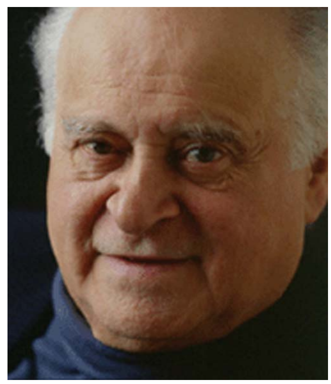
Advances in Colloid and Interface Science 244 (2017) 1–5

Contents lists available at ScienceDirect

Advances in Colloid and Interface Science

journal homepage: www.elsevier.com/locate/cis

Eli Ruckenstein – A Rare Researcher, Teacher, and Mentor par Excellence



Researchers cannot miss the name of Ruckenstein when they are looking in the literature for key insights and research directions in numerous and diverse areas including heat and mass transfer in laminar and turbulent flows, separation processes, catalysis, colloids and emulsions, molecular assembly phenomena, polymer membranes, superconducting materials, immobilized enzymes, nucleation, stability of thin films and foams, design of antifouling surfaces, thrombus growth, etc. They naturally wonder whether there are many researchers named Ruckenstein since the research areas are highly specialized and most researchers usually are confined to working in just a few closely related problem areas. Their suspicion of multiple Ruckensteins is reinforced by the prolific number of publications they find on each topic. When they finally learn that there is only one Eli Ruckenstein, the overwhelming thought that strikes one is how a single individual could have worked on such multiplicity of topics, and contributed significantly and in such depth to so many diverging themes of modern chemical engineering.

Ruckenstein is one of the world's most influential chemical engineers. He has made ground-breaking contributions in many areas and published more than 1000 scientific papers. He was the first chemical engineer to receive the National Medal of Science, considered the U.S. equivalent of the Nobel Prize. To think of Eli Ruckenstein as an outstanding researcher, a dedicated teacher, and an inspiring mentor of many academic and industrial chemical engineers captures only a partial image of his persona. Indeed, he is among the select few in the community of international chemical engineering and in the history of our profession.

It is our pleasure and privilege to dedicate this festschrift issue of Advances in Colloid and Interface Science to Eli as he just marked his 91st birthday. As the guest editors for this special issue, we would like to sincerely thank the editors, specially Prof. Reinhard Miller, and the editorial staff of Advances in Colloid and Interface Science, all the authors who contributed articles, and referees who devoted rigorous efforts for this special issue.

1. Early years of Ruckenstein

Eli Ruckenstein was born on 13 August 1925 in Botosani, a small agricultural town in northern Romania. Growing up, he struggled facing poverty and racial prejudice. He started school at seven but was expelled at fourteen due to the racial laws directed against Jews. The Jewish community responded by organizing a private high school where the teachers were intellectuals who loved their jobs and, although without the necessary credentials, made schooling interesting and exciting. Eli went to this school. In his last two years of high school, he was taken into forced labor six days a week from 5 a.m. to 5 p.m. His task was to carry bricks on a scaffold all day. Although he was out of school, he studied by himself and took exams at the end of each of these two years.

In 1944, a communist regime took power in Romania and Ruckenstein went to the capital Bucharest and enrolled in the Polytechnic Institute of Bucharest by passing a very competitive exam (20 successful candidates out of 400). In 1948, Ruckenstein married Velina Rothstein who was trained as a chemist. “This is the best thing I have ever done”, Eli often said. His wife offered unflinching support of his career. Eli Ruckenstein received his chemical engineering degree from the Polytechnic Institute of Bucharest in 1949 and joined the Institute as an assistant professor. His graduate education took an unusual path as he has described it some years ago. “By tradition, there were no formal graduate courses offered by the Institute.

http://dx.doi.org/10.1016/j.cis.2017.05.017

The library had very few of the books that were available to graduate students in the West and received journals only after a year or more of delay. So Industrial & Engineering Chemistry (the journal published by the American Chemical Society) became my graduate school, my textbook, and my teacher. I read each volume in series, some from cover to cover, beginning with Volume I." This educational process of Eli had its own rewards. His encyclopedic knowledge of the literature on any subject of interest to chemical engineers and his nearly photographic recall of important papers are legendary. However, his Ph. D. degree had to wait because the acceptance for such a degree involved being subjected to indoctrination and passing a difficult exam on Marxism-Leninism! Only when this requirement was lifted, he obtained the Ph.D. degree in 1966, defending his doctor's degree with a dissertation containing major contributions to the knowledge of momentum, heat, and mass transfer process mechanisms.

2. Coming to America

Eli securing the position of Assistant Professor at the Polytechnic Institute was quite a miraculous occurrence considering that he was not a member of the Communist party. Still, because he was not part of the ruling party, it took him 15 years to be promoted to the rank of associate professor. Before 1958 Romanian scientists were not allowed to send papers to the West for publication. When this rule was changed Eli's work reached an international audience, and as a result he became known outside Romania. In 1969 he was invited to spend six weeks in London at the University College and Imperial College.

