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Department of Chemistry and Biochemistry

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Electrical and Thermal Control in the Mitochondrion

The mitochondrion is the primary site of energy production in eukaryotic cells. The energy produced can be stored in pyrophosphate bonds in energy rich compounds such as ATP or can be dissipated as heat. This heat is believed to be generated by the return of the proton back to the matrix through the inner mitochondrial membrane, by-passing ATP synthase. It has recently been proposed that some of this heat dissipation is a "necessary evil" associated with molecular recognition of the protons by ATP synthase, which is a requirement of information theory. A minimum energy of kBTln2 must be dissipated for every proton recognized by ATP synthase [1-3]. Related to this thermogenesis, it has recently been proposed that the mitochondrion might be significantly hotter than its surroundings in the cell [4,5]. This led to the suggestion of novel roles for heat shock proteins and for compatible solutes in mitochondrial "hot" environment, a view corroborated by some bioinformatics results on DNA coding for these proteins in the mitochondrion [6]. Finally, a proposed feedback control of the electric field across the inner mitochondrial membrane will be described.

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