Preface

Sophisticated fluid regulation systems are in place in mammalian organism to maintain basic vital and sensory functions. Such systems control body water homeostasis on a large scale that requires daily filtration and reabsorption of 180 l of fluid from the blood. At the same time, the volume and ional composition of fluids in compartments as tiny as the 40 µl endolymphatic space of the sensory inner ear are meticulously adjusted. Despite early evidence for an inhibitable channel protein that facilitates water permeation at higher rates and with lower activation energy than the plain lipid bilayer, it was not before 1992 that water conductance of an aquaporin (AQP) was demonstrated by Peter Agre. Subsequently, in 2003, Peter Agre was awarded the Nobel Prize in Chemistry for the discovery of the aquaporins. Aquaporins constitute a large and ancient family comprising all kingdoms of life; 13 isoforms are expressed in mammals, i.e. AQP0–AQP12. Besides water-specific, orthodox aquaporins, there are aquaporins with a wider spectrum of permeants, such as glycerol, urea, and ammonia, the so-called aquaglyceroporins. Aquaporins strictly exclude the passage of ions including protons, with the remarkable exception of AQP6, which is permeated by nitrite, chloride, and other anions. Aquaporin expression is found throughout the body but follows a distinct tissue-specific and subcellular pattern with a high concentration in the kidney and in red blood cells. Malfunctions of aquaporins are associated with diseases such as nephrogenic diabetes insipidus and Sjögren's syndrome. Aquaporin water and solute permeability has been further implicated in lung and brain edema, obesity, tumor angiogenesis, and wound healing, to name just a few.

The aquaporin field has matured at an exceptionally fast pace and we are at the verge of developing serious strategies to therapeutically modulate aquaporin function directly or via regulatory networks. Key prerequisites are available today (1) a considerable (and growing) number of aquaporin crystal structures for the rational design of inhibitory molecules, (2) elaborate molecular dynamics simulation techniques for theoretical analyses of selectivity mechanisms and docking experiments, (3) comprehensive data on aquaporin immunohistochemistry, (4) aquaporin knockout animals for physiological studies, and (5) assay systems for compound library screenings. The structure of this volume on aquaporins follows the points laid out

above and thus covers the developments from basic research to potential pharmacological use. Situated between pharmacology textbooks and recent scientific papers, this book provides a timely overview for readers from the fundamental as well as the applied disciplines.

I am grateful to more than 70 colleagues for their positive response to my inquiry and for the contribution of excellent chapters. All the chapters in this volume have been reviewed by leaders in the respective fields. They have taken great care to provide the latest information in a comprehensive and appealing manner, as illustrated by the large number of high-quality figures. Please note that the electronic version of the book contains colored figures. It is a special honor that Nobel Laureate Peter Agre has contributed the introduction – together with Jennifer M. Carbrey – outlining the history, current status, and future potential of aquaporin research. I cannot close without acknowledging and thanking our Desk Editor, Susanne Dathe. She has been an indispensable driving-force behind the project.

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