tumour cells (Eddy, Mulcahy & Thomson, 1967). In the latter system the flow of glycine into the cells is closely coupled to the entry of Na^+ and the efflux of K^+ , a process that occurs in the virtual absence of ATP (Eddy, 1968). If the above analogy meant that similar types of carrier mechanism were involved in both the mammalian and the microbial systems, then the uptake of neutral amino acids by yeast depleted of ATP might be expected to stimulate a stoichiometrical flow of H^+ into the cells accompanied by a loss of K^+ . This novel phenomenon has now been observed as follows.

The yeast was manipulated as described by Eddy (1966) and suspended at 30°C in 5mm-tris solution buffered at pH 4.5–5 with citric acid. Energy metabolism was blocked with 5mm-2-deoxyglucose and $0.2\mu\text{g}$ of antimycin A/mg dry wt. of yeast. Proton movements were monitored with a sensitive glass-electrode system and K^+ efflux was assayed by flame photometry. In a typical experiment at pH 4.8 the addition of small amounts (up to $1\mu\text{mol}/5\text{ml}$ of suspension) of various amino acids (e.g. glycine, L-leucine or L-phenylalanine) stimulated H^+ uptake by the cells (basal rate 1–3equiv./min per mg) by 300%. The induced flow of H^+ (up to about 2equiv./mol of amino acid absorbed) and the stimulated loss of K^+ roughly paralleled the process of amino acid absorption.

In a further series of experiments, both with 'sodium' yeast (Conway & Moore, 1954) and 'potassium' yeast, endogenous energy metabolism continued while the amino acid was absorbed. The complex behaviour of the system under these conditions suggested that the influx of H^+ with the amino acid then led to an ATP-dependent secretion of cations. Various transport models incorporating these observations will be described.

Conway, E. J. & Moore, P. T. (1954). *Biochem. J.* **57**, 523.
Eddy, A. A. (1966). *Proc. 2nd Symp. Yeast*, p. 457. Bratislava: Slovak Academy of Sciences.
Eddy, A. A. (1968). *Biochem. J.* **108**, 195.
Eddy, A. A., Mulcahy, M. F. & Thomson, P. J. (1967). *Biochem. J.* **103**, 863.

Transport of Protons and Univalent Cations in Submitochondrial Particles

By J. M. TAGER, S. PAPA, F. GUERRIERI, G. S. P. GROOT and E. QUAGLIARIELLO. (*Department of Biochemistry, University of Bari, Bari, Italy, and Laboratory of Biochemistry, University of Amsterdam, Amsterdam, The Netherlands*)

Papa, Tager, Guerrieri & Quagliariello (1969) have shown that univalent cations uncouple oxidative phosphorylation in submitochondrial particles, and have proposed that this is due to an energy-dissipating

cyclic transport of the cations. The uncoupling is potentiated by transport-inducing antibiotics (Christiansen, Loyter & Racker, 1969; Cockrell & Racker, 1969; Montal, Chance, Lee & Azzi, 1969; Papa, 1969). To obtain maximal uncoupling (or inhibition of energy-linked reactions) by potassium salts valinomycin + nigericin must be added. With ammonium salts valinomycin on its own gives maximal uncoupling (or inhibition).

In submitochondrial particles obtained by sonication respiratory control may be induced by oligomycin (Lee & Ernster, 1966). Although respiration in these particles is accompanied by an inward translocation of H^+ (Mitchell & Moyle, 1965), Cockrell & Racker (1969) observed that the induction of respiratory control may be accompanied by a slow inward translocation of K^+ .

We have found that oligomycin enhances the respiration-linked proton uptake in submitochondrial particles and depresses the rate of the release of protons on the exhaustion of oxygen. The relationship of these observations to the stimulatory effect of low concentrations of oligomycin on energy-linked reactions in submitochondrial particles will be discussed.

The data to be presented provide further support for the concept that an energy-linked turnover of protons and univalent cations can control the rate of electron flow in submitochondrial particles.

Christiansen, R. O., Loyter, A. & Racker, E. (1969). *Biochim. biophys. Acta*, **180**, 207.
Cockrell, R. S. & Racker, E. (1969). *Biochem. biophys. Res. Commun.* **35**, 414.
Lee, C. P. & Ernster, L. (1966). In *Regulation of Metabolic Processes in Mitochondria*, p. 218. Ed. by Tager, J. M., Papa, S., Quagliariello, E. & Slater, E. C. Amsterdam: Elsevier Publishing Co.
Mitchell, P. & Moyle, J. (1965). *Nature, Lond.*, **208**, 1205.
Montal, M., Chance, B., Lee, C. P. & Azzi, A. (1969). *Biochem. biophys. Res. Commun.* **34**, 104.
Papa, S. (1969). In *The Energy Level and Metabolic Control in Mitochondria*, p. 273. Ed. by Papa, S., Tager, J. M., Quagliariello, E. & Slater, E. C. Bari: Adriatica Editrice.
Papa, S., Tager, J. M., Guerrieri, F. & Quagliariello, E. (1969). *Biochim. biophys. Acta*, **172**, 184.

Properties of some Anion-Exchange-Diffusion Reactions in Rat Liver Mitochondria

By A. J. MEIJER, N. E. LOFRUMENTO, S. PAPA, J. M. TAGER and E. QUAGLIARIELLO. (*Laboratory of Biochemistry, University of Amsterdam, Amsterdam, The Netherlands, and Department of Biochemistry, University of Bari, Bari, Italy*)

The translocators mediating the transport of certain anions across the mitochondrial membrane (Chappell & Crofts, 1966) by an exchange-diffusion