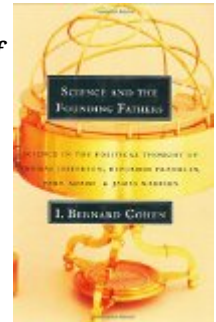


I. Bernard Cohen. *Science and the Founding Fathers: Science in the Political Thought of Jefferson, Franklin, Adams, and Madison.* New York: W.W. Norton & Company, 1997. 368 pp. \$25.00, cloth, ISBN 978-0-393-03501-8.



Reviewed by Shalom Doron

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In the past half century, historians and other scholars who study the origins of the Constitution and the political achievements of the revolutionary generation have spawned a rich interdisciplinary literature. These scholars have shown the influence on those achievements of just about every realm of thought--political, religious, cultural, ethnographic--except one. By and large, historians, political scientists, and constitutional and legal scholars either have overlooked the influences of science on Americans' political thought and action in this era, or they have contented themselves with superficial and hasty references betraying their own lack of knowledge of such matters as Newtonian physics.[1]

For this reason, *Science and the Founding Fathers* is a groundbreaking work on the creation of the American Republic. I. Bernard Cohen, now the Victor S. Thomas Professor Emeritus of the History of Science at Harvard University, helped launch the history of science as an academic discipline; the first recipient of an American university's Ph.D. degree in the field, he has done pioneering work on such subjects as Newton's *Principia* and

Benjamin Franklin's science.[2] In the book under review, Cohen investigates the role of science in the "age of experiments in government," seeking to correct what he sees as a gross oversight by scholars of American political, legal, and constitutional history. Written in simple, engaging prose, *Science and the Founding Fathers* deserves praise as a book that explains, for those with little or no scientific background, complex scientific ideas and their connections to the political thought of the Founding Fathers.

Cohen argues "that scientific issues were related to the political thought and also the political action of our Founding Fathers" (p. 13). The revolutionary generation was heavily influenced by the Enlightenment, with its great emphasis on science; they based much of their political theory on scientific ideas and defended their theories by analogies from the physical, mechanical, and biological sciences.

In his first chapter, "Science and American History," Cohen examines the impact of the Enlightenment, also known as the "Age of Reason," on Americans of the revolutionary generation. He

shows that many of the Founding Fathers—including Thomas Jefferson, Benjamin Franklin, John Adams, and James Madison, the main subjects of this study—repeatedly used scientific ideals, concepts, and analogies to formulate and support ideas about government. These scientific concepts and analogies drew primarily, though by no means exclusively, on the "twin luminaries" of the Enlightenment, the philosopher John Locke and the scientist Isaac Newton. Says Cohen, "There can be no doubt that the Founding Fathers displayed a knowledge of scientific concepts and principles which establishes their credentials as citizens of the Age of Reason" (p. 60).

Chapter Two, "Science and the Political Thought of Thomas Jefferson: The Declaration of Independence," begins by exploring Jefferson's relationship with science in general and with Newtonian physics in particular. Jefferson's education in science was extensive, and he manifested his interest in the promotion of science through the active roles he played to expand scientific knowledge, both as president of the American Philosophical Society (an honor he valued more highly than his election in the same year as vice president of the United States) and as president of the United States. The most important example of his promotion of scientific knowledge was his devising of the Lewis and Clark Expedition, which would explore the territory to the west of what was in 1803 the United States (and which the United States ultimately acquired through the Louisiana Purchase). In preparation for the expedition, President Jefferson had his choice as its leader, Captain Meriwether Lewis, trained by leading American scientists in botany, anatomy, zoology, astronomy, and Indian history. Furthermore, in a remarkable confidential letter that was in effect the expedition's charter, Jefferson instructed Lewis to gather extensive scientific data about the country he would be passing through and its flora, fauna, and inhabitants.[3]

In the 1780s, Jefferson—ever the patriot—used his scientific training and methodology to counter "the widely held 'scientific' theory that plants and animals, and even human beings, of the New World were inferior to those of the Old" (p. 73). French naturalists, led by the Comte de Buffon, argued that all life "degenerated" in America. Jefferson responded in his only full-length book, *Notes on the State of Virginia*, with an analysis of extensive specimens (which he had collected and preserved as evidence) proving that plant and animal life was as large and healthy in America as in Europe, if not more so—thus proving that America was the equal, and perhaps even the superior, of Europe.[4]

