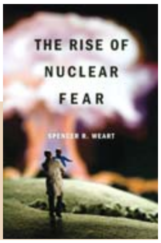
The Rise of Nuclear Fear



Spencer R. Weart
Harvard U. Press,
Cambridge, MA, 2012.
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What comes to mind when you think about the word "nuclear"? Mushroom clouds, fallout, radiation, cooling towers—or something else? Nuclear power and nuclear energy form "one of the most powerful complexes of images ever created outside of religions," writes noted historian of science Spencer Weart in his new book *The Rise of Nuclear Fear*. Weart's latest is an extensively revised version of his 1988 classic *Nuclear Fear: A History of Images* (Harvard University Press).

A lot has changed since then, both in the world and in the book. We have moved from a post-Chernobyl perspective to a post-Fukushima one, and the cold war has been replaced with a much-touted "second nuclear age." Weart's new work bolsters its analysis with citations to recent findings from cognitive psychology to ground its interpretations, but the overall thrust remains similar. On the other hand, the author has sacrificed much of his analysis of global nuclear symbolism—the new book focuses mostly on the US. The result is a more streamlined history accessible to the general reader.

The result is impressive, fusing a bold argument with deep erudition in history, politics, physics, psychology, economics, art, and literature. Belying that enormous range, the former director of the Center for History of Physics at the American Institute of Physics (which publishes PHYSICS TODAY) wears his knowledge lightly. The citations in the book cover only a fraction of the material Weart plumbed to weave this tapestry of the nuclear age. Weart's treatment of fallout, in many ways the central node in his web of nuclear fear, highlights the strengths of his approach. Our associations with fallout fuse specific characteristics of nuclear phenomena: The dust picked up in a nuclear blast and coated with radioactive isotopes is invisible, toxic, potentially omnipresent, and yields to no defense.

As the global reaction to Fukushima demonstrates, those properties of fallout activate certain links on a subconscious level. According to Weart, nuclear fear escalated dramatically with open-air testing, specifically with the 1954 US hydrogen-bomb test on Bikini Atoll—not with the bombings of Hiroshima and Nagasaki. The resulting irradiation of the Japanese fishermen on their vessel, *Lucky Dragon*, became a central episode, and the Ban the Bomb movement morphed into what amounted to a ban-testing movement. The 1963 Limited Test Ban Treaty drove the tests (and thus the fallout) underground and sapped the movement's strength. Weart contends that people with anxieties about nuclear reactors picked up on the same fallout imagery birthed by the weapons; they "sublimated" an anxiety about nuclear war with a phobia of fission reactors.

Weart is candid about his support of nuclear energy—not least to avert catastrophic climate change—and he devotes much of the second half of the book to arguing that Americans' (and others') fear of reactors is irrational on multiple levels. Compared with chemical plants or other forms of energy production, reactors are safer, more tightly regulated, and less damaging to individual health. (Weart attributes 10 000 premature deaths a year to coal smoke.) Yet reactors spawn fear, and symbolism is to blame. Weart writes that citizens worldwide subconsciously associate the tropes from

movies and books about atomic war so that "nuclear reactors were lit by the reflected glare of nuclear weapons: that fear, disgust, and distrust of the industry stemmed in large part from its many intimate associations with the dreaded bombs."

In Weart's history, therefore, the connection between reactors and bombs is purely symbolic. But is the connection between the two, as he suggests, primarily at the level of images? Plutonium for warheads is produced in reactors. The uranium for both warheads and reactors comes from the same mines. Early nuclear engines powered submarines, whose primary task was to carry nuclear missiles. Reactors were promoted by the Atomic Energy Commission and, later, the US Department of Energy, both of which manufactured nuclear weapons. You get the picture. A fully fleshed account of our nuclear past and future should link the political history of nuclear production to Weart's fascinating unfurling of associated nuclear images.

Any future history will have to place Weart's arguments at the center. For example, he demonstrates that the characteristics we have come to associate with all things nuclear were already in place long before the July 1945 Trinity test. The earliest writings on radioactivity from the late 19th century—drawing on symbols that date to Renaissance alchemy and that perhaps are related to the collective unconscious later hypothesized by Carl Jung—invoked tropes of death rays, magical generative energy that could also kill, and utopian cities of the future. *The Rise of Nuclear Fear* is a fresh account of the nuclear age, one in which symbolism is central, and the conventional landmarks—Hiroshima, the Cuban Missile Crisis, the Reykjavik summit—are secondary to images. For Weart, that is what it means to think nuclear.

