

BOOK REVIEWS

Michael Polanyi and His Generation: Origins of the Social Construction of Science, Mary Jo Nye, University of Chicago Press, Chicago, 2011, xxi + 405 pp, ISBN 978-0-226-61063-4, \$45.

When I started studying chemistry in the 1950s, we students knew little history or philosophy of science beyond the anecdotal. However, we understood tacitly that science operated independently of the rules, values, and even language of the sociopolitical world around us. It was obvious that science influenced that world in numerous ways, but as far as we were aware, influence did not flow in the other direction.

Yet in the realm of science studies (the history, philosophy, and sociology of science) new and very different conceptions of the science/society relationship were taking shape. This far-reaching revision, the consequences of which are still being felt, is a major theme of Mary Jo Nye's latest book. For those of us who were innocent of the coming upheaval, Thomas Kuhn's *Structure of Scientific Revolutions* (1962) was the wakeup call. Inquisitive minds that wished to probe further (including Nye herself) discovered the writings of Michael Polanyi, including *Personal Knowledge* (1958) and, especially, *The Tacit Dimension* (1966). Kuhn (1922-1996) and Polanyi (1891-1976) were widely read across the disciplinary spectrum, but they had additional street cred among scientists—Kuhn had a Ph.D. in physics and Polanyi had done cutting-edge physical chemical research in the 1920s and early 30s. Their writings powerfully affected the ways in which generations of young academics perceived and taught science.

Polanyi is less widely known than Kuhn, and the relation of Polanyi's philosophical positions to his scientific career has received little attention. Nye is the ideal person to carry out such an inquiry. In several of her previous books a single scientist, such as Jean Perrin or Christopher K. Ingold, played a central role in the narrative, as Polanyi does in the present one. However, in neither of those cases did the sociopolitical dimension loom very large. It did in Nye's more recent study of the physicist Patrick M. S. Blackett, but Polanyi's multidimensional commitments and influence presented Nye with what has been arguably her greatest challenge. She has been fully equal to it.

Polanyi was a member of the Hungarian intellectual diaspora that included John von Neumann, Eugene Wigner, and Leo Szilard. Many were of Jewish origin; twice displaced, they left Hungary around 1919-1920 and Europe from 1933 on, finding refuge mainly in the UK and the US. Polanyi was trained originally as a medical doctor, and then studied physical chemistry at Karlsruhe; in 1920 he joined Fritz Haber's Institute for Physical Chemistry, part of the Kaiser Wilhelm Gesellschaft. There he did important research on the x-ray structure of metals and fibers, thermodynamics of adsorption, kinetics of gas phase reactions, and theory of reaction rates. After leaving Berlin for Manchester in 1933, Polanyi continued his work in gas-phase kinetics and reaction rate theory, his most significant scientific legacy.

Disturbed by the unfolding menace in mid-1930s Europe, Polanyi focused his attention increasingly on economics and politics, viewing with alarm the intervention of totalitarian regimes in those areas, as well as in sci-

ence. Quoting Polanyi's own words about the resemblance between the organization of science and the working of free markets, Nye reveals how much Polanyi's thinking about the first owes to the second. And in fashioning his new conception of science, Polanyi also drew strongly on his career as an experimental and theoretical scientist.

In 1931 he and Henry Eyring employed a semi-empirical quantum-mechanical formulation in their theory of reaction rates. Roundly criticized by those who believed that only *ab initio* calculations were valid, Polanyi defended his and Eyring's approach, asserting that if chemists had restricted themselves only to areas subject to exact laws, progress in chemistry "would ... have stopped dead." He claimed that "there is not a single rule in chemistry that is not qualified by important exceptions," adding, "The subject of chemical concepts as opposed to physical ones has always been fascinating to me because it shows the great value of inexact ideas" (142). Such experiences emboldened Polanyi to reject prevailing inductivist and logical positivist accounts of science.

Polanyi was in fact convinced that their assumption of a detached scientific observer is a chimera and that complete objectivity in the exact sciences is a "false ideal" (261). However, rejecting those presumptions left the problem of how the veracity of scientific knowledge is to be assured. The answer, according to Polanyi, lies with the scientific *community*, which constitutes a kind of "market" where results, hypotheses, and theories are continually examined and evaluated according to values and rules that are implicitly accepted by all its members. Polanyi's encounters with Nazi Germany and Soviet Russia decisively shaped his conception of this scientific community which, he insisted, would flourish best under democratic rule even as it maintained maximum autonomy with respect to the state and other all other social, political, and economic institutions.

Nye further illustrates the imprint of Polanyi's scientific apprenticeship when she unfolds one of his most original insights, the central role of "tacit knowledge" in scientific creativity. Discovery, he argued, requires surmounting a "logical gap" between prevailing wisdom and new understanding (263) that can be bridged only by a melding of "both formal (objective) and nonformal (subjective) understanding" (264).

Taken together, Polanyi's assertions were seminal contributions to a new and highly influential epistemology of science that came to be called "the social construction of science."

