Phys. Perspect.

https://doi.org/10.1007/s00016-018-0218-y
Physics in Perspective

Book Reviews

Matthew Stanley, *Huxley's Church and Maxwell's Demon: From Theistic Science to Naturalistic Science*. Chicago: University of Chicago Press, 2015, 336 pages, $45 (cloth).

James R. Hofmann*

Matthew Stanley has made an interesting contribution to the extensive literature on the Victorian scientists and public intellectuals who historians often refer to as scientific naturalists. During the nineteenth century, the label "scientific naturalism" was gradually adopted to denote a conception of science in which any references to supernatural entities or processes were explicitly excluded. Those who advocated this view included Thomas Huxley, John Tyndall, Herbert Spencer, William Clifford, Leslie Stephen, Joseph Hooker, and, less publicly, Charles Darwin. Their aggressive argumentation met resistance from those who espoused what Stanley terms "theistic science," a more established school of thought he describes as "the tradition of practicing science in close embrace with Christianity" (3–4). This group included such influential physicists as George Gabriel Stokes, William Thomson, James Clerk Maxwell, and Peter Guthrie Tait. Maxwell serves as Stanley's paradigmatic example of a theistic scientist just as Huxley fills the role of scientific naturalist.

Nineteenth-century theistic science is best thought of as a synthesis of science and a theology of nature that celebrated scientific discovery as an indication of God's bounty. By limiting assertions about God's functions to the initial creation of the universe and the sustaining of nature's laws, conflict with naturalists over purely scientific issues was minimized. Both theists and naturalists conceded that the origin of the material universe was beyond the scope of science and they both accepted the uniformity of the laws of nature. Theists attributed this uniformity to God, whereas naturalists were more likely to use it in arguments against religion. A belief in a supernatural origin for nature and its laws certainly did not act as a "science stopper" for theistic scientists. For theists, scientific confrontation with nature's mysteries was correlated with moral confrontation with the problem of evil; the limited success of both projects was symptomatic of humanity's fallen condition. Although scientific naturalists were apt to mock theistic claims about

* James R. Hofmann is Professor Emeritus of Liberal Studies at California State University Fullerton. He is a Resident Scholar at the Collegeville Institute in Collegeville, Minnesota, and the author of *André-Marie Ampère: Enlightenment and Electrodynamics* (Cambridge, UK: Cambridge University Press, 1995).

Birkhäuser

Published online: 01 March 2018

the supernatural origin of the laws of nature, they could and did practice science in the same way that theists did. Stanley discusses in detail how extensive and vigorous discussion of intellectual freedom, the limits of science, miracles, and the purview of the laws of nature failed to erode a shared commitment to the progress of empirical science.

The issue that came closest to generating a scientifically substantive dispute between the two ideologies involved scientific analyses of the mind, consciousness, and free will. But since no viable scientific account of mind was achieved, this example illustrates how the two schools came into scientific conflict only at the extreme boundaries of science. Stanley calls the methodological values that were common to both groups "valence values" because they bonded the two groups together in scientific practice and allowed them to cooperate in research, teaching, and participation in the same scientific institutions.

Stanley concludes by describing the process through which Huxley and his like-minded colleagues supplanted theistic science with the naturalism that has been a hallmark of science ever since. The transition was not high profile due to the "valence values" that the two perspectives shared all along. What changed was the elimination of theism as the primary mode of justification for these values. Part of Huxley's strategy was to rewrite the history of science to give the impression that science has always been naturalistic at its core with a mere patina of theism that was more detrimental than beneficial. Subsequent historians have been busy re-establishing a more accurate account.

Stanley also draws an interesting contrast between nineteenth-century debates over human consciousness and the modern, intelligent design–based rejection of Darwinian explanations for complex biological phenomena. He argues that there are both similarities and differences between the way the two conceptions of science interacted in nineteenth century Britain and in modern America. For Maxwell and his theistic colleagues, the soul could not be a subject of scientific analysis; materialistic attempts to understand consciousness would necessarily fail due to the non-material nature of that domain. Similarly, modern intelligent-design advocates hold that biological structures that bespeak "design" cannot be understood through Darwinian mechanisms. But they also claim that these structures can be understood scientifically by expanding science to include divine design as an explanatory concept. Although intelligent design proponents never specify the action allegedly taken by a designer, they belittle naturalistic efforts as misguided failures to scientifically acknowledge the necessity of a designer. They insist that this acknowledgment be recognized as a scientific conclusion rather than a religious belief. In this respect, the similarity of their version of theistic science to that of Maxwell breaks down. Maxwell did not advocate the expansion of science to address entities he considered to be non-material and he did not advocate the use of supernatural causality in science.

