OBITUARY

Walter Kohn (1923–2016)

Walter Kohn is one of the most cited and influential scientists of our times. He died on 19 April 2016 in Santa Barbara. He was not only an outstanding scientist, but a special and extraordinary person — due to his charisma, and his alert and critical thinking — whose particular life story reflects the tragedies of the twentieth century.

Walter was born into a well-situated Jewish family in Vienna on 9 March 1923. He had a pleasant and sheltered childhood until 1938 when Austria joined Nazi Germany — the *Anschluss* — and Walter was forced to leave the renowned Academic Gymnasium to continue at a Jewish gymnasium where Emil Nohel, a former assistant of Einstein, elated him about mathematics and physics. In 1939, the Kohn parents sent their 16-year-old son to Great Britain with one of the last children's transport rescue missions (*Kindertransporte*). Walter never saw his parents again, as they were killed in Auschwitz. In spring 1940, when there was the risk of a UK invasion by Germany, he and other men who held a German passport were considered 'enemy aliens' and put in detention camps: first on the Isle of Man, and then Walter was shipped to Canada where he worked in a woodcutter camp. Following his release from internment he studied mathematics and physics in Toronto.

In 1946 he moved to Harvard, where the young Julian Schwinger became his PhD adviser. After two years he was able to finish his PhD thesis about the quantum-mechanical description of the collisions of light nuclei. In the following years Walter's focus turned more and more towards solid-state theory. At the time, this was not a mainstream decision since the field had only just started to establish itself as a subdiscipline in physics and independent research area. An important factor that contributed to his choice of research orientation was his consultancy role for the Bell Telephone Laboratories which took place alongside his research and teaching at the Pittsburgh Carnegie Institute of Technology (now Carnegie Mellon University). This brought him into contact with leading condensed-matter and semiconductor physicists such as William Shockley and acquainted him with the current issues of this research field that were rapidly developing in the 1950s.

Besides working on a variety of prevailing issues in semiconductor physics,

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mostly in close and long-term collaboration with Joaquin Luttinger (for example the Luttinger–Kohn model of semiconductor band structures), Kohn was considering a fundamental challenge of condensed-matter physics: how can one simplify the many-body problem of a solid so that its properties can be quantitatively evaluated? At the beginning of the 1960s, Kohn had the idea to use the density distribution of the ensemble of electrons, not, as was hitherto usual, the wave function. The Thomas–Fermi model of 1927 had the same goal, but was a severe approximation. In Pierre Hohenberg, who he met during a visit at the École Normale Supérieure in Paris, Walter found a congenial partner to help realize this idea. In 1964, both were able to show that the density of the electrons in the ground state uniquely determines the properties of a quantum-mechanical many-body system. The corresponding article was written in only a few weeks and is just six pages long. However, it was clear to Walter Kohn that this general proof was just the theoretical basis for the solution of the problem, and that for practical applications further development was needed. Together with Lu Sham, postdoc at the University of California San Diego — Walter Kohn was the very first physics professor at this university since 1960 — he derived the famous Kohn–Sham equations, which reduce the many-body problem to an effective single-particle problem. This approach then became, after some time, the workhorse of computational materials science, now known as density functional theory (DFT). Today, about half of all publications in quantum chemistry refer to the DFT.

In 1979 Walter became the founding director of the Institute for Theoretical Physics at the University of California Santa Barbara (today's Kavli Institute for Theoretical Physics) and moved to the city. The institute gained a strong international reputation. For his pioneering and groundbreaking scientific contributions he received multiple honours. For example, he was awarded the Nobel Prize in Chemistry in 1998 (together with John Pople) — although, as he emphasized with complaisant irony, as a student he had never taken a single course in chemistry.

Walter Kohn's contributions to modern solid-state physics are impressively diverse. In addition to the already mentioned density functional theory and the Luttinger–Kohn model, he provided fundamental insight into defects in semiconductors, into band structure theory, superconductivity, van der Waals interactions in metals, surface physics, 'nearsightedness' of quantum-mechanical interactions, and much more.

Walter took a stand in contemporary debates, representing uncompromisingly clear ethical principles. In the 1980s, the Waldheim affair divided Austria, and he stood up for those who refuted the belittlement of Waldheim's Nazi past. Walter also showed moral courage and foresight when in January 2003 he publicly took position against a second Iraq war. Although he initiated and organized a request to Congress that was signed by 41 US Nobel Prize laureates and numerous organizations, this war started in March 2003 — with disastrous consequences for the region and the world. Other topics that he felt strongly about were the climate problem and alternative forms of energy.

"I am not a one dimensional man." This statement, expressed two years ago in a personal interview with us, aptly characterizes his life and work. All colleagues will keep him in loving memory, due to his charm and his candour. He is deeply missed by his friends. He will remain a role model for his science and his ethical stand.

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