

# How revolutionary was the scientific revolution?

## To Explain the World The Discovery of Modern Science

Steven Weinberg  
Harper/HarperCollins, 2015. \$28.99  
(432 pp.). ISBN 978-0-06-234665-0

## In the Light of Science Our Ancient Quest for Knowledge and the Measure of Modern Physics

Demetris Nicolaides  
Prometheus Books, 2014. \$19.00 *paper*  
(266 pp.). ISBN 978-1-61592-225-3

Reviewed by Joseph D. Martin

Victor Frankenstein, the curious but callow protagonist of Mary Shelley's gothic masterpiece, meets two professors of natural philosophy, Krempe and Waldman, during his fateful stay as a student at the University of Ingolstadt. The two render opposing judgments on the likes of Paracelsus and Cornelius Agrippa, premodern alchemists who had sparked Frankenstein's interest in science. Krempe scolds the youngster: "You have burdened your memory with exploded systems and useless names." Waldman, however, praises the alchemists' enthusiasm and reassures Victor: "The labours of men of genius, however erroneously directed, scarcely ever fail in ultimately turning to the solid advantage of mankind."

That contrast, though crude, captures the difference between the histories presented in the two books under review. In *To Explain the World: The Discovery of Modern Science*, physics Nobel laureate Steven Weinberg contends that the ancients were fundamentally misdirected. He presents the scientific revolution as a sharp discontinuity and argues that the collective accomplishments of Nicolaus Copernicus, Galileo Galilei, Johannes Kepler, Isaac Newton, and other luminaries launched the sequence of scientific discovery that continues to this day. By contrast, physics professor Demetris Nicolaides, with *In*

*the Light of Science: Our Ancient Quest for Knowledge and the Measure of Modern Physics*, identifies the pre-Socratics as the first scientific thinkers. He finds manifold similarities between ancient philosophy and modern physics, both of which he sees as timeless expressions of the human condition.

Both books essentially pose the following question: How should we view premodern efforts to understand nature from the standpoint of modern science? Historians of science, who prefer to judge historical eras by historical standards, would call this "whiggish." Whiggishness consists in imposing current values on the past. It is usually a pejorative designation, but Weinberg embraces the charge with the same zeal he shows in reclaiming "reductionism" from those who would use it as a slur.

Nicolaides, although he does not mount an explicit defense of whiggishness, is also convinced that current scientific knowledge can enrich our interpretations of the past.

In advocating for and deploying a principled whiggishness, Weinberg and Nicolaides are in line with such philosophers of science as Hasok Chang, who, in his book, *Is Water H<sub>2</sub>O? Evidence, Realism, and Pluralism* (Springer, 2012), suggests that dogmatic anti-whiggishness might shut off fruitful lines of inquiry. We historians of science persist in objecting to the approach, but if we grant license on the point, an interesting question emerges: How do Weinberg and Nicolaides, from the same starting point, reach such different conclusions?

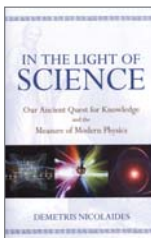
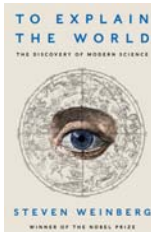
The first half of *To Explain the World* synthesizes ancient Greek physics and astronomy before pivoting to the Middle Ages to show how Greek thought was preserved and extended in the Islamic world and Western Christendom. Weinberg begins distinguishing modern science from its premodern counterpart early. He puzzles over the fact that Aristotle never used observations of ships appearing mast-first over the horizon to argue for Earth's sphericity. He finds irony in Ptolemy's failure to use his investigations of reflection and refraction to magnify astronomical

bodies. Historians will cry anachronism. Observations made at sea have long been distrusted, and with good reason. The ancient understanding of a super-lunar realm governed by heavenly rather than terrestrial order would have made optical magnification of stars and planets unthinkable. That anachronism is Weinberg's very point: The ancients, he claims, did not know how to interrogate nature in the systematic way necessary to wring reliable scientific knowledge from it.