Cohen then discusses how "Jefferson's most renowned political statement, the Declaration of Independence, exhibits signs of his commitment to the Newtonian Philosophy" (p. 68). Cohen finds Newtonian echoes in the preamble of the Declaration of Independence, where "Jefferson defines the 'separate and equal station' as one to which the people are entitled by 'the Laws of Nature'" (p. 110). In using the plural "Laws," rather than the singular "Law," Cohen argues, Jefferson was referring not to the common law, but to the scientific "Laws of Nature," a reference to Newton's laws of motion. Referring to human rights as "self evident," Jefferson means to say, in Cohen's view, that they are "axioms," just as the "Laws of Nature" were considered to be "axioms," but in the Newtonian sense, not the Euclidian sense—that is, the truths of the Declaration "are plainly self evident only in a particular way" (p. 133).

Cohen's third chapter, "Benjamin Franklin: A Scientist in the World of Public Affairs," outlines Franklin's extensive scientific credentials, including his work in the new science of electricity, of which he was a principal founder. (Here Cohen draws on his work on Franklin covering more than five decades, from his 1941 edition of Franklin's *Experiments and Observations on Electricity* to his 1990 collection of essays, *Benjamin*

Franklin's Science.^[5]) Cohen first proves that Franklin's reputation as a scientist was an important qualification for his appointment to diplomatic office, first as colonial agent (that is, lobbyist for several American colonies) to the parliament and king of Great Britain, and later, with the coming of the American Revolution, as American minister plenipotentiary to France. Cohen then discusses the examples of scientific analogy that appear in Franklin's political thought and arguments. Most notable of these is Franklin's argument in favor of a unicameral legislature for the new nation, wherein he compared John Adams's suggested two-house legislature to a specimen of natural history, a two-headed snake which, if "one head should choose to go on one side of the stem of a bush and the other head should prefer the other side...neither of the heads would consent to come back or give way to the other" (p. 155), and the snake--and by analogy the nation--would die. This episode illustrates how Cohen's perspective enriches our understandings of perennial subjects of scholarly inquiry; though the controversy over unicameral versus bicameral legislatures has long been a staple of historians' understandings of the evolution of American constitutionalism,^[6] no previous scholar has noted the invocation of scientific analogies by the key figures in that dispute.

Like Jefferson, Franklin used science to promote the importance of America. In his 1751 pamphlet, "Observations Concerning the Increase of Mankind," Franklin used the mathematical science of demography to study the population explosion in America as compared with Europe, "predicting that under the American conditions which provided unchecked growth, the population would double every twenty or twenty-five years" (p. 158); from these calculations, Franklin concluded that "British America was destined to become the most populous and the most important part of the British system" (p. 159).

Cohen's third chapter, "Science and Politics: Some Aspects of the Thought and Career of John

Adams," deals with science in Adams's political thought, as seen through Adams's debate with John Taylor of Caroline in the early 1800s over the principle of balance in government. Though Adams was not as well-versed in science as Jefferson or Franklin, his Harvard education (in particular, his studies with Professor John Winthrop) gave him a background in both physics and mathematics. By choosing "balance," most notably "balance of power" and "balance of property," as the basis of his political philosophy, Adams rejected Newton's dynamics, the study of forces and accelerations, for the equilibrium of statics, "the science of forces at rest" (p. 216). Adams attributed to the seventeenth-century English political thinker James Harrington (who predated Newton) this concept of political power balanced by its proportion to ownership of land; Harrington believed "that the physical sciences are of absolutely no use as sources of analogies for political discourse" (p. 217). Cohen's crucial point is that Adams's balance was *not* Newtonian, for all that he seems to have thought it was.

Responding to John Taylor's charge that the Constitution of the United States might be "complicated with the idea of a balance" (p. 225), Adams responded with an image "of balanced machinery, of wheels within wheels" (p. 226), which promotes equilibrium in the system, which the people desire for its tendency to promote their interests. Indeed, according to Adams, the people "have invented a balance to all balances in their caucuses," where, Adams wrote, "*elections are decided*" (p. 226). Adams *did* cite Isaac Newton's third law of motion--erroneously--to defend this system of balance in the context of his argument for a bicameral legislature. In response to Franklin's ridicule of the system as impractical, Adams cited Newton's third law--"that reaction must always be equal and contrary to reaction," or there can never be any *rest*" (p. 229). Adams, Cohen notes, had forgotten the meaning of Newton's third law, which applies to the forces that bodies exert on each other, not equal and opposite forces

acting on the same body, which produces Adams's image of equilibrium or "rest." Adams's political theory, while scientific, was not Newtonian, though Adams still sought to "hang his hat" on that esteemed sage of the Enlightenment.

