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The Control of Fluid Transport in Tissues and Cells

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Foreword

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The control of water movement in tissues and cells is an area of great current interest. Alongside the standard view, that fluids move across cell membranes by osmosis, and its natural extension to epithelial fluid transport and water movement in plants driven by osmotic gradients, others have co-existed, involving transport by the paracellular system. The discovery of aquaporins (AQPs) gave considerable impetus to the subject but the field is becoming more complicated, not only by the variety and distribution of AQPs, but by the fact that their removal by genetic manipulation has only a slight effect on fluid movement in many cases.

In this Issue there is a spectrum of views about the transport of water and its possible relation to aquaporins, much of it involving epithelia. From the traditional viewpoint, Levin and Verkman review the considerable data on the epithelial systems of the eye, much of which has come from mouse models and techniques developed in their laboratory, whilst Burghardt et al. provide an overview of pancreatic fluid production which demonstrates the complexity of this system. On the other hand, Hill and Shachar-Hill propose a model involving paracellular transport controlled by AQPs which gains support from the study of Murakami et al. on the salivary gland, involving rat strains deficient in AQPs. The paracellular route is the basis of a new model by Fischbarg et al. for fluid transport in the corneal endothelium in which electro-kinetic effects are clearly involved. In plants, which express a plethora of AQPs, MacRobbie reviews the control of water flow in stomatal guard cells and presents evidence that AQPs may be involved in turgor control. Finally, Sugiya and Matsuki show that AQP is involved in the control of vesicle swelling and volume control in salivary cells.

The field is at an interesting stage, possibly an unstable one, in which new approaches and paradigms are likely to emerge in the near future. The mechanisms involved in the control of fluid movements are so important that their elucidation may transform many areas of cell physiology.

Key words: Fluid transport — Epithelia — AQP control — Paracellular flow — Volume control — Water flow

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