History of Science

NEWTON THE ALCHEMIST: Science, Enigma, and the Quest for Nature's "Secret Fire" by William R. Newman. Princeton, NJ: Princeton University Press, 2019. xx + 537 pages, including four appendices and an index. Hardcover; $39.95. ISBN: 9780691174877.

If there is one person associated with developments in the physical sciences, it is Isaac Newton (1642–1727). For many, he represents the culmination of the seventeenth-century Scientific Revolution: its point of convergence and simultaneously the point from which science began to exercise its full influence on society. His work is often considered as thoroughly modern: well-designed experiments; precise and clearly articulated mathematical-physical principles which invite deductions further tested by measurement and experiment; and great discoveries in astronomy (universal law of gravitation), in optics, in mechanics, and in mathematics (the calculus). For many, Newton provided the model for physical theory for the next two hundred years.

And yet, this generally accepted description of Newton fails to capture the tension and diversity in Newton's work. The discovery of Newton's alchemical manuscripts (containing no fewer than one million words) by the economist John Maynard Keynes at an auction at Sotheby's in 1936 partially lifted the veil. In 1947, Keynes offered his rather candid assessment of Newton's alchemical work: he "was not the first of the age of reason" but rather "the last of the magicians."

However, in the last two decades, we have come to understand and appreciate that alchemy was not simply deviant behavior by "magicians" or charlatans, but rather part and parcel of the make-up of the Scientific Revolution. Alchemy, or better, chymistry, was a central part of the early modern study of nature. One of the leaders of this historiographical revolution has been William Newman, distinguished professor in the Department of History and Philosophy of Science and Medicine at Indiana University. [For more on this revolution, see my review of Lawrence Principe's book *The Secrets of Alchemy* in *PSCF* 66, no. 4 (2014): 258–59.] Newman has written several seminal books: for example, *Atoms and Alchemy: Chymistry and the Experimental Origins of the Scientific Revolution* (2006) and *Promethean Ambitions: Alchemy and the Quest to Perfect Nature* (2004).

Newton the Alchemist displays Newman's fifteen-year dedicated study of Newton's alchemical manuscripts. This is the book for anyone who wishes to understand the background, implementation, and experimentation characteristic of Newton's long and abiding interest in alchemy. Newman introduces us to a Newton who wished to be an adept alchemist (even as a student at the Free Grammar School in Grantham) and kept the alchemical fires burning throughout his life, not only in Trinity College at Cambridge University, but also as warden of the Royal Mint. Newman also shows that alchemy is not inherently unscientific or irrational, nor that Newton was an outlier. Such contemporary luminaries as Robert Boyle, Gottfried Leibniz, and John Locke were also involved in alchemical endeavors.

In the first chapter, "The Enigma of Newton's Alchemy: The Historical Reception," Newman addresses the claims of two of Newton's most illustrious interpreters: Richard Westfall and Betty Jo Teeter Dobbs. For Dobbs, Newton's belief in alchemical transmutation was a religious quest, with the "philosophic mercury" acting as a spirit mediating between the physical and divine realms. For Westfall, Newton's alchemical research, involving invisible forces acting at a distance, allowed him to develop his theory of universal gravitation, published in the *Principia* of 1687. Newman calls both claims into question based on his close reading of the extant alchemical papers, many of which Dobbs and Westfall were not able to see. Newman wishes to determine the "hidden material meaning of the text" (p. 46), rather than advance any broad metaphysical or soteriological claims on Newton's part.

In chapter 4, "Early Modern Alchemical Theory," Newman reveals how heavily influenced Newton was by European alchemists, above all by the Polish alchemist Michael Sendivogius. Drawing on their experiments, Newton, in the 1670s, developed an all-encompassing geochemical theory of nature, according to which the earth functions as "a 'great animall' or rather an 'inanimate vegetable'" (p. 64). In Newton's view, this process explained gravitation (among many other things), although he would abandon this idea when he came to write the *Principia*.

In collaboration with others, many at Indiana University, Newman has organized, read, and carefully compared Newton's alchemical manuscripts. [Readers can see the results at www.chymistry.org.] In his analysis, Newman employs an approach which he calls "experimental history." This involves at least two elements: (1) a careful textual linguistic analysis of alchemical manuscripts and their experimental details; and (2) an effort to repeat the experiments in a modern laboratory setting. To understand alchemical manuscripts is indeed a challenging undertaking involving an understanding of "materials, technology, and tacit practices," as well as deciphering "hidden terms or *Decknamen*" used for chemical substances, and the intricate symbols employed to designate them (see "Symbols and Conventions," pp. xi–xvii).

