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SCIENTIFIC PRACTICE AND POLITICS: A PRELIMINARY LOOK AT BLACKETT AND POLANYI IN MANCHESTER

(Revised version of a paper presented at the University of Manchester, 23 May 1995)

Born in Budapest, Michael Polanyi (1891-1976) moved in 1933 from his position at the Kaiser Wilhelm Institute for Physical Chemistry in Berlin to the University of Manchester, where he stayed until he became a Fellow at Merton College Oxford in 1959. In the early 1930s Polanyi was well-known for his studies in thermodynamics, especially chemical kinetics and transition-state theory, and he was experienced in x-ray analysis of fibers and crystals. This latter x-ray work was of immediate interest to Manchester's Longworthy Professor of Physics, William Lawrence Bragg, one of the world's innovators and experts in x-ray crystallography.[1] Bragg was enthusiastic about hiring Polanyi.

Four years later, in 1937 Patrick Maynard Stuart Blackett (1897-1974) arrived in Manchester. He had spent more than ten years in Ernest Rutherford's Cavendish Laboratory while a fellow at King's College (1922-1933) and he left his position as professor of physics at Birkbeck College in London to succeed Bragg at Manchester. Blackett was internationally known at this time for his experiments and photographs demonstrating the disintegration of the nitrogen nucleus by alpha particles and the existence of positrons in cosmic rays.

Blackett had been an external examiner at Manchester since 1933. He was acquainted with Polanyi and had seen him socially in London as well as in Manchester. Blackett shared with Polanyi an interest in physical chemistry, dating from Blackett's work on the specific heats of gases with the Cambridge physical chemists Eric Rideal and D. Henry.[2] Polanyi and Blackett and their wives Magda Polanyi and Constanza Blackett, whom the Blacketts' friends called "Pat," were good friends who kept up correspondence that can be found in the Royal Society's archives until well into the 1960s. Blackett addressed Polanyi by the familiar "Mischi," and Polanyi signed his letters to Blackett "Misi."[3]

A common interest shared by Blackett and Polanyi was politics, though in political matters they very often found themselves on opposite sides of an increasingly wide ideological divide. This divide was the line between Blackett's marxist-influenced Fabian socialism and Polanyi's free-market influenced conservative liberalism. In their political activities, neither followed the example of Bragg. When interviewed by David Edge in 1969 and asked about his political views and about those of his father William Henry Bragg, Sir Lawrence replied as follows as in the interview:

> Edge: Political views --- your father didn't talk about this? Was he essentially a conservative?
>
> Bragg: I don't think so. I think he was a-political, and I think I am a-political, too.

You presumably both vote?

Bragg: We generally voted . . . did we always vote conservative . . . perhaps we always have. I'm not sure . . . .

Edge: You don't see in any way any relationship between your scientific work and discipline and the values that are involved in that and political . . .

Bragg [interrupting]: Certainly not.[4]

In contrast to Bragg's apparent disinterest in politics, Polanyi, the son of a railroad entrepreneur, was involved as a very young man in intellectual and political meeting groups in Budapest. These groups numbered among their members his brother Karl Polanyi, the mathematician George Polya, the physicist Bela Balazs, and the social theorists Karl Mannheim and George Lukacs. It was ostensibly because of his participation in the Galileo Circle, a Hungarian nationalist group founded in 1908 by his brother Karl and by Oscar Jaszi, that Polanyi's visa to the United States was held up in 1951 under the McCarron Act on the grounds of his past involvement with a subversive organization linked to communists.[5] Blackett also could not get a visa to the United States in these years.

As Polanyi told Thomas S. Kuhn in an interview, he was about to take up a position in the government of the new Hungarian Republic in the fall of 1918. At the time Polanyi had a medical degree and a Ph.D. in physical chemistry. Bela Kun and the Communist Party came to power the following spring of 1919 and by the summer's end there was a coup d'état led by the authoritarian, conservative, and anti-Semitic Admiral Nicholas Horthy.

