

## MICHAEL POLÁNYI'S EARLY YEARS IN SCIENCE

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The literature on Michael Polányi's philosophy is abundant. His philosophical system has become a classic, particularly in the field of philosophy of science(1). His most famous book, *Personal Knowledge*(2), has been analyzed in short papers as well as in substantial books, sometimes in strong agreement sometimes in disagreement but seldom very objectively. Some philosophers are not even aware of Polányi's work in chemistry or else ignore it. On the other hand, historians of science consider him a major figure in 20th century physical chemistry as well as in some fields of physics, and they ignore his philosophy which they regard as unimportant. Both groups seem to feel that the question whether a relationship can be found between Polányi's philosophy and his chemistry is a problem for the future, or else they see the two as totally independent from each other as if they were created by two different persons. In this paper the Hungarian chemical origins of Polányi's scientific thinking will be analyzed. This part of his career has not been investigated. A

detailed Polányi biography does not yet exist, only some sketches having appeared so far(3). Although not analyzed here, his philosophical commitments can also be traced back to his education in Hungary, to his family, to his early schools, and to his early social and political experiences(4).

In 1928, Michael Polányi was living in Berlin where the editor of a popular Hungarian newspaper asked him about the educational scene in Hungary. He contrasted it with Germany where(5):

...the professors grab with great enthusiasm the hands of students who are thought to be gifted. They are like art collectors whose main passion is to discover talent. Here, [in Berlin] this belongs to the duties of a professor. They educated me, they placed me here where I can do my utmost. They provide me with everything and do not ask for anything. They trust that the man who is aware of the joy of science, will not leave it for the rest of his life.



*M. Polányi*

Michael Polányi, *Biogr. Mem. Fellows R. Soc.*,  
1977, 23, 413-448

He contrasted this situation with that of Hungary(6):

Looking back, I see many Michael Polányis stuck in the mud halfway, my good friends, unknown poor boys, a dozen of them like me or even better, fired from the university, knocked down by *numerus clausus*.

This sorry description does not explain how he managed to get near the German professors who "grabbed his hands like art collectors"(7). But he says in the same paper(8):

In the second semester of my university years, I got to the laboratory of Ferenc Tangl who took care of me from then on. In 1913, I became a medical doctor. Thanks to the help of Ignác Pfeiffer, by agreeing to serve as a companion to the son of a wealthy family, I was able to go to Karlsruhe [in the summer of 1912 and again in 1913/14] to study chemistry at the Technical University.

In the following, I will try to describe these first schools of Michael Polányi which, in spite of his critical remarks, could produce extremely good scientists. Around the turn of the century, a generation of outstanding scientists was born in Hungary. They made their impact in various fields such as philosophy, psychology, sociology, and the natural sciences. Among them were George de Hevesy (1885-1966), the Nobel laureate discoverer of the radioactive tracer method, Albert Szent-Györgyi (1893-1986), who won the Nobel prize for his theory of cellular oxidation and for discovering vitamin C, and physicists who became world-famous for their contributions to the Manhattan Project, among them Leo Szilárd (1898-1964), Eugene Wigner (1902-1995), Edward Teller (1909-), and John von Neumann (1903-1957), who became most famous for building the first giant electronic computer. All went to school in Hungary but at some point in their higher education moved to Germany or Switzerland, where after some years they gained scientific positions. However, they kept their contacts with the Hungarian scientific community and collaborated with their old colleagues in Hungary.

Michael Polányi, one of the most interesting personalities in this remarkable group, was born in Budapest in 1891. He went to high school in Budapest, a "Gymnasium" as it was called, founded by the father of another great emigrant scientist, Theodor von Kármán (1881-1963). Edward Teller, Nicholas Kürti (b. 1908, low temperature physics, Oxford), and the outstanding economists of England, Nicholas Káldor and Thomas Balog, went to the same school(9).

