

The prime minister, his key science adviser, and the partnership that wasn't

Churchill's Bomb How the United States Overtook Britain in the First Nuclear Arms Race

Graham Farmelo
Basic Books, 2013. \$29.99 (554 pp.).
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Reviewed by Benjamin Wilson

In October of 1941, US president Franklin Roosevelt sent British prime minister Winston Churchill a vague proposal that the two countries' nuclear efforts "may be coordinated or even jointly conducted." Churchill waited almost two months to send his noncommittal reply. Britain would swiftly become a junior partner to the US in their joint wartime development of nuclear weapons. After the war, Britain was fated to take its own lonely road to the bomb.



Why didn't Britain join the Americans on more equal terms in pursuit of the first atomic weapons? That's the central question posed by Graham Farmelo, author of *Churchill's Bomb: How the United States Overtook Britain in the First Nuclear Arms Race*. Britain boasted some of the world's finest nuclear scientists; Britain set up the first nuclear advisory body—the MAUD (Military Application of Uranium Detonation) Committee—whose blockbuster report sparked the American effort; and Britain's own "Tube Alloys" nuclear program started months before the Manhattan Project.

In this entertaining book, Farmelo finds his answer in Churchill, especially in the man's approach to science advice. Farmelo is the author of the terrific biography, *The Strangest Man: The Hidden Life of Paul Dirac, Mystic of the Atom* (Basic Books, 2009); in *Churchill's Bomb*, he showcases his gifts as a writer and

portraitist, sensitive to the human side of technical subject matter. He builds on British historian Margaret Gowing's classic works on the subject, including *Britain and Atomic Energy* (Macmillan, 1964) and subsequent volumes. But Farmelo's style is more personal, his gaze trained on Churchill and his scientists.

The Quebec Agreement Churchill signed with Roosevelt in 1943—and brandished in later years as evidence of his nuclear forwardness—was an action too little too late, as Farmelo sees it. The Manhattan Project was already miles ahead of Tube Alloys. And after the war, the US government's McMahon Act of 1946, which forbade the sharing of American nuclear information with foreigners, dashed any lingering hope of further cross-Atlantic nuclear collaboration.

Farmelo pins substantial blame for Churchill's blunder on his narrow use of technical advising. On scientific and technological matters, one man had his ear: physicist Frederick Lindemann, known in establishment circles as "the Prof." Starting in the 1920s, Lindemann had summarized developments in modern science for Churchill. In 1931 he drafted a summary that contemplated the prospects of nuclear energy. The Prof had studied among the best physicists in Berlin, including Albert Einstein, before World War I. By the time of his appointment to the University of Oxford in 1919, he was "an admired experimentalist and theoretician," working on low-temperature physics and astrophysics.

Apparently, by the early 1930s, Lindemann was a hack whose best scientific work was long behind him, as evidenced by his garbling of the new quantum theory in a 1932 book. His personal traits were even less commendable. He was petty and vain, an aristocratic hanger-on, and a snob. In some ways *Churchill's Bomb* calls to mind C. P. Snow's take on Lindemann in *Science and Government* (Harvard University Press, 1961), which tells of the Prof's tempestuous rivalry with the respected military research administrator Henry Tizard. Snow called Lindemann "un-English" and "reactionary." Farmelo judges him "not a deep or imaginative thinker and certainly not an expert in nuclear science."

Some readers of *Churchill's Bomb* might be more reluctant than Farmelo to conclude that Roosevelt's overture to Churchill in 1941 really amounted to a proposal "that they embark on an equal-harness collaboration to develop the Bomb." Those readers may also be skeptical that the collaboration would have lasted long in the emerging Cold War—especially after British theoretical physicist Klaus Fuchs was unmasked as a Soviet spy in 1950. And even supposing that Churchill had capitalized on Britain's early nuclear advantage, it is still hard to imagine the postwar US-British nuclear relationship taking a radically different course. The curtain of American nuclear secrecy was bound to drop sooner or later.

The real strength of *Churchill's Bomb* rests with its lively sketches of British nuclear scientists and their world. Farmelo expertly draws their personalities and relationships, and their struggles with the Whitehall bureaucracy. We get a feel for, among others, James Chadwick, whose work on the bomb drove him to a steady diet of sleeping pills, and William Penney, an expert calculator of blast effects who went on to direct British bomb design at a new facility in Aldermaston and whom Farmelo memorably dubs "a curator of nuclear carnage."

Churchill's scientists eventually gave him the bomb, but not until 1952, during his second term. Soon after, Churchill was horrified to learn of the obscene power of thermonuclear weapons; he remarked in one of his final speeches to the House of Commons in 1955 that now the only possible policy was "defence through deterrence." The nuclear revolution had become real for him as he exited the political stage.

Introduction to Computational Materials Science Fundamentals to Applications

Richard LeSar
Cambridge U. Press, 2013. \$95.00
(414 pp.). ISBN 978-0-521-84587-8

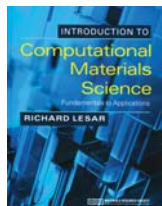
Investigating the properties of solid-state matter with computational ap-

proaches is an established practice that has received contributions from such fields as condensed-matter physics, physical chemistry, and engineering. Thanks to those many contributing sources, approaches exist to describe solids across an impressive range of length and time scales—from the quantum realm to the mesoscale and beyond. The field, my own research interest for more than 25 years, has attracted increased attention in the past few years, as evidenced by the US Materials Genome Initiative launched in 2011. Its goal is to design and deploy materials to be used for clean energy and national security, among other things. Crucial to the success of the initiative will be a judicious combination of experimental and computational approaches.