Newman repeated many of Newton's experiments, revealing many of his laboratory practices for the first time. The results are sometimes spectacular (see, for example, the colored plates 4–10 between pages 314 and 315). They clearly show how dedicated Newton was in his efforts to improve his knowledge of the natural world. Newman's final assessment: "Nowhere in

Newton's scientific work can we see the same degree of combined textual scholarship and experiment that we encounter in his alchemy" (p. 498).

What may we learn from reading *Newton the Alchemist*? One thing for sure: that our contemporary scientific textbooks and enlightened culture celebrating Newton's "positive" results—the astronomical "System of the World" and his three laws of motion in mechanics—are a one-sided picture of Newton's work and life. By blithely neglecting his interests in alchemy, cabbalism (number mysticism), theology, chronology, and biblical prophecy, as well as Newton's deep sense of vocation (calling), they all too frequently divide his work into two predetermined categories: science and pseudo-science. It is certain that Newton's alchemy is not pseudo-science. History, and scientific practice as well, are never, if ever, so tidy. Newton's passionate pursuit of a coherent worldview is a reminder to us of the rich context in which science is embedded. Newman's book underscores the fact that science, our science too, is impelled by deep commitments, social and political factors, and personal ambition and motives.

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NEGOTIATING SCIENCE AND RELIGION IN AMERICA: Past, Present, and Future by Greg Cootsona. New York: Routledge, 2020. 206 pages + index. Paperback; $44.95. ISBN: 9781338068537.

In *Negotiating Science and Religion in America: Past, Present, and Future*, Greg Cootsona examines the history of religion and science in America in the context of emergent adulthood. He begins with Alfred Whitehead's claim that religion and science are the two strongest cultural forces within American culture, with the future of America being dependent upon the cultivation of a positive relationship between them. Much of the book is a historical exploration of the relationship between religion and science in American culture framed by the categories put forth in Ian Barbour's *Issues in Science and Religion*: conflict, co-existence, dialogue, and integration—although Cootsona chooses to collapse dialogue into integration. While he finds Barbour's typology helpful, Cootsona sees the need for new categories to better reflect the experience of millennials living within the pluralism of the twenty-first century.

Cootsona argues that Protestantism, as the dominant religious force within American culture, contributed to the conflict/co-existence approaches to science and faith throughout much of American history. This situation has now given way to a religious pluralism that makes new forms of integration possible. However, given the increased secularity of millennials and emergent adults, which Cootsona supports with Pew research, the National Study of Youth and Religion, as well with his own qualitative research, this new form of integration is less about a robust dialogue between science and religion, and more about the manifestation of a tolerant individualism seeking to avoid conflict. According to Cootsona, "As Americans become less conventionally religious, they also become less personally conflicted with science" (p. 163). This explains why Barbour's typology needs to be reworked—as emergent adults disassociate from organized religion, the categories that frame the relationship between science and religion must change. For Cootsona, emergent adults are "religious bricoleurs" who need better maps to frame the conversation in order to discover new trajectories.

The first two-thirds of the book represent the author's version of the map. He divides American history into sections, tracing the relationship between religion and science from Newton to Barbour, with a final chapter focusing on future possibilities. In this way, he models the mapping needed for the future of the religion/science discussion. He provides an insightful historical narrative that describes developments within the religion/science relationship, ending with contemporary models of Barbour's typology—Stephen Jay Gould (co-existence), Richard Dawkins (conflict), and Francis Collins (integration). The final chapters explore the shifting religious experience of contemporary American culture that has seen a decline in religious affiliation, the rise of spirituality, and a new cultural and religious pluralization. Cootsona's historical narrative provides a helpful snapshot of the complicated relationship between religion and science in America. His interdisciplinary focus offers an important lens for interpreting the historical events and movements, providing a helpful model of the mapping that he believes is necessary for emergent adults living in a pluralistic culture, to better engage the conversation. There are, however, a few critiques to consider.

Cootsona's portrayal of Barth's theology follows a predictable, but unfortunate, trajectory. He refers to Barth's opposition to "natural theology" in a way that suggests a lack of concern for science. A close reading of *Church Dogmatics* Book III, however, shows how Barth views the incarnation as the basis for affirming and encouraging scientific exploration. For Barth, this is not merely co-existence, as Cootsona seems to suggest; instead, it is the instance that the revelation of God's love for the world in Jesus Christ affirms every opportunity to learn more about God's good creation through scientific inquiry. Barth writes to his niece,

> Thus one's attitude to the creation story and the theory of evolution can take the form of an either/or only if one shuts oneself off completely either from faith in God's revelation or from the mind (or opportunity) for scientific understanding. (*Karl Barth Letters: 1961–1968*)

Barth embraces evolutionary theory, but he strongly opposes any form of human knowledge morphing into a dominant ideology. Cootsona's dismissal of Barth misses an opportunity for a much more robust theological engagement of science that moves beyond