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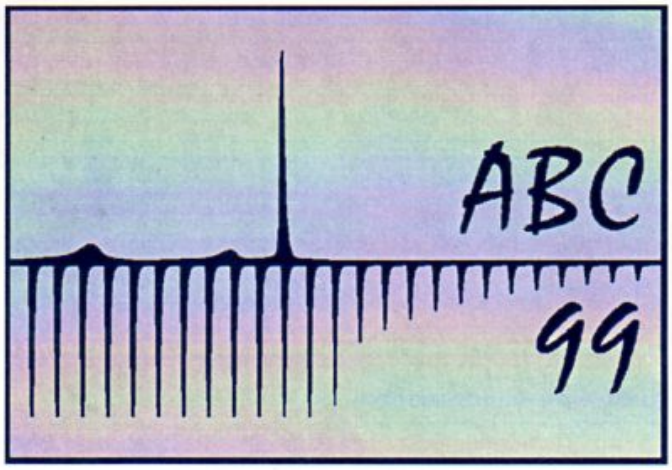

PROGRAMM

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COUPLING FACTOR GLUTATHIONE: INTRODUCTION INTO THE ELECTROPHYSIOLOGY AND THERMODYNAMICS OF MITOCHONDRIA

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Th. Wieland and E. Bäuerlein formulated in 1968 [1] a mixed anhydride of sulfenic and phosphoric acid, R-S-O-PO_3H^- , to explain the conversion of energy obtained by oxidation into the energy-rich binding between two phosphate groups, as for instance found in ATP. In 1970, Painter and Hunter [2] showed high amounts of ATP-formation in a model system containing oxidized glutathione as essential catalyst. During my attempt to elucidate the mechanism of oxidative phosphorylation in mitochondria, I came to the conclusion that an (H^+) activated disulfide in the lipophilic membrane had to be involved [3]. I proposed a phosphate reaction with ATP on this activated disulfide in a synchronous reaction mechanism without the real build-up of a sulfenylphosphate intermediate [3]. – The research performed during the last 20 years lead inevitably to the formulation of the mitochondrial F_0F_1-complex as coupled K^+/H_2O-pump (similar to the nAChR) with H^+/P_i^-inducible ATPsynthase as well as to the respiratory chain substrate driven K^+/H^+-antiport system. These systems are linked together in anticyclic energy driven K^+/H_2O, H^+/P_i-movements and oscillations (swelling plus contraction of the mitochondrial matrix space by oxmotically active K^+-ions), controlled by O_2 and the free Mg^{2+}- and Ca^{2+}-concentrations in the cytosol of the cells [4]. The systems is responsible for the thermoregulation of our body [5]. – The cyclic hydrolysis/synthesis of ATP and the concomitantly cyclic release/binding of Mg^{2+} in the „steady state flow system" releases heat (q) and the temperature (ΔT) is permanently raised. The released heat is constantly distributed throughout the entire body by the oscillating mitochondria, as well as the pumping heart, and is used up by the normal body functions. Disturbances of this system are normally compensated for by lower/higher respiration rates [5]. For clarification, one should study the theory of Carnot [6]. The essentially by iron and its state of oxidation dependent H^+/e^-displacements, current (i), lead to high local voltages (ΔV) over the membrane with corresponding magnetic fields (H). The under physiological conditions operating mitochondriotic membrane acts thereby simultaneously as capacitor, transmitter and supraconductor (37°C!). The entire system is dependent on oxidized and reduced glutathione. To gain more insight into this system, one should read an introduction to the theory and equations of Maxwell and Kirchhoff. Further studies based on Faraday's and Oerstedt's equations should lead to the complexity of mitochondrial electrophysiology, its influence on memory and thinking, and the basics of the chinese acupuncture [6,7].

References

[1] Th.Wieland and E.Bäuerlein, Angewandte Chemie 21, 915-916 (1968)
[2] A.A.Painter and F.E.Hunter, BBRC 40, 369-373 (1970)
[3] R.Kiehl, Dissertation, Uni Heidelberg u. MPI für Med.Forschung; E.Bäuerlein and R.Kiehl, FEBS Letters 61, 68-71; R.Kiehl and E.Bäuerlein, FEBS Letters 72, 24-28 (1976)
[4] R.Kiehl, Biol.Chem.H.-S. 374, 742 (1993); 14th Conference GDCH-Biochemie, Abstr. 28 and 25. GDCH-Hauptversammlung Abstr. BC7 p.56 (1995)
[5] R.Kiehl 3./4. Int.Kongreß on Amino Acids, Amino Acids 9, 20 (1993/95)
[6] R.Kiehl, 15th Conference GDCH-Biochemie, Abstr. P3, p.35; Habil-thesis, Uni München, Med.Fak. and JMB, submitted (1996)
[7] R.Kiehl, 16th Conference GDCH-Biochemie, Abstr. 3, p.3 and Amino-Acids, submitted (1997)