Polanyi, a Jew, was baptized in the Catholic church about this time and left Hungary for Germany, first for Karlsruhe and then for Berlin. In 1928 Polanyi, Leo Szilard, and John von Neumann began following a seminar in economics with Jacob Marschak, trying, as Polanyi put it, "to understand the Russian phenomenon." [6] The Russian problem was not new to Polanyi. His mother was born in Vilna, Lithuania and his sister moved to the USSR in the 1930s.

By 1935, when Polanyi wrote a long paper critical of Soviet economics published by the *Manchester School of Social and Economic Sciences*, he had visited Russia four times. He was a fervent critic of arguments by British scientists sympathetic to Marxism, socialism, and centralist planning for science. These arguments were made in books, articles, and radio broadcasts by J. D. Bernal, Julian Huxley, Joseph Needman, Hyman Levy, J. B. S. Haldane, and Lancelot Hogben, as well as by the *Manchester Guardian* science correspondent J. G. Crowther and by Polanyi's friend Patrick Blackett.[7]

In 1935, Blackett was serving on the committee chaired by Henry T. Tizard to advise Winston Churchill and the Air Ministry on military strategies, especially radar and saturation bombing.

This was one of many government and Labour-Party committees on which he would serve. Blackett was a member of the recently radicalized Association of Scientific Workers, which had been founded at the conclusion of the First World War. A naval officer, grandson of a vicar, and the son of a stockbroker, Blackett had been voting Labour since 1922 when he campaigned for Hugh Dalton in a motor bicycle and side-car. Blackett was encouraged to stand as a Labour candidate in 1935 but declined.[8] One of the reasons he left Cambridge was that he did not feel his left-wing politics fit in well there. (He also left Cambridge because he felt that Rutherford did not sufficiently appreciate him, favoring Piotr Kapitza.) [9]

The lives and careers of Partick Blackett and Michael Polanyi form the type of intellectual and social pattern that S. S. Schweber has characterized by the paradoxical trope of the intersecting trajectories of parallel scientific lives. Schweber has been using such parallels and intersections in order to construct a biography of the contemporary physicist Hans Bethe.

My aim in focussing on Blackett and Polanyi is both similar and different. Each merits a scientific biography that not only focusses on his work in physics or in physical chemistry, but that addresses his philosophy of doing science and his beliefs about the scientist's ethical and political responsibilities. Currently I am taking a biographical approach simultaneously to both Polanyi and Blackett with the intention of understanding each all the better by juxtaposing their scientific work and political commitments while these two men were friends and rivals at the University of Manchester.

Blackett was a consummate experimentalist whose work embodies the principles of tacit knowledge that Polanyi expostulated in his influential book *Personal Knowledge*. At the end of the Second World War, Blackett returned to his laboratory at Manchester and embarked on an ambitious new investigation of magnetism that he thought would be even more important than the earlier work for which he was awarded the Nobel Prize in 1948. Polanyi at this time definitively left the laboratory, exchanging his professorship in physical chemistry for one in social studies, convinced that he never had achieved in his scientific work the significant achievement that he coveted. Their Manchester colleague, the registrar William Mansfield Cooper noted the paradox:

> Blackett the great theoretical planner had a genius for improvisation and getting things done. Polanyi the exponent of freedom and the critic of planning was most meticulous and cautious in action. ... there was no feuding ... always reason and sometimes near affection and certainly respect supervening.[10]

However, as I have implied, my aim is not only biography. I also intend by focussing on two scientific friends with such very opposite views on matters of politics to explore more fully the aims and values that were shared by the British community of physical scientists in the historical period from the 1920s to the 1960s, as well as those aims and values that were profoundly contested. Thus my study is specifically localized in individuals and their precise roles in the history of science, but it also endeavors

to ask questions about scientific values that have meaning for the entire scientific community and its place in the cultural fabric of modern society. The locus of my community is Great Britain, but implications are broader.

With this long introduction, let me turn now to some specific aspects of my project that deals with Polanyi's and Blackett's years in Manchester. I will outline some of the themes of their work and their controversies and conclude by asking for comments and advice from you on some of these matters.

