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PERMEABILITY AND ACTIVE TRANSPORT IN MALPIGHIAN TUBULES

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In a paper on regional specialization in the lower Malpighian tubule of *Rhodnius prolixus*, Maddrell (1978) reported that active recovery of potassium chloride from the tubular fluid is confined to the lowest region of the tubule, and is inducible by 5-HT. He also reported that the gross influx of potassium, measured by movement of K^{42} from the bathing solution into the lumen, shows a 200-fold stimulation by 5-HT in this part of the tubule, but not in the non-transporting region. He could not explain the effect.

I propose the following explanation. The mechanism which pumps KCl out of the lumen and which is turned on by 5-HT is reversible; and like a chemical reaction it proceeds *in both directions* at the same time, to achieve a net flow in the direction which results in overall loss of free energy. Only if the loss of free energy is large does a reaction approach irreversibility. This will be true also of active transport, and in such a case it would operate with low efficiency. Complete irreversibility would imply a mechanical efficiency of zero. If it is to be reasonably efficient the energy released by the driving metabolic reactions must be not very much greater than the energy needed to translocate the ion(s) *in vivo* (Fletcher, 1977).

These conclusions on the reversibility or bi-directionality of the pump may also be justified by thermodynamic considerations (Fletcher, 1976) and so are not dependent on the analogy. However, pursuit of the analogy of a chemical reaction suggests that if the rate of supply of energy is not infinite, ionic fluxes in each direction will depend on their concentrations on *both* sides of the membrane (C. R. Fletcher, in preparation), thus showing 'exchange diffusion' effects, and it would be of interest to see whether the potassium influx to this region of the Malpighian tubule depends on the luminal potassium concentration in a saturating manner, as predicted.

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