flourish.

Coen meticulously traces the works of the four gifted brothers Adolf (jurist), Karl (physicist), Sigmund (physiologist) and Franz Seraphin (physicist) and their sister Marie, who married a physician and became an important figure in the intellectual and social circles of the Exner clan. Coen shows how probabilistic reasoning blossomed toward the turn of the century into a significant moral and intellectual resource for an embattled *Bildungsbürgertum*. By quantifying uncertainty, she argues, liberals sought to avoid the spectres of left-wing anarchy and right-wing clericalism that beset Austrian politics and culture for the remainder of the nineteenth century and beyond.

Coen's study does not rest content in the universities and salons of the metropolis, but follows the Exners to their summer colony, Brunnwinkl in lower Austria. Founded in the 1880s, this idyllic setting played host to rich cultural, intellectual, familial and professional interactions. The Exners counted among their students, teachers, friends and colleagues Hermann von Helmholtz, Ernst Mach, Ludwig Boltzmann, Sigmund Freud, Erwin Schrödinger and the writers Gottfried Keller and Marie Ebner von Eschenbach. Some of Coen's most interesting research shows how the lives of the Exners during the *Sommerfrische* informed their activities in the laboratory, courthouse and lecture hall. Sigmund Exner applied a statistical approach to cerebral localization and self-consciously fashioned his scientific persona as naturalist–hunter after his encounters with nature in Brunnwinkl. Seraphin and his student Erwin Schrödinger monitored 'the respiration, the variable pulse, of the earth itself' (p. 260) by measuring the electrical potential of the air at various altitudes. According to Coen, these open-air measurements – as opposed to those of the ideally (but never perfectly) isolated laboratory of the city – would dispose Viennese physicists to view fluctuations in nature, such as Brownian motion, not as disturbances or experimental artefacts to be explained away but as significant phenomena in their own right. A non-deterministic but nonetheless objective physics was to provide a viable alternative to Max Planck's determinist physics. Contra Paul Forman's account of acausal Weimar physics ('Weimar culture, causality, and quantum theory, 1918–1927', *Historical Studies in the Physical Sciences* (1971), **3**, 1–116), Coen urges that Franz Seraphin and his students' probabilistic approach was not a capitulation to hostile forces: 'Those who renounced the goal of certainty did so not in rejection of Enlightenment values but in defense of them. They "tamed" uncertainty by quantifying it' (p. 13). While the work of Michael Stöltzner and others has helped historians of science to appreciate the special nature of Viennese science as a countervoice to German physics, Coen's book enriches our understanding of the cultural and political dimensions of this development.

In the third generation, Felix Exner's studies of water movement in the adjoining Wolfgangsee informed his later work on Brownian motion and statistical meteorology. Felix would become an

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