In his fifth and final chapter, "Science and the Constitution," Cohen studies science as it influenced the political thought of James Madison and other members of the Federal Convention of 1787, as it emerges in the text of the Constitution, and as it was used by Madison to defend the Constitution in his essays in *The Federalist*. This chapter also serves as an epilogue to pull together all the diffuse parts of the book and represent them as a cohesive whole, arguing a single thesis.

Cohen begins this chapter with the single direct reference to science in the Constitution--namely, the power granted to Congress under Article I, section 8, clause 8: "To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the Exclusive Right to their respective Writings and Discoveries." Cohen analyzes the various versions of the provision recommended in and considered by the Convention, as well as some practical applications, such as the invention of the steamboat.

Cohen continues with a discussion of whether the Constitution is a Newtonian document, citing Woodrow Wilson and others, who contend that it is Newtonian (and, in Wilson's case, Darwinian as well), both in its structure and its background. Cohen sets out to disprove those claims, and achieves his goal. In sum, he agrees with the late political scientist and historian Clinton Rossiter that, even though it goes too far to say that the Constitution is a Newtonian document, Newtonian physics and the science of the Enlightenment in general "quickened the advance toward free government" (p. 255) in three ways--by conquering superstition; by its kinship with democracy, leading promoters of science to promote "free government" as well; and by its system of "immutable natural laws," which gave "sanction to

the doctrine of natural law" (p. 256). Moreover, as Cohen notes, the Constitution's framers did make extensive use of scientific metaphors and analogies in the debates over the Constitution, both in the Convention and during the ratification controversy.

For example, *The Federalist*, the handiwork of Alexander Hamilton, John Jay, and James Madison, was the primary book of arguments for the proponents of the Constitution during the ratification controversy. Cohen shows that its authors often used scientific metaphors, even though science was not their primary concern. "What is significant, therefore," Cohen notes, "is not that science provided metaphors in a prominent way for the authors of *The Federalist*, but rather the fact that there are any such metaphors at all" (p. 272). Scientific references in *The Federalist* indicate that science pervaded the thought of its authors, and of the Revolutionary generation as a whole, so completely that they referred to it unconsciously in their political debates.

Cohen's overarching thesis is that science influenced the political theories and debates of the Revolutionary generation, by providing them with ideals to achieve and models to imitate, as well as analogies to support and illustrate their arguments in debate. Cohen makes his thesis more complex by implying, in his last chapter, that the influence of science is not always deliberate. That is, the Founders did not necessarily incorporate scientific language into their arguments intentionally; rather, it had become second nature to them.

We have two serious criticisms of this book, neither of which reduces its importance as a groundbreaking work in the field of early American history. The first is structural, or perhaps, editorial: this book is too diffuse. In attempting to open up a completely new approach to the study of the formation of the American Republic, Cohen has tried, and predictably failed, to address every important aspect of the scientific influence in the politics of the period. Attempting to do too much

is always a danger when one goes "where no one has gone before." Furthermore, Cohen's method of burying discussions of key issues in "Supplements" rather than in integrating them into his main text, and of failing to provide clear cross-references to those Supplements at points when they would illuminate his discussion, often leaves the reader at sea.

Our second, more serious criticism is that Cohen insists that every scientific reference that he, an expert on science and its history, finds in the writings of the Revolutionary generation, must be intentional and must therefore imply or contain every meaning that he finds within it. Cohen's thesis would become richer and more accurate if he expanded it to say that even the political theory of the Revolutionary generation sometimes draws on science quite by accident, because science permeated their thinking, and therefore such references do not necessarily mean or imply all that Cohen claims they do. (Cohen's acknowledgment, previously mentioned, that scientific references were second-nature to the Revolutionary generation to the extent of being unconscious or inadvertent should have been more central to his argument.)