Such know-how would not appear until the scientific revolution, the focus of the second half of Weinberg's book. Wherever one stands on his claims about the distinctness of modern science, his summary of the intellectual trajectory early modern physics and astronomy followed is a bravura performance. Writing

with grace and verve, Weinberg explains complex conceptual nuances with admirable clarity. Reconstructions of key discoveries made between Copernicus and Newton lead into his account of what distinguishes the modern scientific attitude from prescientific philosophizing. Weinberg presents those earlier figures as archetypes of scientific virtue, who built a self-correcting, thoroughly modern science by seeking naturalistic explanations, insisting on an impersonal disposition toward their work, and developing standards of mathematical rigor.

Whereas Weinberg differentiates modern from ancient science, Nicolaides emphasizes their commonalities. *In the Light of Science* also cleaves roughly in two. The first half gives a sweeping history of the conditions that first allowed human civilizations to flourish. Nicolaides presents the drive to understand nature as a basic human biological and cultural impulse—the same impulse that gave rise to mythology and religion—and he writes that settled, agricultural civilization was the precondition necessary for it to thrive. That section of the text is deeply speculative. Some of the discussions are compelling, such as those about the role of the Greek language in promoting systematic thought. Others, such as those about the evolutionary advantages of scientific habits, are



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somewhat less so. Nicolaides nevertheless turns his welcome sensitivity to complexity toward the question of why the Greeks were the first to develop a robust program of natural inquiry.

The book's second half draws a series of comparisons between the core intellectual traditions of pre-Socratic philosophy and foundational issues in modern physics. Nicolaides finds echoes of the modern quest for a theory of everything in Thales's notion of sameness as a universal principle; he sees Empedocles's conception of force

as a prelude to the standard model of particle physics. Those comparisons are often strained and superficial, but they do offer a competent and accessible reconstruction of the views of noteworthy Greek philosophers and an introduction to the current frontiers of physical inquiry. Even if direct connections between ancient and modern science fall flat, Nicolaides succeeds in communicating his admonition to consider today's scientific progress within the broader sweep of human history.

Reading Weinberg and Nicolaides

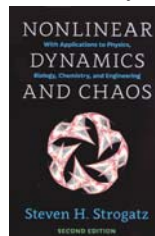
side-by-side makes it clear that a whiggish approach does not imply a consensus narrative. Whiggishness involves reading the past through the lens of current values—but whose values? For Weinberg, the independence of science from other human affairs is its most necessary and powerful attribute. Nicolaides sees science as but one incarnation—albeit the most successful—of the impulse that drives all essentially human activities. *To Explain the World* and *In the Light of Science* diverge in their historical interpretations because their authors advocate different perspectives on the values science does and should embody. In that sense, the two books are as much philosophical as historical and as much about the present as the past.

## Nonlinear Dynamics and Chaos With Applications to Physics, Biology, Chemistry, and Engineering

Steven H. Strogatz  
Westview Press, 2015. 2nd ed.  
\$60.00 paper (528 pp.).  
ISBN 978-0-813-34910-7

It's clear from the books he has written that Steven Strogatz—a prolific and able writer and a professor of applied mathematics at Cornell University—has broad interests and knowledge in many scientific fields, including physics: In 2014 he was elected an American Physical Society Fellow. For popular audiences, he has penned such engaging works as *Sync: How Order Emerges from Chaos in the Universe, Nature, and Daily Life* (Hachette Books, 2003) and *The Joy of "x": A Guided Tour of Math, from One to Infinity* (Houghton Mifflin, 2012).

Strogatz's latest book, *Nonlinear Dynamics and Chaos* (2nd edition), is aimed broadly at scientists and engineers and is suitable as an undergraduate or graduate course textbook. That's no accident since much of the content of this book, and the first edition (Westview Press, 1994), originated from a course Strogatz taught at MIT and Cornell. The new edition has a friendly yet clear technical style; it feels like concepts are not just printed on the page but are being spoken to the reader. Strogatz enhances his already engaging tone with historical notes and nods to things not yet under-



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