Unshadowed lens on the past

Robert P. Crease examines Steven Weinberg's radical retelling of the story of science.

With *To Explain the World*, Nobel-prizewinning physicist Steven Weinberg is sure to raise the hackles of professional historians of science. The book is based on lecture notes for his undergraduate courses in the history of science at the University of Texas at Austin. But he states at the outset: "I am a physicist, not a historian". He is unapologetic about judging past science from the viewpoint of the present, and scornful of scholars who view scientific results as historical or cultural products. He focuses almost exclusively on Western science (including that of medieval Islam). Although other civilizations generated much scientific knowledge, Weinberg explains, the scientific method — a special technique that "allows us to learn reliable things about the world" — was discovered and exploited first in the West.

The result is unique and provocative: imagine a history of architecture that judged edifices by the extent to which they met modern needs and building codes. Weinberg demotes many luminaries in the pantheon of science history, including philosopher René Descartes and early empiricist Francis Bacon. He elevates others, such as Aristarchus of Samos — the classical proponent of heliocentrism — and early-modern chemist Robert Boyle, an exponent of the "new aggressive style of experimental physics".

A strength of the book is its knowledgeable assessments of mechanical and astronomical systems, including those of Nicolaus Copernicus and Isaac Newton. Included is a valuable, 100-page-long set of technical notes covering the mechanical, optical and astronomical issues of early science, such as derivations of the law of refraction and the mathematics of planetary orbits.

Weinberg can be a wise and witty writer, as shown by his popular classic on the origins of the Universe, *The First Three Minutes* (Basic, 1977). In *To Explain the World*, he discusses the rejection of Aristotelian science at the University of Paris in the thirteenth century thus: "the condemnation saved science from dogmatic Aristotelianism, while the lifting of the condemnation saved science from dogmatic Christianity". He often derives lessons about science from history, illustrating them with twentieth-century examples. He notes that Copernicus's work shows "that a simple and beautiful theory that agrees pretty well with observation is often closer to the truth than a

complicated ugly theory that agrees better with observation". He then tells a story from the history of quantum mechanics, involving Erwin Schrödinger's method for calculating the energy states of hydrogen atoms. After charging the eleventh-century Persian scholar al-Biruni with using misplaced precision in calculating Earth's radius, Weinberg describes an episode when, as a summer intern, he calculated magnetic-field measurements to eight meaningless significant figures.

The approach has weaknesses. Bacon and Descartes did often err in scientific judgement, but they defended science in its infancy and helped to establish it as an intelligible and useful activity, creating a cultural niche for Weinberg's profession. These achievements are negligible only in a very narrowly conceived history of science.

Weinberg admits that he feels more at home with physics from the seventeenth century on, after the scientific method was established. His discomfort with earlier periods shows when he sometimes carelessly fails to appreciate the context of a figure or a statement. Most strikingly, he claims that Socrates was "not very interested in natural science". He bases this on a passage in Plato's *Phaedo* in which the philosopher

expresses disappointment with his predecessor Anaxagoras's description of heavenly bodies "in purely physical terms, without regard to what is best". But there is more to that story. In the *Phaedo*, Socrates notes that he had once embraced Anaxagoras's view of a Universe ruled by a divine mind, but later rejected it because it failed to show how or why the mechanics of the cosmos are the inevitable choices of that mind — which is in any case ultimately unknowable. So he developed his own method of investigation, starting with the strongest-looking hypothesis and testing it through questioning.

Weinberg thus cites a remark from a position that Socrates explicitly states that he has abandoned. And although Socrates' key terms, such as hypothesis and logic, do not mean for us exactly what they did for the Greeks, the philosopher was putting into motion something that Weinberg fails to recognize. His open-ended, hypothetical method of inquiry rejected foundation in pure reason or divine knowledge and, combined with mathematics, is seen by many scholars as an early formulation of the scientific method.

Weinberg opens *To Explain the World* with an excerpt from John Donne's poem 'A Lecture Upon the Shadow'. Two lovers are talking in the morning; gradually their shadows shorten, then finally vanish as the Sun moves directly overhead. The last line that Weinberg quotes is: "to brave clearness all things are reduced". He concludes his book with unapologetic praise of reductionism as the right path for science, providing "a view of why the world is the way it is".

The reductionist approach clarifies many bits and pieces of the past, such as key aspects of early astronomical and optical models. Weinberg also displays a much deeper and more intuitive insight into scientific practice than many historians and philosophers. "We learn how to do science," he writes, "not by making rules about how to do science, but from the experience of doing science, driven by desire for the pleasure we get when our methods succeed in explaining something". Still, sometimes you have to see the shadows — how something fits into its surroundings — to see it as it is. ■

Robert P. Crease is a professor of philosophy at Stony Brook University in New York, and co-author of *The Quantum Moment*.
e-mail: robert.crease@stonybrook.edu

To Explain the World: The Discovery of Modern Science
STEVEN WEINBERG
Allen Lane/Harper
Collins: 2015.

Nicolaus Copernicus's heliocentric system, illustrated in 1660.