When, for example, Jefferson referred to "the Laws of Nature" and "self evident" truths in the Declaration of Independence, he did not necessarily intend to imply the more specific Newtonian references that Cohen attributes to him. Thus, Jefferson's inadvertent resonances with Newtonian thought are analogous, so to speak, to James Madison's use of scientific analogies in *The Federalist*. Moreover, recall Cohen's insistence that Jefferson was the American of his generation who was by far most conversant with Newtonian physics. Had Jefferson intended to incorporate direct and specific references to Newtonian physics in the Declaration, by Cohen's own analysis Jefferson would have been writing over the heads of the vast majority of his intended audience—including the other two leading members of the committee as-

signed to draft the Declaration, John Adams and Benjamin Franklin. (Cohen notes that, because Franklin could not read Latin, he could not read Newton's original Latin text of the *Principia*; there is no evidence that Franklin owned or read the contemporary English translation of Newton's leading work.)

By claiming that all these scientific implications or resonances were in fact intended, and so understood by contemporary readers, Cohen is guilty of the very crime that he accuses experts on legal and political history of committing—that of claiming ultimate authority, by virtue of his expertise as a historian of science, to interpret American founding documents "in all cases whatsoever." As we have noted, Cohen sells his thesis short by limiting it as he does; a more complex reading of the evidence does not diminish his achievement, but rather enhances it immensely. We look forward to further work in this vein—by historians of politics, law, and science—which will expand on what Cohen has begun, and thus enrich our knowledge of the founding of the American republic and the complex interactions among scientific ideas, technological innovations, and constitutional arrangements in American history.

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Notes

[1]. But see Michael Foley, *Law, Men and Machines: Modern American Government and the Appeal of Newtonian Mechanics* (London and New York: Routledge, 1990), which discusses previous historians' superficial and careless references to Newtonianism and the Constitution.

[2]. For example, I. Bernard Cohen, *Introduction to Newton's "Principia"* (Cambridge, Mass.: Belknap Press of Harvard University Press, 1971); I. Bernard Cohen, *The Newtonian Revolution* (Cambridge, Eng.: Cambridge University Press, 1980); I. Bernard Cohen, *Revolution in Science* (Cambridge, Mass.: Belknap Press of Harvard University Press, 1985); and I. Bernard Cohen, *Interactions* (Cambridge, Mass.: MIT Press, 1994).

[3]. Thomas Jefferson, "Instructions to Captain Lewis," 20 June 1803, reprinted in Merrill D. Peterson, ed., *Thomas Jefferson: Writings* (New York: Library of America, 1984), 1126-1132.

[4]. See generally Thomas Jefferson (William Peden, ed.), *Notes on the State of Virginia* (Chapel Hill, N.C.: University of North Carolina Press for the Institute of Early American History and Culture, 1955); Charles A. Miller, *Jefferson and Nature: An Interpretation* (Baltimore: Johns Hopkins University Press, 1993); Antonello Gerbi (Jeremy Moyle, ed. and trans.), *The Dispute of the New World* (Pittsburgh: University of Pittsburgh Press, 1973); Henry Steele Commager, *The Empire of Reason: How Europe Imagined and America Realized the Enlightenment* (New York: Anchor Press/Doubleday, 1977); Henry Steele Commager and Elmo Giordanetti, eds., *Was America a Mistake? An Eighteenth-Century Controversy* (New York: Harper and Row, 1967); and Richard B. Bernstein with Kym S. Rice, *Are We to Be a Nation? The Making of the Constitution* (Cambridge, Mass.: Harvard University Press, 1987), chapter Five.

[5]. I. Bernard Cohen, ed., *Benjamin Franklin's "Experiments": A New Edition of Franklin's "Experiments and Observations on Electricity"...* (Cambridge, Mass.: Harvard University Press, 1941); I. Bernard Cohen, *Franklin and Newton*

(Philadelphia: American Philosophical Society, 1956); I. Bernard Cohen, *Benjamin Franklin's Science* (Cambridge, Mass.: Belknap Press of Harvard University Press, 1990).

[6]. See generally Gordon S. Wood, *The Creation of the American Republic, 1776-1787* (Chapel Hill, N.C.: University of North Carolina Press, 1969; rept., with new introduction, 1998); Donald S. Lutz, *The Origins of American Constitutionalism* (Baton Rouge: Louisiana State University Press, 1988); Willi Paul Adams (Rita and Robert Kimber, trans.), *The First American Constitutions* (Chapel Hill, N.C.: University of North Carolina Press, 1980); Jackson Turner Main, *The Upper House in Revolutionary America, 1763-1787* (Madison: University of Wisconsin Press, 1967); and Bernstein with Rice, *Are We to Be a Nation?*, Chapters Two and Five.

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