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Reviews

In memoriam Hugo Aebi 1921-1983

The following two contributions are presented in memory of Hugo Aebi, former editor of Experientia. Professor Aebi died in the Swiss mountains on July 15, 1983 at the age of 62. Hugo Aebi began his career in medicine at the University of Basel, graduating in 1945. His first post was at the Institute of Medical Chemistry in Basel and at 33 he became the Chairman of the Institute of Medical Chemistry at the University of Bern. His scientific interests focused on *nutritional research* and *enzyme interactions*. His role within the university was multifaceted; as a teacher, he ably transmitted his enthusiasm and as an organizer, he never refused responsibility. Hugo Aebi served as Dean of the Medical Faculty, as Rector of the University, as a colonel in the Medical Corps of the Swiss Army, and – during the years of economic recession – as the President of the Swiss Advisory Council for Science. Many younger biochemists have benefited from Hugo Aebi's freely given advice in his function as editor of Experientia, an office he held from 1974 until his untimely death.

Silvio Weidmann

Mitochondria: the utilization of oxygen for cell life

by A. Azzi

Medizinisch-chemisches Institut, Universität Bern, Postfach, CH–3000 Bern 9 (Switzerland)

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A fuel cell

Most of the energy (more than 95%) of animal cells is delivered by oxidative phosphorylation and mitochondria are the cell organelles where this process takes place. The mechanism by which the chemical energy of a substrate is transferred to ATP in the mitochondria is electrical in nature. That transmission of biochemical power occurs in mitochondria through electricity, is surprising because mitochondria do not contain a sufficient density of electron conductors. In these organelles, however, the conduction of protons, in proteinaceous and aqueous regions, substitutes for that of electrons in the electric conductors of metallic power lines of artificial systems[55]. The insulating elements are provided by the low conductors constituted by the membrane bilayer.

The mechanism by which mitochondria generate electricity, or better, 'proticity', is complex but can be essentially considered similar to what occurs in a hydrogen-burning fuel cell. Here there are two elements of the fuel cell: the one in contact with O_2 becomes positively charged and produces O^{2-}; the other, in contact with H_2 becomes negatively charged and produces H^+. The connection between the 2 elements with a H^+ conductor (H_2O) results in a source of electricity; the connection with an electric conductor results in a source of 'proticity'[55]. Mitochondria function essentially in this 2nd form. They have an electron transport chain which allows separation of OH^- in one compartment from H^+ in another compartment and in this way proticity is produced. This form of electrical energy can be utilized to synthesize ATP.

The terminal respiratory enzyme of mitochondria, cytochrome *c* oxidase, represents an element of the respiratory chain capable of electric conduction through its metal centers and separation of H^+ from OH^- through a proton pump. Such a system has an extreme complexity whose present understanding will be reviewed below.

The terminal respiratory enzyme

The terminal oxygen-reducing enzyme of the respiratory chain in mitochondria and in many bacteria is cytochrome *c* oxidase; cytochrome *c* reduces through it molecular oxygen to produce water and in so doing it allows electron flow in the respiratory chain to proceed associated with energy conservation. The enzyme itself is, in addition, capable of storing the energy associated