When Polanyi arrived in Manchester in 1933, he had been courted by Manchester physicists and chemists for a couple of years. Arthur Lapworth, who was chairing the chemistry department, had been seeking to make an eminent appointment after the departure in 1928 of the organic chemist Robert Robinson. F. G. Donnan, the influential and well-connected physical chemist at University College London, was as interested in bringing Polanyi to England as he had been in getting Robinson to come to Imperial College in 1928.

When Polanyi first interviewed at Manchester in 1932, he greatly impressed Bragg with his knowledge of x-ray crystallography. He also delighted those members of the Manchester faculty who admired his erudition and shared with him a common interest in the detective stories of the London chemist A. W. Stewart, who wrote novels under the pseudonym of Connington.

Polanyi was interested in leaving Berlin largely because of the political situation in Germany, but he hesitated to leave very good laboratory facilities and a very cosmopolitan city for an inferior laboratory and a city that was filled with smog during his visit. So he turned down the offer in Manchester and Lapworth successfully offered the position to the organic chemist Ian M. Heilbron.

After Hitler was appointed Chancellor in January 1933 and civil-service purge laws were passed in March, Polanyi renewed discussions about the Manchester appointment and gratefully accepted it.[11] By August he and his family had packed their personal belongings and he had arranged the shipment of much of his Berlin equipment, including high-vacuum mercury pumps and a precision machine lathe, as well as two technicians to run them.[12]

In 1933 Polanyi was working mainly on reaction kinetics and transition theory. He had experienced some setbacks and disappointments in his work before the late 1920s. Three separate lines of investigation had given him results that were regarded as inconclusive or mistaken. His first original work in thermodynamics had been undertaken in 1913, right after he completed his medical degree, as he began studies in physical chemistry with Georg Bredig and Kasimir Fajans in Karlsruhe. Using Walther Nernst's third law of thermodynamics and reasoning by analogy from low temperatures to high pressures, Polanyi proposed that entropy would decrease to zero at infinite pressure. A young and ambitious Polanyi requested Bredig to send the paper to Einstein in Zurich, who liked the paper and corresponded with Polanyi on some points of disagreement. The theory, however, was more or less a

dead end because of the impracticality of the limiting condition of infinite pressure.[13]

Polanyi's doctoral thesis at Karlsruhe in 1917 addressed the adsorption of molecules of gas on a solid surface. When he discussed it in Berlin in 1921, his theory was strongly criticized by both Nernst and Einstein on the grounds that the long-range forces required by the theory were impossible. Polanyi's new Berlin colleague Hermann Mark was much more positive from a chemist's point of view, but Polanyi remained bitter even in the 1960s that Irving Langmuir's monomolecular theory of adsorption was preferred to his multi-layer theory even after Fritz London helped Polanyi reformulate the theory in terms of quantum mechanics.[14]

Polanyi arrived in Berlin in the fall of 1920, first as a researcher at the Kaiser Wilhelm Gesellschaft in Reginald Herzog's Institute of Fiber Analysis. From 1923 to 1933, he was head of a department for reaction kinetics in the KWG Institute for Physical Chemistry and Electrochemistry directed by Fritz Haber. Two more investigations during the 1920s led to what seemed failed theories: first, a theory of chemical reaction activation by a mechanism of radiation seated in an aether; and secondly, the speculation that x-ray studies of cellulose suggested a long-chain macromolecular structure for this fiber.

The first theory was strongly disliked by Max Born, James Franck, and Einstein. It formed part of a debate in the 1920s about radiation and reaction mechanisms that was resolved in favor of a kinetic theory of collisions worked out by Cyril Hinshelwood[15]. The second theory was strongly disliked by a good many organic chemists but was proved correct in the 1930s by Kurt Meyer, Hermann Mark, Hermann Staudinger, Walter Carothers, and other founders of the science of macromolecules.[16]