Polányi's career was quite unusual. He not only emigrated from countries like Hungary and Germany, to settle down finally in Manchester, England, but also changed scientific fields. Though as a schoolboy, particularly after reading H. G. Wells' *The World Set Free*, he was deeply interested in science, he became a physician. He decided to do this because his family was in constant financial difficulty after his father's early death, and his relatives felt that a good physician could always earn a fair amount of money. But his attraction to science prevented his staying long in medical practice, and he turned to physical chemistry and some aspects of physics. As a respected, very successful professor, he emigrated once more. In 1948, he resigned his chair of physical chemistry in Manchester and became professor-at-large of social sciences at the same university. He died in England in 1976. As a chemist, he was mostly engaged in the theory of adsorption, mechanical characteristics of solid, and X-ray analysis, but his most successful research was in reaction kinetics and the mechanism of chemical reactions(10). He followed an ambition that originated in his youth, to become a philosopher only after establishing himself as a scientist(11). At the age of 57, he was able to achieve his life-long ambition of becoming a philosopher and was drawn particularly to the philosophy of science, where his views have become classic. They became very influential in sociology, political philosophy, ethics, and even in aesthetics and religious studies.

Polányi's long path from medicine to physical chemistry went through a number of stages. 1. As a student he began to work in the laboratory of Ferenc Tangl. 2. With the help of Ignác Pfeiffer he studied physical chemistry in Karlsruhe, beginning in 1912. 3. He obtained his doctorate in chemistry at Budapest University in 1917 on the basis of his German research publications. 4. He worked as assistant to George de Hevesy in 1919. 5. In the same year, he left for Karlsruhe and then for Berlin to work with Fritz Haber. There are two Nobel laureates on this path, Hevesy and Haber, and two internationally less known persons, Tangl and Pfeiffer.

Ferenc Tangl (1872-1917), professor of physiology had a somewhat unusual career compared to his fellow professors of the time. He did not attain high university or political positions but was a very conscientious, precise researcher. His work in physiology dealt with subjects such as theories of ontogenesis, the development of bird embryos, energetics of the metamorphosis of insects, and problems of metabolism. Perhaps his most important skill was his ability to recognize outstanding intellectual qualities and excellence in research. Because

he could not find a position in the faculty of medicine of Budapest University, he worked for Budapest's Veterinary School and in 1893 was appointed to the chair of physiology and pathology in that school after visiting the most famous laboratories in his field, among them those of Robert Koch and Nathan Zuntz. He became head of the department of physiology at the medical school of Budapest University only in 1914, although he had worked in the university beginning in 1903 but in another department(12). In 1896 he organized a new institute for animal physiology and nutrition, the first in this subject in Hungary. The institute soon became an internationally recognized research center where Russian, English, American, and also Japanese scientists conducted research. This was unique in Hungary at that time. Tangl understood the significance of physical chemistry in physiology. He supported one of his former students, Gyula Groh, to succeed him in his department at the Veterinary School and asked him to help gifted young people as Tangl himself had done. This is how Hevesy carried out some of his earliest experiments with radioactive indicators at this institute, sometimes together with László Zechmeister (1889-1972), later professor at Caltech. Elisabeth Róna (1890-1981), the well-known researcher at Oak Ridge Laboratory after the second World War, also began her career here, continuing it in Vienna at the Institut für Radiumforschung.

This was Michael Polányi's earliest exposure to physical chemistry. His first papers were dated from Tangl's laboratory at Budapest University, where he learned the basic technique of precise experimental work. Polányi's choice was very lucky, as it would have been difficult to find such a serious, fruitful laboratory elsewhere in Hungary. His first paper, published in 1910, dealt with some properties of brain fluid taken from sick people(13). The paper contained accurate measurements of density, surface tension, and conductivity, showing that Polányi had learned to be a scientist. His later papers from the same laboratory contained more and more physical chemistry, especially colloid chemistry(14). This direction became very fruitful to him from two points of view: first, the attention he attracted from Albert Einstein because of his interpretation of the third law of thermodynamics helped him greatly in establishing himself as a scientist(15); second, he found one of his most successful subjects, adsorption, the theme of his doctoral thesis in chemistry(16).

