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Book Review

Michael Polanyi and His Generation, Origins of the Social Construction of Science, by *Mary Jo Nye*.
The University of Chicago Press, Chicago 2011.
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Acclaimed as a physical chemist, neo-Keynesian economist, philosopher of science, sociologist of science, and public intellectual, Michael Polanyi left behind a legacy that has been examined in countless articles published in the periodicals of the three Polanyi societies and elsewhere as well as in over a dozen monographs. The literature about Polanyi has been recently enriched by a book written by Mary Jo Nye.[i] Nye's insightful and revealing volume aims to trace how Polanyi "and other natural scientists and social scientists of his generation – including John D. Bernal, Ludwik Fleck, Karl Mannheim, and Robert K. Merton – and the next – notably Thomas Kuhn – arrived at a strong new conception of science as a socially based enterprise that does not rely on empiricism and reason alone, but on social communities, behavioral norms, and personal commitments that ultimately strengthen rather than weaken the growth of scientific knowledge."[ii]

Michael Polanyi (1891-1976) belonged to a wave of "surprisingly intelligent Hungarians" who moved to Berlin in the wake of WWI and its aftermath in Hungary – the Bela Kun-led communist revolution and the anti-semitic Miklos Horthy-led counter-revolution. Polanyi had done his first degree in medicine in Budapest in 1913. He then studied physical chemistry with Georg Bredig and Kasimir Fajans at the Technical University in Karlsruhe, completing a doctoral thesis in 1917 on the thermodynamics of gas adsorption, which he defended in Budapest. In September of 1920 he took a position at the Kaiser Wilhelm Institute for Fiber Chemistry in Berlin-Dahlem, whence he transferred in 1923 to the adjacent Kaiser Wilhelm Institute for Physical Chemistry and Electrochemistry, headed by Fritz Haber.

Even Polanyi's work in physical chemistry had an uncommonly wide scope, ranging from the study of the structure of cellulose (whose macromolecular character Polanyi anticipated in 1921) to the structure and properties of crystals (in particular crystal defects) to adsorption of gases (physisorption) to heterogeneous catalysis (the Horiuti-Polanyi mechanism of hydrogenation) to chemical kinetics, his foremost preoccupation. With his mutually "trusting but critical" team of young theorists, which included Eugene Wigner, Fritz London, and Henry Eyring, Polanyi laid the conceptual foundations for kinetic theory consistent with the new quantum mechanics and foreshadowed the coming of chemical reaction dynamics, which would only arrive in the early 1960s America. Of paramount importance was Polanyi's team's work on the dynamics of the simplest chemical exchange reaction, $H+H_2 \leftrightharpoons H_2+H$, which was prompted by the discovery at Haber's institute of para-hydrogen and the study of its interconversion with ortho-hydrogen. This work established a way of looking at the process of making and breaking of chemical bonds which, for thermal and hyperthermal reactions, prevails until this day: a ball, representing the configuration of the constituent atoms' nuclei, rolls on the potential energy surface, given by the eigenenergy of the atoms' electrons. En route from the valley of the reactants to the valley of the products, the ball follows a path restricted by the reaction's energy disposal. This view of the reaction entails a separation between the nuclear and electronic motions, known today as the Born-Oppenheimer approximation. London's tackling of the H_3 system breathed new life into Svante Arrhenius's 1889 concept of activation energy, by reinterpreting it as the summit-to-be-conquered between the electronic eigenenergy valleys of the reactants and products. The rate at which the ball makes its transit over the summit—and hence the rate of the reaction—was evaluated in 1932 in Polanyi's group by Hans Pelzer and Wigner who made use of statistical mechanics and the London-Eyring-Polanyi semiempirical potential energy surface. This was the first take on the "transition-state" or "activated complex" theory of chemical reactions, which would be developed by Eyring and his collaborators at Princeton and Polanyi and Meredith Evans at Manchester in 1935, and later refined by others.[iii]

Polanyi's Berlin years, of which Wigner said, "I doubt [Polanyi] was ever again as happy as he had been in Berlin," came to an end with the rise of the Nazis to power

and Polanyi's forced emigration from Germany in August of 1933. He found a new academic home at the University of Manchester, where he received the chair made famous by John Dalton. In Manchester, Polanyi published about forty percent of his overall scientific output, including his "activated complex" theory. This despite the modest working conditions there; as Polanyi once jokingly explained to a visitor, his "laboratory's floor … was so weak and unstable that they had to make instrument readings by first standing on the right foot, then on the left foot, and then taking the average."

