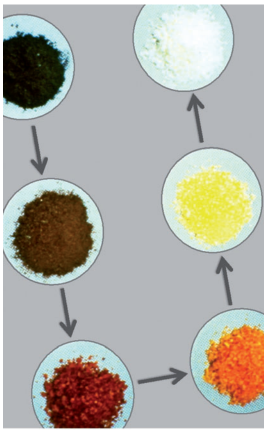
Arnim Henglein



The color change of a material from black (macroscopic material) via brown, red, orange, yellow to white in size-quantized semiconductor particles. Such samples were first prepared in Henglein's laboratory.

Arnim Henglein (1926–2012)

Arnim Henglein died on January 5, 2012 in Freiburg at the age of 85. The scientific community has lost a pioneer in numerous areas of research.

Arnim Henglein was born on May 23, 1926 in Cologne. His father was section head in the pigment factory Bayer in Leverkusen. In 1934 the family moved to Karlsruhe after his father was made professor of technical chemistry the the TH Karlsruhe. Arnim's schooling was stopped in August 1943 when he had to serve in the army. After the war, which he served out as a prisoner of war near Garmisch-Partenkirchen, he returned to Karlsruhe. He began his chemistry studies in the winter semester of 1945, and completed his Diplom in 1949. He carried out his doctoral thesis at the Max Planck Institute for Chemistry in Mainz, which he completed in 1951, in less than two years, with physics as the major. After two further years at the Max Planck Institute, he began work in the physics laboratory of the Bayer pigment factory in Wuppertal-Elberfeld in February 1953. The path back to academic life began on April 1955, when he took up a position as senior assistant at the Institute for Physical Chemistry at the University of Cologne. Only one year later, he completed his Habilitation and in 1958 was a Research Fellow at the Mellon Institute in Pittsburgh. In 1959 he took up the chair of Physical Nuclear Chemistry at the TU Berlin, which was linked to the position of Director of the Radiochemistry section at the Hahn–Meitner Institute in Berlin Wannsee, where his research laboratories were to be found. Henglein led a productive and passionate scientific life, which manifested itself in 420 scientific publications on various areas of physics and chemistry and a book on radiochemistry (1968). In 1977 he received the J. J. Weiß Medal of the Association for Radiation Research in London and in 1988 the Heyrovský Medal in Gold of the Czechoslovakian Academy of Sciences. In 2003 he was honored with a special issue of the *Journal of Physical Chemistry*, and a special issue of the *Zeitschrift für Physikalische Chemie* for his 80th Birthday.

Henglein's scientific carrier was always marked by the need to search for something new. None of his numerous research areas has already been established when he started work on them; he was always one of the pioneers. His time in Berlin started with work on radiochemistry. It was the zenith of the development era of nuclear reactors, and there was a desire to know how highly energetic radiation acted upon chemical compounds. Experiments with gamma sources and electron accelerators directed the research, and a deep understanding of radical reactions was obtained with fast time-resolved measurements. This area of research gained technical importance in particular in polymer chemistry, which experienced growth in this era and radical polymerization was highly seen. Henglein astutely began a polymer chemistry group. Radicals also played an ever-increasing role in the gas phase. At the time, mass spectrometry had developed into one of the most important analytical methods. He also began work in this area, from which a group working on molecular beam experiments and cluster physics developed.

With investigations into reduction processes with pulsed electron beam experiments, he laid the foundation for one of the largest interdisciplinary research areas today: When silver ions are reduced with hydrated electrons, homogeneously distributed silver atoms are formed in solutions, which then develop into silver clusters and nanoparticles in the presence of stabilizer molecules. What was then simply known as colloid chemistry is now known as nanoscience.

Henglein indeed discovered size-dependent redox potentials at the time and observed a charging of the particles after all of the silver was consumed by reduction, which ended in hydrogen formation. This discovery was timely during the oil crisis; however, the desire was to use visible light rather than γ radiation. Photocatalysis with semiconductors, which generate electrons and holes for reduction and oxidation, respectively, upon illumination thus received impetus.

Henglein chose to use colloidal semiconducting nanoparticles, because the charge carriers in these are generated next to the surface, and diffusion pathways, observed for macroscopic materials, can be avoided. This heralded the birth of the size-quantization effect, where it was literally attempted to make the particles smaller and smaller and thus reach the quantization regime. The colorful images of fluorescing quantum dots, which are nowadays found as the classic example of quantum mechanics in many chemistry textbooks, came originally from Henglein's laboratory. To celebrate this, the first photograph of a dried sample of Cd_3P_2, with which this effect can be impressively seen, is shown here. (The powder could also be redissolved back then, and a colloidal solution was obtained.)

Much work on quantum dots, photocatalysis, and plasmonics with noble-metal particles have their origins in Henglein's pioneering work, although this fact is often forgotten. I was lucky enough to work as a postdoctoral fellow and later to habilitate in Henglein's group at the beginning of this time, and thus to lay the foundations for my scientific career there. Apart from myself, numerous colleagues and friends, who are distributed all over the globe, have been students of Henglein and have profited from his sharp wits and his talent for seeking out what is new and important; they are

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now at top-rate universities leading their own groups. Henglein never hung on to a topic and encouraged us continually. He often changed topics himself when one of his scientific protégés achieved success. He always had ideas, and his last research area returned him to his roots: sonochemistry with ultrasonics, which he had worked on in Cologne and with which water is split into radicals in cavitation bubbles with temperatures of up to 3000 K.

After reaching emeritus status in 1995, he remained active scientifically. For several years, he was a guest professor at eminent universities in Europe and the USA. After his return to Germany, he moved to Freiburg, from where he could also enjoy the beautiful house of his parents in Saig in the nearby Black Forest. I remember a visit and the picture gallery in this house, which showed many great figures in science as guests of the family. Arnim Henglein grew up in this atmosphere, and it had no doubt made an impression on him. In return, he had passed on these impressions to his students and the scientific community.

We will miss him as an important scientist, mentor, and a colorful person.

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