

**William von Eggers Doering (1917–2011)**

William von Eggers Doering, Mallinckrodt Professor of Organic Chemistry, Emeritus of Harvard University, and one of the preeminent chemists of the twentieth century, died on January 3, 2011 in Waltham, Massachusetts at the age of 93.

Doering played a major role in the development of physical organic chemistry. An understanding of reaction mechanisms with deep insight into the course of chemical reactions is the basis of modern chemistry. This knowledge has led to the success of chemistry in various areas of daily life. It was important to Doering that general conclusions could be made from his work that not only led to an understanding of chemical processes but also allowed predictions to be made about unknown reactions. His goal was thus to gain “intellectual control”, as he called it, over chemistry.

In 1944, at the beginning of his scientific career, Doering together with Robert B. Woodward gained much attention with the publication of the brilliant quinine synthesis, which even reached the daily newspapers (including the New York Times). Subsequently, Doering concentrated his efforts on solving the structures of organic compounds and elucidating reaction mechanisms. At the beginning of the 1950s, pioneering work on the tropylium ion, which is unusually stable for an organic cation, provided important experimental evidence for the validity of the Hückel rules and thus opened the door to the field of nonbenzenoid arenes, which were subsequently investigated by many notable scientists (for example, Ronald Breslow, Virgil Boekelheide, Franz Sondheimer, and Emanuel Vogel). At the same time, Doering and his co-workers also carried out fundamental work on dichloro- and dibromocarbenes and on the mechanism of C–H insertion of singlet methylene. Milestone publications by Doering and Roth in 1962/63 described the stereospecific path of the thermally induced Cope rearrangement of 1,5-hexadienes via a chair-like transition state as well as to fluxional molecules (3,4-homotropolidene, “barbaralene”, and “bullvalene”).<sup>[1]</sup> There is a nice anecdote regarding the name “bullvalene” for the tricyclic hydrocarbon (C<sub>10</sub>H<sub>10</sub>), for which more than 1.2 million identical structures are found in a rapid equilibrium: In the Doering group at Yale University, the PhD students and postdocs at the time secretly called the weekly seminars, which were feared by those who were poorly prepared, “Bull Sessions”. They were thus all the more surprised when Doering himself proposed the name “bullvalene” for the new molecule. Doering’s research interests were diverse. Apart from the work mentioned above, he elucidated the mechanism of the Baeyer–Villiger oxidation. Furthermore, he

investigated asymmetric induction, [4+2] and [2+2] cycloadditions, and the stabilization energy of conjugated polyolefins (dienes, trienes, tetraenes, and styrene derivatives) and free radicals (such as allyl, pentadienyl, and heptatrienyl radicals). Towards the end of his career, his research concentrated on thermal rearrangements in which diradicals function as reactive intermediates but do not undergo conformational equilibration, so that the configuration and distribution of products depends on the respective starting materials. Doering called these processes in which reaction dynamics play an important role “continuous diradical” reactions or “not obviously concerted reactions”.

William von Eggers Doering (called Bill by his friends) was born on June 22, 1917 in Fort Worth, Texas. His parents Antoinette Mathilde von Eggers and Carl Rupp Doering, who met for the first time at the Conservatorium in Leipzig, moved with their family in 1924 to Cambridge, Massachusetts, where the young Bill, after completing high school, began his studies at Harvard University. He completed his BSc in chemistry in 1937 and his PhD in 1943 under the supervision of Sir Reginald Patrick Linstead. After finishing his PhD thesis, he worked together with Woodward to synthesize quinine first at Harvard. After his move to Columbia University he continued this work there; he remained at Columbia University until 1952. He then took up a professorship at Yale University and was made Whitehead Professor for organic chemistry in 1956. In 1967, he moved to Harvard University and in 1968 was made Mallinckrodt Professor. From 1947 until 1967 he was also research director of the Hickrill Chemical Research Foundation in Katonah, New York. Upon retirement in 1986, he was conferred emeritus status and carried on his research at Harvard with postdoctoral fellows. Doering was active in research for over 70 years; his first scientific publication appeared in 1939<sup>[2]</sup> and his last in 2008.<sup>[3]</sup> Doering received several prizes for his scientific achievements, only a few of which are mentioned here: the ACS Award in Pure Chemistry in 1953, the August Wilhelm von Hofmann Memorial Medal of the GDCh in 1962, the ACS Award “Creative Work in Synthetic Organic Chemistry” in 1966, the ACS James Flack Norris Award for Physical Organic Chemistry in 1989, the Robert A. Welch Award in Chemistry in 1990, and the Kosolapoff Award of the ACS Auburn Section in 1995. In 1973 he was Humboldt fellowship holder in Germany, and he was awarded honorary doctorates by the Texas Christian University (1974) and the University of Karlsruhe (1987), and he was made an honorary professor of Fudan University in Shanghai (1980).

Apart from research, teaching was of upmost importance to Doering. His fascinating lectures on organic chemistry inspired students and colleagues



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alike. An impressive number of scientific colleagues started an academic career after working with Doering, including Jerome Berson, Kenneth Wiberg, Andrew Streitwieser, Maitland Jones, Jr., Ronald Magid, Charles DePuy, William Dolbier, Jr., and Robert Rando, who were active with Doering over the various eras at Columbia, Yale, and Harvard University. Through collaborations with German scientists, such as Wolfgang Roth, Gerhard Schröder, Wolfgang Kirmse, Horst Prinzbach, Gerhard Klumpp, and Wolfram Grimme, who were postdocs with him, he also had a significant influence on chemistry in Germany in the 1960s and 1970s. I met Bill Doering in Bochum in 1973 when he stayed there as a Humboldt fellow. We became friends and collaborated in the area of cycloadditions and Cope rearrangements for more than thirty years. Doering was also politically active at that time and was involved in various leadership functions in the "Council for a Livable World" (CLW). In 1978 Doering traveled to China and initiated the Chemistry Graduate Program (CGP), which enabled Chinese graduate students to earn their PhD in the USA. He led the program from 1980 until 1986, and in this time 250 Chinese students completed their PhDs in the USA. His affection for Germany, which began with a bicycle tour when he was seventeen, remained throughout

his life. He visited Germany regularly at least once a year and liked to spend time in his house in the Black Forest, where he withdrew to work on publications undisturbed. Apart from chemistry, he also loved classical music and opera in particular. A sharp mind, integrity, humanity, and a passion for science were outstanding qualities of Bill Doering. He is survived by his daughter Margareta Doering Volk and two sons, Christian and Peter Doering.

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- [1] W. von E. Doering, W. R. Roth, *Angew. Chem.* **1963**, 75, 27–46; *Angew. Chem. Int. Ed. Engl.* **1963**, 2, 115–122. An overview of Doering's work appeared recently: "William von Eggers Doering's Many Research Achievements during the First 65 Years of his Career in Chemistry": F.-G. Klärner, M. Jones, Jr., R. M. Magid, *Acc. Chem. Res.* **2009**, 42, 169–181.
- [2] W. von E. Doering, C. R. Noller, *J. Am. Chem. Soc.* **1939**, 61, 3436–3437.
- [3] W. von E. Doering, X. Zhao, *J. Am. Chem. Soc.* **2008**, 130, 6430–6437.

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