His other mentor, Ignác Pfeiffer (1868-1941), became professor of chemical technology at the Technical University of Budapest in 1912, the year Polányi made his first trip to Karlsruhe. Pfeiffer's most significant in-

vestigations were related to the hardness of water. He worked out an analytical method to measure hardness and a way to soften water. He published pioneering research on combustibles, firing equipment, fuel technology, particularly coal and gas fuel. Later he was engaged in various problems of lighting devices(17). Although Pfeiffer had not taught Polányi, they had met several times. Their first and, from Polányi's point of view, most important contact occurred in 1912 when Pfeiffer helped him go to Karlsruhe as companion to a wealthy student. There he attended summer courses in elementary physical chemistry, electrochemistry, surface chemistry, and catalysis. This was Polányi's first schooling in his favorite subject, physical chemistry. He also established some important relationships, particularly with the outstanding Polish scientist, Kasimir Fajans, who later collaborated with Elisabeth Róna, another Tangl and Hevesy student. Moreover, Hevesy had heated discussions with Fajans on the new conception of chemical elements, and Polányi tried to mediate in an unpleasant situation. Both men had been his bosses at some time. It was a small world.

It is difficult to tell how and when Pfeiffer made contact with Polányi. There are various possibilities. First, Pfeiffer knew Tangl well, and the latter may have spoken to him about the extremely gifted medical student who needed first-class training in physical chemistry. The second possibility is more complicated. Pfeiffer suffered seriously from political persecution. After the first World War, two revolutions broke out in Hungary; and Pfeiffer took an active part in the second, the Communist one(18). Though Polányi had never been a revolutionary, a Communist, nor even a leftist, he was a member of a radical intellectual student organization called Galilei Circle. The secretary of this Circle was his brother, the renowned economist, Karl Polányi; and practically all the significant young intellectuals of the time were members, including Leo Szilárd and George Pólya (1887-1985), the famous mathematician who later went to Stanford. Pfeiffer attended the stimulating and nonconformist meetings. The discussions covered the most fashionable intellectual subjects of the time, such as sociology which was a new discipline in Hungary at the time, Ernst Mach's philosophy, and contemporary international and national politics. This professor of the Technical University, a member of the Freemason movement and later of the Zionist movement, was open-minded enough to listen to the younger generation. The two may well have met in this group. Of course, these are only conjectures. Hungarian middle class intellectuals moved in very small circles.

During the first of the two revolutions, the democratic one, Polányi won high rank in the ministry of health. He became state secretary, worked out a way of reorganizing the Hungarian health system, and contemplated giving up his scientific ambitions for a political career. When the Communists came to power, he gave up his position and went to teach in Hevesy's department. Pfeiffer, however, took on an important position during the second, the Communist revolution, becoming head of a section in charge of chemistry.

Both men changed careers after the revolutions. The new rightist regime forced Pfeiffer to retire from his university department. He was offered the position of head of the newly established private research laboratory of the United Lamp factory. He proceeded to organize the laboratory which became highly successful in developing the krypton bulb as well as in some basic research in experimental physics(19).

Polányi was terminated by the university because of his Jewish origin and democratic views, as can be concluded from a letter Hevesy wrote to Niels Bohr. Although he did not mention Polányi by name, he said that his two excellent assistants were ousted for the above mentioned reasons(20). Hevesy lost not only his professorship but also his right to lecture at the university where he had been *Privatdozent* since 1913. He left Hungary for Copenhagen where Bohr gave him a position in his newly established institute, which soon became the famous Copenhagen school of quantum physics. Thus a potentially superb scientific center in Budapest was dissolved because of narrow-minded right wing politics(21).

Pfeiffer, of course, was aware of Polányi's abilities and employed him as a consultant while he was living abroad. It became a long lasting relationship, quite advantageous also for Polányi who earned only a meager salary in Germany. This relationship persisted after Pfeiffer's retirement, during Polányi's Manchester period.

