Ahmed H. Zewail (1946–2016)
A Nobel laureate, who pioneered femtochemistry, promoted a scientific renaissance in the Middle East

By Peter B. Dervan

Ahmed H. Zewail, an Egyptian-American scientist who won the 1999 Nobel Prize in Chemistry for pioneering investigations of fundamental chemical reactions on the femtosecond time scale, died on 2 August 2016. He was 70 years old. Zewail was an academic star at the California Institute of Technology (Caltech) and spent his final years advocating for investment in science education and research in Egypt.

Zewail was born in 1946 in Damanhur, Egypt, and studied at Alexandria University in the city where he grew up. After earning bachelor’s and master’s degrees, he looked abroad to pursue his Ph.D. in chemistry. Egyptians seeking overseas education in 1969 typically went to the Soviet Union. In a stroke of good fortune, the University of Pennsylvania offered him a scholarship and he came to the United States. After earning his doctorate from Penn, he spent 2 years as a postdoctoral researcher at the University of California, Berkeley, and then joined the faculty at Caltech in Pasadena in 1976. Zewail, the Linus Pauling Professor of Chemistry and professor of physics, set out to make movies of chemical reactions with the world’s fastest camera—one with shutter speed measured in femtoseconds, a millionth of a billionth of a second.

Before Zewail’s work, chemists could only infer the structures of short-lived intermediates between reactants and products during the breaking and making of bonds in chemical reactions. Transition states are so fleeting that they had never been observed directly. A femtosecond is shorter than the period of a nuclear vibration or rotation in the molecule and Zewail was able to freeze the system in time using ultrafast laser spectroscopy. Zewail’s brilliant insight was the demonstration that rotational and vibrational coherence is the key to making femtosecond movies. He was able to choreograph an ensemble of molecules and synchronize their motion. Using two laser pulses—a pump pulse to start the clock and trigger the reaction, followed by a probe pulse—Zewail photographed snapshots of the evolution of chemical reactions. Zewail’s hero and friend, Caltech’s Linus Pauling, won the Nobel Prize in 1954 for his research on the nature of the chemical bond. Zewail connected the chemical bond to its dynamics by setting those bonds in motion.

Zewail received honors from around the globe, including 46 honorary degrees, the Grand Collar of the Order of the Nile (Egypt’s highest state honor), and the Order of Légion d’Honneur. He was an elected member of academies and learned societies including the U.S. National Academy of Sciences, the Royal Society of London, the American Philosophical Society, the French Academy, the Russian Academy, the Chinese Academy, and the Swedish Academy. Among his more than 100 international prizes and awards, he was recipient of the Benjamin Franklin Medal, the Leonardo da Vinci Award, the Robert A. Welch Award, the Wolf Prize, the King Faisal Prize, and the Priestley Medal.

After the Nobel in 1999, Zewail became an outspoken leader in global affairs, particularly as they relate to progress in science and education in the developing world. In 2009, he was appointed to Obama’s President’s Council of Advisors on Science and Technology and appointed U.S. Science Envoy to the Middle East. He still found time to write some 600 research articles and 14 books. Zewail was passionate about his next discovery in chemical physics—seeing structures with electrons in the four dimensions of time and space. He and his group developed femtosecond electron diffraction for direct imaging of the architecture of biological molecules or materials changing with time.

Ahmed was a brilliant scientist who combined vision, hard work, and optimism in his research. Ahmed and I were colleagues together for 40 years at Caltech, and I was fortunate to hear his thoughts about the importance of fundamental research, the widening gap between the haves and have-nots, and his hopes for the Middle East. Although he loved America and was grateful to be at Caltech for 40 years, his commitment to Egypt, the country of his birth, never wavered.

In a 2013 op-ed, Zewail wrote, “A part of the world that pioneered science and mathematics during Europe’s dark ages is now lost in a dark age of illiteracy and knowledge deficiency.” Ahmed’s message to the Arab world was to build a “scientific society.” Shortly after receiving the Nobel, he proposed to President Mubarak the creation of a science and technology institute in Egypt. He imagined a private research institute unimpeded by bureaucracy and political instability—a Caltech model in Egypt. During the 2011 Egyptian revolution, he supported the students’ goals—democracy, and social and economic change. In 2013, the Zewail City of Science and Technology began enrolling students in biomedicine, solar energy, nanotechnology, and other fields. The question remains whether his dream for an independent Egyptian science and technology institute will live on.

Like his role model Benjamin Franklin, Ahmed Zewail was an intellectual and a statesman who made important contributions to both science and society. He was a charismatic person with an infectious laugh and a sonorous voice. All his colleagues delighted to be in his presence. His personal warmth made everyone feel like they were his best friend. Caltech, the scientific community, and the entire Arab world deeply mourn his loss. He was buried in Egypt with a full military funeral on 7 August 2016. Ahmed Zewail was the first Egyptian and the first Arab to win a Nobel Prize in the sciences.

He is survived by his wife, Dema Faham, and four children: Maha, Amani, Nabeel, and Hani.
Editor's Summary

This copy is for your personal, non-commercial use only.

**Article Tools**  Visit the online version of this article to access the personalization and article tools:
http://science.sciencemag.org/content/353/6304/1103

**Permissions**  Obtain information about reproducing this article:
http://www.sciencemag.org/about/permissions.dtl