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Principles of Multiscale Modeling

Weinan E
Cambridge U. Press, New York, 2011. $75.00 (466 pp.).
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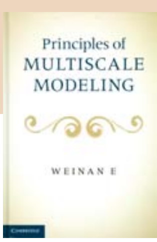

During the past 30 years, researchers have rapidly developed multiscale modeling. Nowadays it is ubiquitous throughout science and engineering, in subjects as varied as epidemiology and materials science. As a sign that the field has reached maturity, many publishers offer at least one journal with "multiscale" in the title.

Physicists familiar with multiscale modeling naturally associate it with the multigrid algorithm for elliptic partial differential equations developed by Achi Brandt and others starting in the late 1970s. However, in *Principles of Multiscale Modeling*, Princeton University professor Weinan E takes an unusually broad view that encompasses everything from Fourier analysis to matched asymptotics, from moving contact lines to the deformation of carbon nanotubes, and from fast multipole methods to domain decomposition.

Written by a leader in modern applied mathematics, *Principles of Multiscale Modeling* is a unified and well-organized synthesis of the physical ideas and mathematical techniques behind the multiscale approach to understanding physical phenomena. Other books on the subject tend to focus on a single aspect. For example, *Multiscale Stochastic Volatility for Equity, Interest Rate, and Credit Derivatives* (Cambridge University Press, 2011), by Jean-Pierre Fouque and coauthors, focuses on specific applications; *Multiscale Methods: Averaging and Homogenization* (Springer, 2008), by Grigorios Pavliotis and Andrew Stuart, centers on mathematical techniques; and *Multiscale Finite Element Methods: Theory and Applications* (Springer, 2009), by Yalchin Efendiev and Thomas Hou, focuses on computational algorithms.

However, *Principles of Multiscale Modeling* reflects its author's breadth of experience and interest in physics, mathematical analysis, and scientific computation. It is ambitious in scope and in its insistence on taking seriously all stages in multiscale modeling, from fundamental physical models to efficient computational algorithms by way of rigorous mathematical analysis. I am not aware of any other work that covers all those topics with equal attention and rigor.

Chapter 1 explains that traditional macroscopic models based on constitutive relations derived using entropy considerations, symmetry, or linearization sometimes fail. In that case one needs a hierarchy of models to properly describe the macroscopic behavior: Coarse-graining a microscopic model is insufficient. The next chapter is a crash course on analytical methods; it's reminiscent of the classic text *Advanced Mathematical Methods for Scientists and Engineers* (Springer, 1978) by Carl Bender and Steven Orszag, but it is supplemented with more recent material on renormalization-group analysis and homogenization. Chapter 3 is a review of what Weinan E calls classical multiscale algorithms—for example, multigrid methods, fast multipole methods, and adaptive mesh refinement. Chapters 4 and 5 derive and analyze a hierarchy of physical models—quantum mechanical and continuum mechanical—and then use that hierarchy to derive particular "multi-physics" models. The next five chapters are each devoted to numerical algorithms for a particular problem: macroscopic behavior, singularities, elliptic equations, multiple time scales, and rare events.

Principles of Multiscale Modeling is really a guide, not a textbook. It is highly compressed and lacks exercises and weblinks to numerical codes. It also assumes a depth of cultural immersion in numerical analysis and physics beyond that of the average graduate student. Indeed, several chapters include the caveat that what is covered is not "an exhaustive treatment" but "we hope to convey the basic ideas."

Although the book is comprehensive, it inevitably has some gaps. It does not mention the adaptive wavelet method as an alternative to adaptive mesh refinement. A brief discussion of that and related methods, along with other applications of multiresolution analysis, would have fit naturally in the chapter 3 section on multiresolution analysis and wavelet bases. I would also have liked to see a discussion of reduced-order models for complex macroscopic physical phenomena such as turbulent solutions of the Navier–Stokes equations.

I do have a quibble with this book. It seems to have been produced cheaply using standard LaTeX macros and fonts; even the cover design is undistinguished. This excellent book merits the same attention to quality found in such Cambridge University Press series as the *Cambridge Texts in Applied Mathematics* and the *Cambridge Monographs on Applied and Computational Mathematics*. I am also surprised that it is not available as an ebook.

Nevertheless, *Principles of Multiscale Modeling* is uniquely suitable for advanced graduate students and researchers who want to survey the