When Eli returned home, there were letters from the University of Minnesota and Clarkson University inviting him to the U.S. The University of Minnesota wanted him to make arrangements through the Romanian Academy of Science which was not viable because of the policy of the Academy to discriminate against persons who were not members of the Communist Party. Clarkson University had received a grant from the National Science Foundation for a visiting European scientist. This allowed Eli to bypass the Romanian Academy, and consequently he spent one academic year at Clarkson. Subsequently, he received a permanent position as Full Professor with tenure at the University of Delaware in 1970, which was to remain his home for the next 3 years. In 1973, encouraged by Professor William Gill, who had moved from Clarkson College to the State University of New York (SUNY) at Buffalo as the Dean of the Engineering School, Ruckenstein moved to SUNY at Buffalo as a Faculty Professor of Engineering and Applied Sciences. These early years in the U.S. were challenging to Eli and Velina since they had to leave their minor children Andrei and Lelia in Romania when they came to the U.S. It took 2 years for the children to be allowed to leave Romania and to join their parents.

Ruckenstein was named as SUNY Distinguished Professor in 1981, a position he retained until his retirement in 2012. In the intervening years, he has been a visiting Professor at the Catholic University of Leuven, Belgium (1977-78), Technion, Haifa, Israel (1978), Bayreuth University, Germany (1986), Carnegie-Mellon University, Pittsburgh, PA (1988-89), and the Institute of Polymers at ETH, Zurich, Switzerland (1994).

3. Breath of Eli's work

Most of Ruckenstein's work in Romania had concerned more traditional aspects of heat and mass transfer such as distillation and fluidization and interfacial phenomena. At Delaware, the ready availability of chemical engineering literature created a dramatic change in his research directions, with Eli's interests turning to the areas of catalysis and colloids. At Buffalo, Ruckenstein's research continued to expand. It will take many chemical engineers to assess the contributions of Eli Ruckenstein to the various areas of chemical engineering. Indeed, we know of no other chemical engineer who has worked on as many fields as Eli and who will be able to even describe all of Eli's contributions. We can only briefly highlight the breadth of his work by citing the problems he has tackled in different areas.

- Transport Phenomena: A two time and length scales dimensional analysis; Physical models for turbulent mass transfer; Stability of fluidized beds; The interaction force boundary layer approach to predict rates of deposition of Brownian particles and cells; Similarity transformation for unsteady mass transfer; Mass transfer in wave motion; Turbulent mass transfer treated as a deterministic process; Electrodynamic theory of osmosis and reverse osmosis; Stability of molecularly thin liquid and solid films; Transient phenomena in facilitated transport; Scaling in laminar and turbulent heat or mass transfer; Algebraic method to obtain expressions for the heat and mass transfer coefficients in complex cases.
- Separation Processes: Plate efficiency when the mixing is partial; Potential barrier chromatography, a new method for protein separation; Separation by solubilization in surfactant solutions; Theory of molecular distillation; Separation of immunoglobulins by potential barrier chromatography; New methods to prepare selective membranes by colloidal and emulsion pathways.
- Catalysis: Kinetics and thermodynamics of sintering and redispersion of supported metal catalysts; Electron microscopy investigation of the shape of supported metal crystallites; Mechanism of selective oxidation of mixed oxides; Electronic theory of poisoning and promoting of metal catalysts; Kinetics of selectivity of catalytic processes; Spectrum of landing areas of mixed oxides catalysts; Design and development of experimental techniques involving several time scales of pulses combined with isotopes for evaluation of catalytic mechanisms; Design of pores in alumina; Role of the interactions between atmosphere, substrate and metal in the shape of supported crystallites; Role of physical and chemical interactions on the behavior of supported metal catalysts; The coexistence of the crystallites with a multilayer film; Optimum design of diluted zeolite catalysts; Solid solution catalysts for methane conversion; Carbon-based catalysts for nitrogen oxide reduction.
- Colloids, Emulsions and Interfaces: Role of surface chemistry in double layer forces and in rates of deposition of colloidal particles on surfaces; Thermodynamics of double layers; Thermodynamics of adsorption of hydrated ions; The origin of hydration forces; Thermodynamics of microemulsions; The origin of the low interfacial tensions between phases containing a microemulsion phase; Phase behavior of microemulsions; The origin of the middle phase microemulsion; Effect of salinity on the oil-water interfacial tension in the presence of surfactants; Thermodynamics and dynamics of wetting; Thermodynamics of aggregation; Thermodynamics of solubilization; Selective solubilization of aromatics by surfactant solutions; Thermodynamics of phoretic motions; Interfacial turbulence; Experiments and theory on Marangoni effect; A theory of the polarization layer generated in a polar liquid by the dipoles present on a solid surface; The role of polarization layer in colloid stability; The coupling between the polarization and double layers; The role of the polarization layer in the interaction forces between cells; Phase behavior of mixtures of colloidal particles and polymers; A theory for the sticking coefficient of aerosols over the entire range of Knudsen numbers; Characterization of the surface properties of polymers.
- Biological Problems: Deposition of cells on surfaces; Kinetics of thrombus growth; Electrokinetic phenomena in enzymatic reactions; Diffusion of surfactant molecules through porous and non-porous membranes; Stability of the cell membrane; Deposition of cancer cells on surfaces; Effect of electrokinetic phenomena in the effectiveness factor of immobilized enzymic reactions; Optimization of the rates of immobilized enzymic reactions by facilitation with weak acids; A surface energetic criterion of blood compatibility of foreign surfaces; Design of antifouling surfaces;