But this is another story; it does not belong to Polányi's early schools in Hungary. It belongs to his period of world success which was a result of his Hungarian schooling. By that time Polányi had become a leading personality in his field and had trained many significant chemists. Two Nobel laureates belong to the wide circle of his students: Eugene Wigner and Melvin Calvin. His Hungarian schooling also contributed to his success. Besides gaining a colorful, rich culture from his family, from high school, and from the lively intellectual life of Budapest [see Paul Ignatus, "The Hungary of Michael Polanyi"](22), he also gained a good

education from his professors. The revolutions, the failures of the extreme right and the extreme left, molded the philosophical convictions and moral commitments that were characteristic of Michael Polányi's thinking throughout his life.

## REFERENCES AND NOTES

1. One recent volume besides analyzing his philosophy, contains a detailed bibliography of Polányi's works. See H. Prosch, *Michael Polányi. A Critical Exposition*, University of New York Press, Albany, NY, 1986.
2. M. Polányi, *Personal Knowledge*, University of Chicago Press, Chicago, IL, 1958.
3. The most informative biographical sketch is E.P. Wigner and R.A. Hodgkin, "Michael Polányi," *Biogr. Mem. Fellows R. Soc.*, **1977**, *23*, 413-448.
4. See L. Congdon, "Michael Polányi and the Treason of the Intellectuals," *Currents in Modern Thought*, **1987**, 629-637.
5. M. Polányi, *Pesti Futár*, **1928**, *21*, 37-38.
6. *Ibid. Numerus Clausus* was a law passed right after the first World War limiting the number of Jewish students admitted to the universities. Many young people came back from the battlefields intending to begin or continue their studies and the universities had insufficient space and staff to handle them. But instead of selecting students on the basis of merit, which would have favored Jewish students, they used ethnic and religious criteria claiming that Jewish students were "over-represented." A quota of Jewish students was predetermined. As a consequence, many gifted young people were forced to attend universities outside Hungary.
7. *Ibid.*
8. *Ibid.*
9. I. Kiss, *A Trefort utcai "Minta" az ELITE SÁGVÁRI ENDRE GYAKORLÓISKOLA TÖRTÉNETE* (The History of Trefort Street "Minta", the Sagvari Endre Practice School of Eotvos Lorand University), Budapest, 1987.
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  16. M. Polányi, "Gázok (gőzök) adsorptiója szilárd, nem illanó adszorbensen" (Adsorption of Gases by a Solid Non-volatile Adsorbent), Ph.D. Thesis, Budapest, 1917.
  17. L. Móra, *Pfeiffer Ignác*, Budapest, 1977.
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  20. Hevesy to Bohr, October 25, 1919, Historical Sources of Quantum Physics (See Ref. 11).
  21. See G. Palló, "Why did George von Hevesy Leave Hungary?" *Periodica Polytechnica*, **1986**, 30, 97.
  22. Ref. 10, pp. 131-143.

**ENDNOTE:** An early version of this paper was presented in the "Mineralcontor" International Conference on the History of Chemistry and Chemical Industry, Veszprém, Hungary, August 12-16, 1991, and was published in a limited edition of the conference proceedings as a separate issue of *Technikatörténeti Szemle* XIX, **1992**, 189-193.

I am engaged in a major project on the migration of scientists from Hungary. See: G. Palló, "Hungarian Scientists' First Step of Emigration: from the Hungarian Periphery to the Center," *Periodica Polytechnica*, **1990**, 34, 319-323; Hungarians' Second Step of Emigration", *ibid.*, 1991, 35, 78-86; "Polányi Mihály pályája" (Michael Polányi's career) in E. Nagy and G. Ujlaki, Ed., *Polányi Mihály filozofiai írásai* (Michael Polányi's philosophical writings), Atlantisz, Budapest, 1992, pp.320-329; "Hevesy in Hungary" in G. Marx, Ed., *George de Hevesy (1885-1966)* Festschrift,

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