Stanley's account makes clear that modern adherence to "methodological naturalism" owes a great deal to Huxley's efforts. Both atheists and theists practice science with a shared set of methodological values that for the most part had theistic origins and do not preclude non-scientific religious beliefs. More controversial is Stanley's interpretation of how Maxwell would have reacted to the present reliance upon methodological naturalism. I do not think that Stanley has made a case to support his claim that "Maxwell would not have agreed that his work was methodologically naturalistic—he saw God and religious considerations as critical facets of his scientific methodology" (268). On my reading, Maxwell did adhere to methodological naturalism in his practice of science. Maxwell's "demon" is the only example Stanley discusses that might serve as a counterexample. Nevertheless, Stanley concedes that the demon is not intended to be a supernatural causal factor but is part of a thought experiment illustrating the statistical nature of the second law of thermodynamics. Maxwell's justification of methodological values was theistic, but his scientific practice was not. Calls from some intelligent design proponents for a "return" to theistic science thus are misleading if applied to the nineteenth century. The theistic science they desire is certainly not the theistic science that Maxwell practiced.

Liberal Studies Department
California State University Fullerton
Fullerton, CA 92831
e-mail: jhofmann@fullerton.edu

Paul Halpern, *The Quantum Labyrinth: How Richard Feynman and John Wheeler Revolutionized Time and Reality*. New York: Basic Books, 2017, 336 pages, $30.00 (hardcover).

Gino Segrè*

In September 1939, Richard Feynman, a twenty-one-year-old recent MIT graduate, walked into the office of the graduate adviser Princeton University had assigned him. Feynman would have achieved greatness as a physicist no matter who his adviser had been, but the choice of John Wheeler, only seven years older than Feynman, was a happy selection for both of them. As Halpern artfully narrates the story of their relationship we see that, behind the surface of an ultra-colorful, freewheeling spirit, Feynman was a hardheaded theoretical physicist with close links to experimental observations. Wheeler, on the other hand, the very picture of propriety in his personal life, had more than a streak of wildness in his conjecturing of physics scenarios.

Their early collaboration was important for both of them. It ended however, except for intermittent contact, by 1942, when each of them was drawn into war work. Feynman, with a PhD in hand, went on to establish himself as a key member of the theoretical team assembled in Los Alamos, New Mexico, while Wheeler's

* Gino Segrè is a professor emeritus of physics and astronomy at the University of Pennsylvania. His latest book, co-authored with Bettina Hoerlin, is *The Pope of Physics: Enrico Fermi and the Birth of the Atomic Age* (New York: Henry Holt, 2016).

assigned mission was to provide expertise in nuclear physics at DuPont's laboratories in Wilmington, Delaware, and then at the Hanford reactor in Washington.

It would have been interesting to see in the book a description of this last episode, since Wheeler and Fermi diagnosed the early failure of the Hanford reactor. It was being poisoned by the production of unstable isotopes that absorbed neutrons. Their insights and the solutions they proposed were key to the United States being able to produce plutonium for nuclear weaponry.

Admittedly this would have been a digression from the book's main theme: the theoretical physics contributions covered in the book's two main characters. Though Feynman's studies of such varied phenomena as liquid helium, the parton analysis of deep inelastic electron nucleus scattering, and the currents of the weak interactions are all immensely important, he is best known for his formulation of the path integral approach to quantum field theory and for his studies of quantum electrodynamics. It is not an exaggeration to say that much of the progress that has been made in quantum field theory would have been impossible without Feynman's diagrammatic techniques providing the tools for calculation and the necessary visualizations of what was being calculated.

Wheeler, on the other hand, though a very accomplished nuclear physicist, is best known for spearheading the rebirth of general relativity and the analysis of such apparently far-fetched notions as black holes, geons, and the wave function of the universe. He did not do this alone, for he was also the influential teacher who trained a number of prominent theoretical physicists who followed in his footsteps, the 2017 Nobel Prize winner Kip Thorne being the best known of them.

The book's greatest strength is Halpern's ability to render at least a feeling for the very difficult and abstract ideas this book deals with by his facility choosing the right analogy and his apt selection of similes. He intersperses these themes with nicely worded descriptions of both Feynman and Wheeler's personal lives, as well their interaction with the larger community. This gives the book an agreeable balance.

Halpern does occasionally overreach. Saying, as he does on page 13, "much of the visionary work in the late twentieth and twenty-first centuries derives from their bold discourse, including the basis of the Standard Model of particle physics," overstates the case, but this is a minor flaw. The book is not intended as an authoritative description of the work of these two great theoretical physicists, nor does it claim this role. It is instead intended for a curious public that has heard of wormholes, many universes, et cetera, and is seeking to gain at least an inkling of the problems these notions address and a sense of how they are dealt with. In this sense *The Quantum Labyrinth* ranks as a clear and commendable success.

Department of Physics and Astronomy
University of Pennsylvania
209 South 33rd Street
Philadelphia, PA 19104
e-mail: segre@physics.upenn.edu