

# Preface

In 1969, Cosens and Manning found a spontaneous mutation in *Drosophila melanogaster* that was revealed by a defect in the electroretinogram, in which the steady electrical response normally evoked by a sustained light pulse becomes transient. This impairment occurred in the receptor potential of the photoreceptor cells. For this reason, the mutant was termed Transient Receptor Potential, TRP. In 1989, Montell and Rubin cloned the gene and proposed that it encoded a novel ion channel, an idea that was confirmed in the following years by several laboratories. A second channel was also identified in the same cells by Phillips and coworkers in 1992, and was called TRP-like (TRPL), for its similarity with TRP. The first mammalian TRP channel sequence was reported independently in 1995 by the Montell and Birnbaumer laboratories, and it is known today as TRPC1, one of the seven members of the Canonical TRP (TRPC) channel subfamily, which also includes *Drosophila* TRP and TRPL. After the molecular cloning of TRPV1, the first member of the Vanilloid subfamily of TRP channels by David Julius and his group in 1997, our understanding of the molecular and cellular mechanisms underlying sensory transduction has made dramatic progress. Since then, a vast number of publications have accumulated in the literature regarding this remarkable ion channel superfamily.

The TRP superfamily is divided into seven subfamilies: TRPC (seven members in mammals with the two closely related fly channels, TRP and TRPL), TRPV (Vanilloid, six members), TRPM (Melastatin, eight members), TRPN (name derived from the fly mutant no mechanoreceptor potential C, one member), TRPA (Ankyrin, one member), TRPP (polycystic, three members) and TRPML (Mucophilin, three members) (See the phylogenetic tree of TRP channels in Chap. 1 of this book, Fig. 1.2). TRP channels are key molecular components of many physiological processes. One of the most salient features of the TRP channels is the paramount role that they play in a wide variety of sensory modalities, underlying the receptor potential in the corresponding primary sensory neurons. They participate in photo-, chemo-, thermo-, mechano- and osmoreception, pain and itching perception, and other sensory reception modalities. It is also noteworthy that, contrary to channels belonging to other superfamilies, TRP channels exhibit an impressive structural diversity, a characteristic that has contributed to complicate their classification; nev-

ertheless, the large majority of these channels possess six transmembrane domains, reminiscent of many voltage-dependent channels. Although some of these channels appear to respond mainly to a single stimulus type, many of them are polymodal, capable of being gated by stimuli of entirely unrelated nature, such as natural and artificial compounds, voltage and temperature, as is the case of the eleven thermoTRP channels that has been described. All TRPs are cation selective, many of them for monovalents, several additionally let  $\text{Ca}^{2+}$  through, while a few are strictly  $\text{Ca}^{2+}$  selective.

So far, only a small number of TRPs have been studied in some detail in intact sensory structures. An important factor for this is that they are usually confined to small and often inaccessible cellular compartments specialized in sensory transduction, such as microvilli, cilia and nerve terminals. Heterologous expression has been a powerful strategy for the study of TRP channels, mainly because it circumvents the difficulty of accessing their native location in their respective sensory cells. However, this approach must be taken with caution, because the functional properties of the channels may be largely modified when expressed in a foreign membrane, as observed in several cases (as for example *Drosophila* TRP and TRPL; Chap. 4 of this book).

This book comprises ten chapters written by experienced researchers in the field of sensory transduction, and particularly TRP channels. The origin of the present book was a symposium on TRP channels and sensory transduction, organized by the Editors for the First Meeting of FALAN (Federation of Neuroscience Societies in Latin America, the Caribbean and the Iberian Peninsula) in Cancún, México, in 2012. This symposium interested Springer NY, which kindly offered us to carry out this book.

The aim of this book is to offer up-to-date discussions regarding some iconic members of this highly interesting ion channel superfamily, which additionally are among those that are best characterized. Rather than extensive and exhaustive, the chapters attempt to be comprehensive to a non-specialized audience, as well as informative to those in the field. Inevitably, for instructive purposes, a small number of technical issues treated in a formal manner were included in some chapters. We felt that these formalisms were necessary for the comprehension of the thermodynamics and dynamic modeling of thermoTRPs.

We would like to thank the authors for their excellent contributions that made this book possible. The editors also thank Simina Calin and Portia Wong, Editors of Springer NY, for efficient guidance, support and excellent editorial advice.

We hope that the book will be found useful for Neurobiology students, teachers and specialist in sensory transduction. Enjoy to this TRiP to the Senses.

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