With the deterioration of the political climate in the 1930s Europe, the "twice-exiled" Polanyi embarked on a mission which would gradually claim most of his attention: standing up for political and economic freedom in general and for academic freedom in particular. Mary Jo Nye notes that "the freedom of research that [Polanyi] had experienced in a tightly networked community of world-class colleagues within the tree-lined precincts of Dahlem [a.k.a. 'the German Oxford'] became an induplicable but idealized memory that formed the foundation for his later writings on the nature of scientific life and scientific achievement. The loss of his Berlin scientific community and gradually of his own scientific productivity led to later reflections on the social conditions of scientific work and on the difficulty of transplanting established traditions in new terrain." The University of Manchester, "was not deterred by suspicions that Polanyi could never be more, academically speaking, than an amateur philosopher. … Was not Polanyi, in the strict academic sense, an amateur in everything except his early skills in medicine? And could anyone quarrel with the result?"[iv] and created a chair in "Social Studies" for him in 1948. What made this appointment even more audacious was that Polanyi would need ten more years to write his first major work outside of physical chemistry. Aided by philosopher Marjorie Grene, Polanyi toiled on *Personal Knowledge*, his philosophical *magnum opus*, at least since delivering his 1951-1952 Gifford Lectures. Interestingly, the University of Chicago, under its liberal president Robert Maynard Hutchins, was interested in Polanyi the philosopher and public intellectual as well and offered him in 1951 a chair in social philosophy. Polanyi decided to accept it, but couldn't because he was denied a U.S. visa based on absurd McCarthyite allegations of his association with communists. In 1959, Polanyi moved from Manchester to Merton College, Oxford, as Senior Research Fellow.

By Polanyi's own account, "The principal purpose of [*Personal Knowledge* (1958)[v] and of its abridged and more accessible variant, *The Tacit Dimension* (1966)[vi]] is to achieve a frame of mind in which I may hold firmly to what I believe to be true, even though I know that it might conceivably be false. … I'm trying to convince myself." The starting point of Polanyi's project, conceived ambitiously as a new epistemology, was that "*we can know more than we can tell*" and that "all knowledge is grounded in [such] tacit knowing." Polanyi's favorite example is the "art of recognizing a characteristic appearance by unspecifiable particulars … We practice it every day when watching the delicately varied expressions of the human face, and recognizing its moods without being able to identify, except quite vaguely, the signs by which we do so." And Polanyi adds that the most "striking concrete example of an experience" that relies on tacit knowing is simply "the experience of seeing a problem, as a scientist sees it in his pursuit of discovery." Another, more sociological element of Polanyi's philosophy, is concerned with the transfer of scientific knowledge from teacher to pupil: "the master chooses the problems, selects a technique, reacts to clues and difficulties, and keeps speculating all the time. It is a system of apprenticeship rooted in tacit knowledge that often cannot be articulated and constitutes a tradition passed from mentor to apprentice." At the same time, personal knowledge is not subjective, as it establishes contact with reality in "anticipating an indeterminate range of yet unknown true implications." Polanyi spoke of "intellectual passions" as constituents of the personal engagement that is needed for scientific work. *Personal Knowledge* is permeated with historical examples none of which, however, came from Polanyi's own research. One of the examples stands out, namely Einstein's work on special relativity: from the fact that Einstein did not cite in his 1905 paper on the subject the Michelson-Morley experiment, Polanyi concluded that Einstein's theory was conceived "on the basis of pure speculation, rationally intuited by Einstein before he had ever heard about [the experiment]." In 1992, summarizing his research under the heading 'An Experimental Proof of Tacit Knowledge,' the physicist and historian of science Gerald Holton showed that Polanyi had been essentially right.[vii]

Polanyi's philosophical writings have not become as well known as those of his contemporaries, Karl Popper (whose logical empiricist characterizations of science as a system of detached objectivity were anathema to Polanyi) or Thomas Kuhn (with whom Polanyi agreed on key issues and whom he inspired). Stefania Ruzsits Jha points out that "Polanyi's choice of language seems to be the greatest barrier to understanding his works, especially his philosophy of science."[viii] Mary Jo Nye aptly adds that, "When Polanyi abandoned his work in physical chemistry in order to launch a crusade on behalf of a liberal and humane science in a free society, he did so without having experienced the apprenticeship and mentorship in social science and philosophy that he knew were necessary for membership in a discipline."