Most of the textbooks devoted to computational materials science focus on a particular computational approach, such as molecular dynamics (MD) simulations or electronic-structure calculations. However, researchers in that maturing field need a more comprehensive view that spans a wide range of approaches and their overlap. That is the path taken in *Introduction to Computational Materials Science: Fundamentals to Applications*. Author Richard LeSar has worked at the forefront of the field at Los Alamos National Laboratory, Ames Laboratory, and Iowa State University. As he explains in the preface, the book is intended as an accessible resource for upper-level undergraduate students and graduate students, and in large part, the book is written at that level. But it also provides an overview that is sure to be valued by practitioners seeking to branch out or wanting a comprehensive review.

The author's introduction of each topic is clear, and the book's overall organization makes it quite readable. For example, it covers specialized topics in concise appendices, both at the end of chapters devoted to related topics and at the end of the book. That construction allows the main narrative to flow well without getting bogged down.

The chapters focus on computational approaches that span length and time scales, from the electronic-structure scale to the atomic scale and mesoscale. Curiously, the finite-element modeling approach is not included. The pedagogical material is up to date and mentions cutting-edge approaches that are sometimes left out of other texts. For instance, the chapter on MD simulations includes accelerated MD, and the



chapter on interatomic potentials includes some that were developed less than 10 years ago. Other usually omitted topics found in this book include cellular automata and phase-field methods.

Along the way, LeSar makes connections between the models and physical concepts—for example, he relates the random-walk model to diffusion coefficients. He also provides physical materials-science-based examples for topics such as coarse-grained MD, mesoscale models, and phase-field

models. Fewer such examples are provided for atomic-scale and electronic-structure methods. That is probably because it is challenging to discuss the mesoscale models in a manner that is divorced from the topics for which they were developed, whereas it is more straightforward to discuss the fundamental physics associated with atomic-scale and electronic-structure methods. And although the book provides many illustrative examples, it contains no problem sets or project assignments.

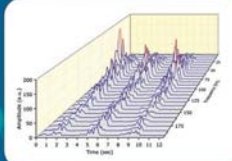
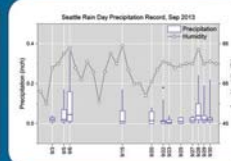
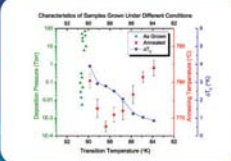
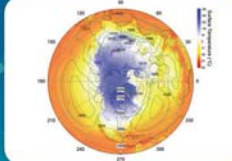
To enable the inclusion of a wide range of topics, LeSar sacrifices depth in

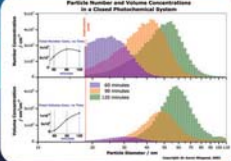
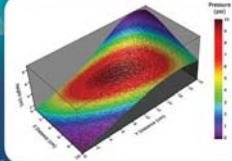
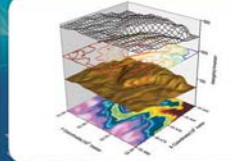
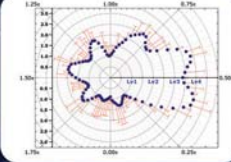
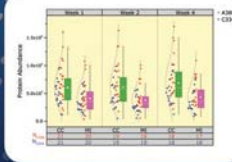
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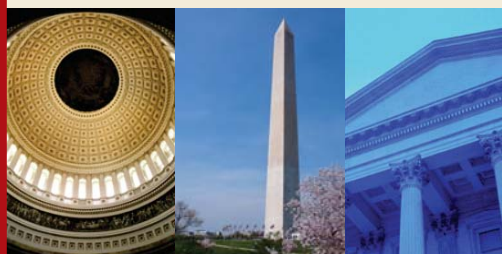
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books

any individual topic, as he acknowledges in his preface. That is acceptable for many courses and is highly desirable for engineering undergraduate students. But graduate students and those seeking to fully understand the associated physics or appreciate the origins of methodological approximations will need to consult other sources.

Some of the material included in the appendices at the back of the book—for example, on units and energy conversions—can be readily found elsewhere. I also question the need for an appendix to introduce readers to materials science: Any readers lacking the basic knowledge summarized too briefly there will most likely struggle with many of the topics covered in the book. In contrast, the appendices that provide overviews of mathematical concepts and classical mechanics will enhance the text for nonexperts.

These criticisms don't appreciably detract from the overall utility of the book. *Introduction to Computational Materials Science* offers one of the more accessible recent overviews of an increasingly popular field. I expect it will become a favorite of many students and instructors.

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Modern Particle Physics

Mark Thomson
Cambridge U. Press, 2013. \$75.00
(554 pp.). ISBN 978-1-107-03426-6

Like researchers preparing a talk and lecturers preparing a course, authors must make difficult choices when writing a textbook: What level should be strived for, what must be included, what can be left out? For the most part, I believe University of Cambridge professor Mark Thomson made excellent choices in his text *Modern Particle Physics*. The book is aimed at upper-level undergraduates or graduate students. It assumes just a basic knowledge of quantum mechanics and special relativity, but it's more advanced than such modern-day classics as David Griffiths's *Introduction to Elementary Particles* (2nd edition, Wiley, 2008) or Francis Halzen and Alan Martin's *Quarks and Leptons: An Introductory Course in Modern Particle Physics* (Wiley, 1984).