After laying out the main precepts of Polanyi's philosophy, Nye compares his positions with those of his younger contemporary, Karl Popper (also a Hungarian refugee), and Thomas Kuhn, a generation younger than both. Popper and Kuhn were in accord with Polanyi about the decisive role of the scientific community in assuring the reliability and objectivity of scientific knowledge, and in this sense their individual philosophies all fit under the rubric "social construction of science," despite many strong differences among them on other issues. Kuhn, Popper, and Polanyi also agreed on the sharp distinction between pure and applied science; on the special epistemological status of scientific knowledge; and on the progressive nature of science. With respect to this last point, however, there was substantial disagreement between Popper and Polanyi on the one hand and Kuhn on the other. Both Popper and Polanyi believed that science is able to converge on an increasingly truthful representation of reality; Kuhn held that although scientific knowledge became progressively more comprehensive, that fact could not guarantee that it approached more closely to a true picture of reality.

Among Polanyi's generation, people of progressive views took it for granted that science was beneficial to society. Polanyi stressed that these benefits would be maximized when science was free from social constraints and political direction. Nye juxtaposes his stance with that espoused by a group of eminent British scientists of a Socialist or Marxist bent such as Patrick Blackett, the biologist J. B. S. Haldane, and the physicist-turned-biologist J. D. Bernal. They avowed that the state should ensure that scientific research concerned itself explicitly with bettering the human condition. The postwar revelations about the baleful effects of intervention in science by various totalitarian regimes provided powerful support for Polanyi's position. But the social and political upheavals of the 1960s initiated a re-evaluation that led many to claim that the supposed autonomy of science from any overt social obligations meant in reality that science had become the handmaiden of the military industrial state. The controversy hasn't gone away.

Whatever the very substantial differences between Polanyi and Popper on the one side, and Blackett, Haldane and Bernal on the other, they were all of one mind regarding the veracity of scientific knowledge and its privileged epistemological status. As Nye observes, "The writings of this first generation on the social nature of science ... were meant to strengthen public trust in science by demonstrating the stable foundations of science as a consequence of its institutionalized norms, values, and

interpretive frameworks” (302). However, a number of those in science studies who followed Polanyi, Popper, and Kuhn took their pioneering insights about the social grounding of science in directions the first generation never intended and which often distressed them.

Thus, Nye’s final chapter (the Epilogue) deals with movements such as SSK (sociology of scientific knowledge) and such figures as Barry Barnes, Harry Collins, David Bloor, Steven Shapin, and Bruno Latour. In one way or another they each raised questions about science’s special claim to truth and the disinterestedness not only of individual scientists but of the scientific enterprise as a whole. Even the ability of science to truthfully describe reality was called into question. Such impieties evoked strong, sometimes outraged reactions from many (although not all) scientists and numerous other defenders of science’s traditional claims. One very unfortunate result was the so-called science wars of the 1990s which, *inter alia*, gave rise to much hyperbolic rhetoric and *ad hominem* attacks, leaving behind fractured friendships and a bad taste in many mouths before finally petering out.

The scholarship behind Nye’s book is both wide and deep; its organization very thoughtfully plotted; and its presentation remarkably coherent, given the many-layered narrative. Due to the scope of the inquiry, readers like this reviewer may encounter individuals and ideas previously unknown to them from the fields of sociol-

ogy, philosophy, economics, and politics, in addition to a number of lesser known scientists. There were times when one wished for a scorecard to keep track of the players, but Nye has made a determined effort to focus attention on the main story lines by judicious choice of chapter titles, final paragraphs that adumbrate the thrust of the following chapter(s), and chapter openings that introduce some of the principal issues at stake in what follows.

The Epilogue summarizes the work’s overarching objective as follows: “It has been the argument of this book that Polanyi’s concern with a new epistemology of science evolved out of the experiences of his changing scientific career in Austro-Hungary, Germany and Great Britain during the revolutionary and catastrophic decades of the early twentieth century” (302). Nye’s case in support of this assertion is totally compelling. As she has also made clear, the contentions from this rich period of innovation and criticism continue to reverberate throughout the sciences, academia and the larger political and social sphere. Nye’s nuanced and persuasive narrative will amply reward the reader who gives it the close attention it deserves.

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Prospero’s America. John Winthrop, Jr., Alchemy and the Creation of New England Culture, 1606-1676, Walter W. Woodward, The University of North Carolina Press, Chapel Hill, 2010, viii + 317 pp, ISBN 978-0-8078-3301-8, \$45.

John Winthrop Jr. was born in Groton, England, in 1606 and educated at Trinity College in Dublin. In October of 1629, his father, John Winthrop Sr. (1587/8-1649), a wealthy Puritan, was selected to lead Massachusetts Bay Company’s Dissenting Puritans to the colony. Winthrop the elder served as Governor of the Massachusetts Colony from 1629 until his death. His rule was marked by religious moderation. Winthrop the younger arrived in New England in 1631 and was appointed Governor of Connecticut and of Saybrook in 1635. He returned to

England and remained between 1641 and 1643, then returned to America and founded what is now New London, Connecticut, in 1646. Winthrop served as Governor in 1657-1658, and again in 1659. Winthrop the younger’s rule was similarly moderate and tolerant and he took an active stand in opposing the execution of “witches” in seventeenth century New England.

The younger Winthrop developed an early interest in Christian alchemy while studying law at London’s Inner Temple in 1624. He attempted to make contact with members of the Brotherhood of Rosicrucians during this period. His growing interest in science and notably alchemy led young Winthrop to book passage to Constantinople to seek the wellsprings of alchemy. Modern studies of alchemy, notably by William Newman