A chapter in Mary Jo Nye's book is dedicated to illustrating her point that "Polanyi's truly original ideas in philosophy of science occurred in [his] explicitly political writings that appeared well before the publication … of [*Personal Knowledge*]." Polanyi developed his views on science policy and economics, his first non-chemical interests, through intense discussions with other scientists and economists, including his older brother Karl, a noted socialist political economist. Appalled by the inefficiency of Soviet central planning and by John D. Bernal's 1939 Marxist appeal to introduce central planning in science, Polanyi extolled the virtues of the Keynesian capitalist market system and likened the coordination by mutual adjustments within the scientific community to a free market guided by a "hidden hand." The analogy between the workings of the scientific community and a free market economy was the subject of a 1942 draft titled "The City of Science," which would become, once refined and published twenty years hence, one of Polanyi's best know essays, "The Republic of Science."[ix] It ends with Polanyi's redefinition of the scientific community as a "Society of Explorers." Mary Jo Nye points out that, "Polanyi's argument against Bernal that science requires the structure of a liberal republican framework in order to thrive is a clearly political argument and one that was common among natural scientists and social scientists in the West and especially in the United States."

Polanyi's last student, Paul Craig Roberts, who joined Polanyi at Merton College, strengthens Nye's argument by pointing to the centrality of Polanyi's concerns for the intangibles, in particular for "thought as an independent, self-governing force,"

banished, in Polanyi's view, by modern skepticism.[x] This is, according to Polanyi, where positivist empiricism and the moral skepticism of the 20th century had met to spell disaster. Polanyi's remedy, which echoes his maxim "The freedom of a subjective person to do as he pleases is overruled by the freedom of the responsible person to do as he must," articulated in *Personal Knowledge*, is a "Western Commonwealth" in which "all people of the West will have to undergo some assimilation towards a more uniform type of man." Its basis will be the "rule of law, equal citizenship and a religion rather similar to early Christianity with its admixture of Greek philosophy."[xi] Does this ring a bell? Are we there yet or at least getting there? If so, it may be another experimental proof of Michael Polanyi's theory of knowledge. To which Mary Jo Nye's book provides a comprehensive and comprehensible guide all the way down to its roots.

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[i] M.J. Nye, *Michael Polanyi and His Generation, Origins of the Social Construction of Science*, The University of Chicago Press, Chicago, 2011.
[ii] Unless indicated otherwise, quotes are from ref. [1].
[iii] "One Hundred Years of the Fritz Haber Institute": B. Friedrich, D. Hoffmann, J. James, *Angewandte Chemie Int. Ed.* **2011**, *43*, 10022-10049.
[iv] Sir William Mansfield Cooper, as quoted in "Michael Polanyi": E.P. Wigner, R.A. Hodgkin, *Biographical Memoirs of Fellows of the Royal Society* **1977**, *23*, 413-448.
[v] M. Polanyi, *Personal Knowledge: Towards a Post-Critical Philosophy*, The University of Chicago Press, Chicago, 1958.
[vi] M. Polanyi, *The Tacit Dimension*, The University of Chicago Press, Chicago, 1966.
[vii] "Michael Polanyi and the History of Science": G. Holton, *Tradition and Discovery* **1992**, *19*, 16-30.
[viii] Stefania Ruzsits Jha, *Reconsidering Michael Polanyi's Philosophy*, University of Pittsburgh Press, Pittsburgh, 2002.
[ix] "The Republic of Science: Its Political and Economic Theory": M. Polanyi, *Minerva* **1962**, *1*, 54-74.
[x] "Michael Polanyi: A Man for All Times": P.C. Roberts, *Tradition and Discovery* **2006**, *32*, 15-18.

[xi] "Jewish Problems": M. Polanyi, *The Political Quarterly* **1943**, *14*, 33-45.