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In Memoriam

Peter Läuger (1934–1990)

With the tragic death of Peter Läuger on a mountain tour near Mérida, Venezuela on 13 September 1990, membrane biophysics has lost a prominent figure. Almost all his scientific life was devoted to the elucidation of phenomena of membrane transport, covering a vast range of types extending from macroscopic ion-exchanger membranes to the fascinating phenomenon of bacterial propulsion by the rotatory flagellar motor. In all his work, Peter Läuger strove for – succeeding to an admirable extent – a highly detailed quantitative understanding based on rigorous application of physico-chemical principles. It is this truly biophysical approach that characterizes his lasting contributions to membrane science.

Peter Läuger was born on 9 May 1934 in Lörrach in the southwestern corner of Germany. After the grammar school in Lörrach, he attended the Universities of Basle and Hamburg, taking his doctor's degree (Dr. phil. nat.) under the supervision of the late Werner Kuhn (in Basle) in 1961. He continued his work in Basle, studying macrosocpic ion-exchanger membranes and, after a postdoctoral stay with Reinhard Schlögl at the Technical University of Darmstadt, took his second academic degree (habilitation) in physical chemistry in 1964 at the University of Basle.

Peter Läuger early realized the great significance of the methodological breakthrough achieved by Paul Mueller and his colleagues in Philadelphia, who established "black lipid membranes" (BLM; or "lipid bilayer membranes") as excellent models for biological membranes. BLM are bimolecular lipid leaflets spanning an opening between two (electrolyte) solution compartments. This allows for the investigation by macroscopic means (such as macro-electrodes inserted into the adjoining electrolyte compartments) of transport phenomena through these fragile membrane structures. It is bascially with this model system that Peter Läuger made his fundamental contributions to the understanding of biological transport mechanisms.

Following his appointment as Professor of Biology at the newly founded University of Konstanz (on Lake Constance), Peter Läuger was able to attract, assemble, and inspire a flock of gifted experimentalists (and later even a couple of theoreticians). Over the last two decades these people have worked together as a highly efficient research group, usually pursuing several different transport phenomena at the same time. His own propensities and abilities meant that Peter Läuger usually provided the theoretical analysis of the phenomena investigated in extensive detail by the experimentalists fired by his inspiration. He was also very quick to grasp the importance of powerful new experimental methods and to push for their early establishment in his laboratory, such as application to BLM of voltage-clamp techniques, of noise spectral analysis, of the fast "charge-pulse" technique, of single-channel analysis, and of photolabile "caged" compounds for fast chemical pulses.

This list of techniques indicates that the methodological approach used by Peter Läuger and his group may be characterized by the selection for study of a membrane transport process that, at least as a partial process, involves ion transport and thus lends itself to investigation by electrical measurements. Then kinetic methods were applied to their full extent, allowing a wealth of data to be extracted from the system, which in turn was subjected to analysis by most comprehensive theoretical models. In these physico-chemical models, for the sake of tractability Peter Läuger preferred Eyring's rate-kinetic approach to a continuum treatment of diffusional transport. With ingenious variations and specifications, this approach was successfully applied by Peter Läuger and his group to a multitude of bilayer-transport problems of ever-increasing complexity. In succession, substantial contributions were thus made to elucidation of the following transport mechanisms: ion-conductance and rectification of the bare BLM [1], transport of lipophilic ions and mitochondrial uncouplers [2], carrier-mediated ion-transport [3], ion-channels (in particular: gramicidin-pores) [4], light-induced proton pumps [5], sodium/amino acid cotransport [6], and sodium pump [7]. The insights into transport mechanisms derived by these painstaking and at the same time elegant analyses of BLM model systems have greatly

promoted our understanding of the analogous, albeit much more complicated, processes occurring at cellular membranes.

Peter Läuger was able to communicate even complex issues with admirable clarity, as many listeners to his lectures will testify. Just before his death, Peter Läuger completed a book on "Electrogenic Ion Pumps" [8] which summarizes many of his insights into this topic and will appear shortly. German readers will certainly appreciate his didactic skill, which is apparent in the book "*Physikalische Chemie und Biophysik*" [9], of which he was a coauthor.

The scientific achievements of Peter Läuger were appreciated by the scientific community. He was a member of the editorial boards of several specialist scientific journals: *European Biophysics Journal, Biochimica et Biophysica Acta*, and *Journal of Membrane Biology*. He also served as a member of the Council of IUPAB (International Union for Pure and Applied Biophysics). In May 1990, he had been made a member of the Academia Europaea.

It is less well known that in addition to his devotion to biophysical sciences, Peter Läuger was also an exceptionally knowledgeable botanist. He was particularly interested in the plant life of extreme-biotopes, which he studied on his many excursions to remote parts of the earth, and about which he would give captivating reports if he sensed genuine interest. In the last note to his coworkers in Konstanz he wrote on 11 September 1990: "... heute bin ich ... in die Anden gefahren. Die bunte Bergflora ist unbeschreiblich schön." This mountain tour became the end of his life, a life devoted to investigating the fascinating marvels of Nature.

The international community of biophysicists will miss his scientific contributions and his unfailing friendliness and cooperation.

Gerold Adam, Konstanz, FRG

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