Serendipity in Radical Chemistry

Bernd Giese

University of Fribourg, Department of Chemistry, Chemin du Musée 9, CH-1700 Fribourg
bernd.giese@unifr.ch

Unexpected experimental results are important eye-openers for the discovery of new scientific areas. I will discuss how serendipity boosted our research in synthetic chemistry, physical chemistry and biological chemistry.

The research of radical chemistry in biological systems has led to the question why radical reactions in living cells often differ from radical syntheses in the laboratory. One condition for life-sustaining reactions in cells is homeostasis. This means that both concentrations of important reaction intermediates, as well as rates of vital chemical reactions have to remain constant during biological processes. On the other hand, living cells have to adopt to changing environmental conditions. For many redox reactions it turned out to be typical that

1) the site of radical generation differs from the site of radical reactions with the substrate,

2) the generated radical is different from the radical that reacts with the substrate,

3) an electron transporting chain establishes the chemical communication between these different radicals, and

4) reactions of radicals with substrates occur at interfaces (water/protein).

This means that chemical reactions do not occur in homogeneous solutions but in very complex, compartmentalized systems. We have now shown that under these conditions 1) chemical reactions with substrates are often of zero order, and 2) that redox active molecules of the electron transporting chain posses enough flexibility to guarantee stable reaction rates. Thus, “survival of life” is the answer to the question why nature puts a large amount of energy in the synthesis of complex, compartmentalized systems.[1-3]

[1] V. Chaber, L. Babel, M. Füeg, M. Karamash, E. Madivoli, N. Herault, J. Dantas, C. Salgueiro, B. Giese, K. M. Fromm, *Angew. Chem.* **2020,** *59,* 12331.
[2] M. Karamash, M. Stumpe, J. Dengjel, C. Salgueiro, B. Giese, K. M. Fromm, *Front. Microbiol.* **2022**.
[3] B. Giese, M. Kharamash, K. M. Fromm, *FEBS Let*. **2023**, 166.