Where Polanyi's work really did clearly succeed in the late 1920s and early 1930s was in his studies of fast reaction rates, for example of sodium vapor and halogen gas using precipitates or flame analysis, complemented by his development of a theory of the transition state. Eugene Wigner, a fellow Hungarian from Budapest who became a good friend, completed his doctoral thesis in Polanyi's laboratory by studying reaction rates between colliding atoms before turning to quantum mechanics. Another Hungarian, Leo Szilard, was collaborating with Hermann Mark.[17]

Henry Eyring came from Wisconsin to study with Polanyi in Berlin during 1929-1930. He arrived just when Polanyi was thinking of using contour maps for representing the potential energy of a hydrogen/ hydrogen bromide system as the bromine comes near one hydrogen and the other hydrogen recedes. A ball rolling on a surface would describe the position of all three atoms. This approach to energy of activation, with the representation of the transition state as a ball rolling over a peak or hump, proved extremely fruitful both in the short and the long run. They used semi-empirical methods, based in quantum mechanics and relying on experimental data for vibrational frequencies and energies of association. Polanyi and Eyring published together two papers during 1930-1931, followed by Polanyi's publication of the book *Atomic Reactions* in 1932.[18]

By 1933, Eyring and Wigner, as well as Polanyi's Hungarian friend John von Neumann, all were in Princeton, and Polanyi was in Manchester. Some of his students or coworkers came with him from

Berlin, among them Juro Horiuchi, who was studying hydrogen exchange and catalytic reactions of hydrogen, and Andreas Szabo, who was working on hydrogen and halide substitution in the general chemical reactions known as the Walden Inversion (a chemical reaction in which a molecule is turned inside out, in the sense that the configuration of an optically active substrate is converted to its mirror image.)[19]

In the next years at Manchester, Meredith G. Evans was to become one of Polanyi's principal coworkers on reaction kinetics and the theory of the transition state.[20] R. A. Ogg, Jr., a postdoctoral fellow from Harvard, took up investigations of substitution of atoms and radicals in organic reactions.[21] Polanyi's work continued to deal in part with physical organic chemistry, with results that interested his organic colleague Ian Heilbron and then Heilbron's successor Alexander Todd.[22]

Next part

Notes

1. See W. L. Bragg Papers, Royal Institution: R. A. Hogdkin and Eugene P. Wigner, `Michael Polanyi, 1891-1976,' *Biographical Memoirs of Fellows of the Royal Society*, 23 (1977), pp. 421-448.

2. In a report on chemistry at the University of Cambridge in 1933, C.P. Snow noted the importance of the method for measuring specific heats being perfected by Henry and originated by Blackett. In C.P. Snow, `Chemistry,' pp. 97-127 in Harold Wright, (ed.), *University Studies. Cambridge 1933* (London: Ivor Nicholson and Watson, 1933), p. 105.

3. Magda Kemeny Polanyi was an advanced student in chemistry who stopped short of writing a doctoral dissertation at the Karlsruhe Technische-Hochschule. She enrolled at the Berlin Technische-Hochschule after their marriage in 1921 but did not complete the Ph.D. Their son John Polanyi shared the Nobel Prize in Chemistry in 1986 with Dudley Herschbach and Y. T. Lee. Correspondence in the collected papers of P.M.S. Blackett includes a lively letter from Magda Polanyi, dated 13 June 1965, on the occasion of Blackett's receiving the `Companion of Honour'; and a seventieth birthday card and congratulations on Blackett's receiving the `Order of Merit' in November 1967. Royal Society Archives, London. Also, see handwritten draft of letter from Blackett to Polanyi, 11 March 1939, and letter from Polanyi to Blackett, dated 28 October 1941.

4. Interview of David Edge with Sir Lawrence Bragg, 20 June 1969, in Sources for the History of Quantum Physics, American Institute of Physics. REQUIRES PERMISSION FOR DIRECT QUOTATIONS

5. See John M. Cash, *Guide to the Papers of Michael Polanyi. The Joseph Regenstein Library*,

Department of Special Collections (University of Chicago, 1977), pp. 2, 8. Also, Lee Congdon, biography of George Lukacs and *Exile and Social Thought. Hungarian Intellectuals in Germany and Austria, 1919-1933* (Princeton: Princeton University Press, 1991). Karl Polanyi became a distinguished economic historian who emigrated to the United States and held a professorship at Columbia University.

