

## OBITUARY

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# Dušan Ražem

## (1944 – 2018)

**W**ITH deep sadness we announce the sudden death of our colleague Dr. Dušan Ražem.

Dr. Ražem spent his whole career at the Radiation Chemistry and Dosimetry Laboratory (RCDL) at the Department of Materials Chemistry at the Ruđer Bošković Institute in Zagreb. Dr. Ražem was an excellent scientist. His research has been associated with all aspects of the effects of ionizing radiation on matter: radiation chemistry, dosimetry and technology.

Dr. Ražem was a longtime (26 years) leader of the Radiation Chemistry and Dosimetry Laboratory. His scientific successes began in the Laboratory where together with Dr. Igor Dvornik he worked on development of the chemical dosimetry systems based on ethanol-chlorobenzene, both for low and high radiation doses. Concerning the development of these dosimeters, Dr. Ražem conducted research with an exceptionally important contribution to the theory of the dry electron reaction.

In the Hamill model of radiolysis of water, the role and electrons before solvation, which were called dry, was first assumed. Unlike solvated electrons, dry electrons are not visible in the absorption spectrum in the visible area. One of the greatest scientific challenges of Dr. Ražem was to find an experimental confirmation that the reaction of the electron before its solvation really exists.

In the absence of pulse radiolysis techniques on a microsecond time scale, RCDL could not compete, and aiming to prove the existence of a dry electron Dr. Ražem found another approach by simple analysis of chloride ion as the stable radiolytic product in chlorobenzene solution.

Considering the radiation-chemical yields and reactivities of reactive species created by radiolysis and probabilities for possible processes, as well as the reactivity of chlorobenzene towards electrons in the gas phase, he



Dr. Dušan Ražem

concluded that the measured chloride yield results from dissociative attachment of electrons, both thermal and nonthermal, to chlorobenzene. Working with Dr. Hamill and his group from the Notre Dame Radiation Laboratory, Dr. Ražem was the first scientist who confirmed the existence of dry electrons, which was one of the greatest contribution to the radiation chemistry theory.

Dr. Ražem was an innovator and creator for design of laboratory space and devices for powerful sources of radiation. Together with his associates, Dr. Ražem gave an original contribution to determination of the oxidability in a homologous series of unsaturated fatty acids in the pure state without the presence of an initiator and an insight into

the mechanism of action of vitamin E as an antioxidant. Later studies into radiation-chemical effects of radiation on food led him and his associates to the research devoted to the basic questions of kinetics and the mechanism of free radical reactions using spectrophotometry methods and laser flash photolysis.

The work of Dr. Ražem at the RCDL has been recognized through the research of potential applications of irradiations. The establishment of radiation technology in Croatia is certainly one of his biggest contributions. Dr. Ražem has conducted some of the first radiation applications such as radiation sterilization of disposable medical equipment and pharmaceuticals, and radiation microbiological decontamination of food and spices, that have formed the foundations of new, commercial radiation technology. The achievements of Dr. Ražem in radiation processing establishment and development of radiation technology in Croatia are also internationally acknowledged and recognized.

He was the President of the High Dosimetry Subcommittee Subgroup Working Committee for Nuclear Technology and Applications of the American Society for Testing and Materials (ASTM), the representative of the Republic of Croatia in the International Food Aid Advisory Group, an expert and lecturer of the International Atomic Energy Agency (IAEA) and mentor of their scholarships, a consultant of the International Commission for Radiological Units and Measurements (ICRU), a NATO expert and a representative in the Working Subgroup to prepare for EU

accession negotiations. In the meantime, with the help of his associates, he has been able to perform radiation disinfection and microbial decontamination in the service of conservation of objects of cultural and artistic heritage, which we are successfully implementing today.

Dr. Ražem was finally scientifically active in contributing to world science and dedicated work in the editorship of the *Radiation Physics and Chemistry*, and as the editor of the Croatian journal *Kemija u industriji*, he chose the latest world technological achievements and presented many interesting technical notes. He was a longtime lecturer at the doctoral study of Chemistry at the Faculty of Science, University of Zagreb.

Dr. Ražem was the winner of a series of acknowledgments for his scientific work. He published more than 100 papers and 10 book chapters.

Dr. Ražem was an erudite. In addition to philosophy and literature, he was particularly dedicated to studying history and especially the history of science. Many scientists and students will remember him due to his extensive knowledge and speaking skills to share his knowledge with younger generations.

We will forever remember him not only as our leader, but also as a colleague, friend and a nice, soft person whom all of us liked very much.

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Head of Radiation Chemistry and  
Dosimetry Laboratory