

OBITUARY

Jerome Karle, Nobel Laureate in Chemistry (1918–2013)



Jerome Karle retired from the position of Chief Scientist in the Laboratory for the Structure of Matter, US Naval Research Laboratory in Washington, D.C., in 2009. He passed away on June 6, 2013 at the Leewood Healthcare Centre in Annandale, Virginia.

Jerome Karle was born as Karfunkle on June 18, 1918 in Coney Island into a gifted, immigrant family. He was a brilliant student and graduated Abraham Lincoln High School, in Brooklyn, when he was sixteen years old. Karle graduated City College of New York with a B.S. in Biology, in 1937 along with Herbert Hauptman and Arthur Kornberg, two of City College's many Nobel laureates. He went to Harvard University and received his M.S. degree in biology in 1938 and received his doctorate degree in physical chemistry at the University of Michigan, in 1943. There he studied the diffraction patterns resulting from firing electrons at gases.

During his studies he met and married Isabella Lugoski, in 1942, who received her PhD in Chemistry

in 1944 at the age of twenty two. She became a recognised scientist and Jerome's life and scientific companion. Their family life was enriched by raising three daughters: Louise (1946), Jean (1950) and Madeleine (1955). All three have become scientists.

Karle worked on Manhattan project at the University of Chicago 1943–1944 with his wife Dr. Isabella Karle, one of the youngest scientists and few women on the project. Then they both joined the Naval Research Laboratory and in 1946 they moved to Washington, D.C. Karle became the chief scientist for the research on the structure of matter in 1967. They both continued to focus on electron diffraction experiments, whereas Jerome made a theoretical analysis with an idea to apply his theory to the analysis of crystal structures. As a scientific polymath, schooled in biology and chemistry but proficient in physics and mathematics, at that point, he joined the mathematician H. Hauptman with whom he pursued his pioneering research in the 1950s and 1960s at the Naval Research Laboratory. The problem they faced was that although X-rays diffracted from crystal carry information that can produce a picture of the atomic structure, a part of that information is accessible experimentally. Only the amplitude of the electromagnetic waves bouncing off the atoms can be observed by photon detectors; the phase offset of each periodic wave relative to the others cannot be measured. Luckily, for majority of crystals there are many more reflections than atoms implying that reflections must be mathematically interrelated. Karle and Hauptman drew on fundamental knowledge about the nature of matter based on the fact that there is no negative electron density. They defined a probability theory in the seminal monograph "*Solution of the Phase Problem*" published in 1953. However, their revolutionary approach to a phase problem was not accepted by fellow-scientists. As often has happened, a theoretical finding is somewhat distant from everyday life's problems and the application to the solution of the real problem can change a public opinion. Isabella Karle applied the theory to the solution of

crystal structures of amino acids and peptides and together with her husband Jerome published 1966 in *Acta Crystallographica* a landmark paper, which started development of suitable computer programmes for solving crystal structures. The derived computer algorithms based on that theoretical background have been used for determination of numerous crystal structures of all kinds of (macro)molecules including DNA and its complexes, proteins and various macromolecular complexes such as ribozyme, drugs to treat cancer and many other diseases, and many others. Jerome Karle and Herbert Hauptman, for their “outstanding achievements in the development of direct methods for the determination of crystal structures”, were awarded by Nobel prize in 1985. However, it is difficult not to raise a question why Isabella was not a part of Nobel trio.

“It is almost impossible to give an example in the field of chemistry and biology where this method is not being used” was said by Nobel judge, when the prize was announced. This quotation is even more true today.

Jerome Karle was the President of the International Union of Crystallography, 1981–1984. He was a member of the American Physical Society and National Academy of Sciences. He also served as the chairman of the National Research Council, 1973–1975.

In addition to his scientific capacity and high competence he was very supportive and inspirable to his collaborators and young crystallographers all over the world.

Biserka Kojić-Prodić