6. Interview of Michael Polanyi with Thomas S. Kuhn, 15 February 1962, pp. 10 -11. Sources for the History of Quantum Physics, Niels Bohr Library, American Institute of Physics.

7. See William McGucken, *Scientists, Society, and State. The Social Relations of Science Movement in Great Britain. 1931-1947* (Columbus: Ohio State University, 1984) and Gary Werskey, *The Visible College. A Collective Biography of British Scientists and Socialists of the 1930s,* 2nd ed. (London: Free Association Books, 1988.)

8. Blackett, `Interlude on Politics,' 2 pages, from materials intended for autobiography, Blackett Collected Papers, A.10A, Royal Society Library. And Letter from Alex Wood to Blackett, dated 5 February 1935, Blackett Collected Papers, A. 26, Royal Society Library.

9. `Patrick Blackett . . . an appreciation by Sir Edward Bullard,' *Nature,* 250 (2 August 1974), p. 370.

10. Quote as personal communication of 1976 in E. P. Wigner and R. A. Hodgkin, `Michael Polanyi,' Biographical Memoirs of Fellows of the Royal Society, 23 (1977), pp. 413-448, on p. 425.

11. From William T. Scott, `Michael Polanyi's Creativity in Chemistry,' pp. 279-307 in Rutherford Aris, H. Ted Davis, and Roger H. Stuewer, (eds.), *Springs of Scientific Creativity. Essays on Founders of Modern Science* (Minneapolis: University of Minnesota Press, 1983), p. 299. Also, in Alexander Todd, *A Time to Remember. The Autobiography of a Chemist* (Cambridge, 1983) and G. N. Burkhardt, `Schools of Chemistry in Great Britain and Ireland. XIII. The University of Manchester,' *Journal of the Royal Institute of Chemistry,* 78 (1954), pp. 448-460 and `Some Famous Manchester Scientists,' 4 January 1983 lecture at Association for Science Education.

12. Scott, p. 299.

13. See Scott, p. 283 and Gerald Holton, `Michael Polanyi and the History of Science,' *Tradition and Discovery. The Polanyi Society Periodical,* 19, #1 (1992-1993), pp. 16-30, reprinted in Holton's 1995 book of essays on Einstein.

14. Michael Polanyi and Fritz London, `The Theoretical Interpretation of Adsorption Forces,' *Naturwissenschaft,* 18 (1930), 1099 ff. See Scott, pp. 283-284; and Interview of Polanyi by Thomas Kuhn, 15 February 1962, p. 10. (see fn. 6.)

15. Polanyi was a participant at a meeting in Minneapolis in 1926 of the American Chemical Society with Bodenstein, Donnan, Langmuir, Hinshelwood, and Francis Perrin where Hinshelwood's theory was

strongly favored as reported by Hugh Taylor. See Christine King and Keith Laidler, pp. 77, 82 in `Chemical Kinetics and the Radiation Hypothesis,' *Archives for History of Exact Sciences*, 30 (1984), pp. 45-86; Hugh Taylor, `Fifty Years of Chemical Kineticists,' *Ann. Rev. P. Chem*., 13 (1962), pp. 1-18, on p. 11; and remarks by R. G. W. Norrish at the 1923 Faraday symposium on valency, in *Trans. Far. Soc*., 19 (1923-1924), pp. 520-521.

16. See Scott, pp. 287-290. Also M. J. Nye, *From Chemical Philosophy to Theoretical Chemistry*, pp. 121-129 on the radiation theory of chemical activation. On cellulose, see Michael Polanyi, `My Time with X-Rays and Crystals,' pp. 629-636 in P. P. Ewald, (ed.), *Fifty Years of X-Ray Diffraction* (Utrecht, 1962) and Yasu Furukawa, Ph.D. dissertation.

17. Interview of Eugene P. Wigner with Thomas S. Kuhn, Session 2 of 3 sessions, 3 December 1963, pp. 5, 8-9, Sources for the History of Quantum Physics, American Institute of Physics.

It was at this time that Polanyi approached Max Born for help with quantum theory and chemical reactions. Born asked what cases, what laws, Polanyi would like to derive and explain. Polanyi replied that he needed an explanation for the fact that single atoms react much faster with a molecule than molecules with each other, for example, a sodium atom with a chlorine molecule. And according to Polanyi, Born replied that this was far too complicated a problem to do. (Interview of Polanyi with Kuhn, 15 February 1962, p. 9.) Wigner went on to study quantum mechanics and these kinds of problems. For some of Wigner's work with Polanyi, see Polanyi and Wigner, `Formation and Decomposition of Molecules,' *Zeitschrift für Physik*, 33 (1925), pp. 429-434; and H. Pelzer and E. Wigner, `<154>ber die Geschwindigkeitkonstante von Austauschreaktionen,' *Zeitschrift für physikalische Chemie*, B, 15 (1932), pp. 445-471.

18. Michael Polanyi and Henry Eyring, `On the Calculation of the Energy of Activation,' *Naturwissenschaften, 18 (1930),* pp. 914-915, and `On Simple Gas Reaction,' *Zeitschrift für physikalische Chemie*, B, 12 (1931), pp. 279-311; Michael Polanyi, *Atomic Reactions* (London: Williams and Norgate, 1932). See Jeffry Ramsey, `Between the Fundamental and the Phenomenological: The Challenge of `Semi-Empirical' Methods,' *Philosophy of Science*, in press.

19. Michael Polanyi and J. Horiuti, `A Catalyzed Reaction of Hydrogen with Water,' *Nature*, 132 (1933), p. 819; `Catalyzed Reaction of Hydrogen with Water, and the Nature of Over-voltage,' *Nature*, 132 (1933), p. 931; `Exchange Reaction of Hydrogen on Metal Catalysts,' *Transactions of the Faraday Society*, 30 (1934), 1164 ff. Michael Polanyi and A. L. Szabo, `On the Mechanism of Hydrolysis. The Alkaline Saponification of Amyl Acetate,' *Transactions of the Faraday Society*, 30 (1934), 508ff.

20. Meredith Gwynne Evans (1904-1952) was educated at Leigh Grammar School and the University of Manchester. He was appointed Lecturer at Manchester from 1926 {?} until 1939 when he became professor of physical chemistry at Leeds, returning to Manchester in 1949. He was elected FRS in 1947. Source: *DNB*.

21. Michael Polanyi and M. G. Evans, `Some Applications of the Transition State Method to the Calculation of Reaction Velocities, Especially in Solution,' *Transactions of the Faraday Society*, 31 (1935), 875 ff; `Further Considerations on the Thermodynamics of Chemical Equilibria and Reaction Rates,' *Trans. Faraday Soc*., 32 (1936), 1333 ff; etc.; and Michael Polanyi, R. A. Ogg, Jr., and L. Werner, `Optical Inversion by Negative Substitution,' *Chemistry and Industry*, 53 (1934), 614 ff.; `Substitution of Free Atoms and Walden Inversion,' *Trans. Faraday Soc*., 31 (1935), 482 ff., etc. See the book by M. G. Evans's brother Alwyn G. Evans, *The Reactions of Organic Halides in Solution* (Manchester: Manchester University Press, 1946).

22. Sir Ian Morris Heilbron (1886-1959) was educated at Glasgow High School, the Royal Technical College, and Leipzig. He served in the Army during 1914-1918, taught at the Royal Technical College during 1909-1914 and 1919-1920; Liverpool 1920-1933, Manchester 1933-1938, and Imperial College 1938-1949. He was director of the Brewing Industry Research Foundation from 1949-1958. He was elected FRS in 1931 and knighted in 1946. *DNB*. Both Heilbron and Todd did a great deal of work in natural products chemistry, continuing the legacy of Robert Robinson. This included vitamins and penicillin in both cases.

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