Structure and function of ion channels

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Our knowledge of ion channels has made great advances in recent years, so that now there is considerable understanding of both the structure and function of these important proteins found in all cell membranes. Many researchers, including myself, first cut our teeth on this important field by carrying out intracellular microelectrode recordings from skeletal muscle, and were delighted in the 1970s when noise analysis allowed us a first glimpse of single channel properties. Nowadays, of course, patch-clamp analysis of single channel properties is routine. To relate channel structure to function, techniques of molecular biology, mutagenesis and channel expression in oocytes and cultured cells together with electrophysiological investigation has also become the norm. Other techniques such as X-ray crystallography, single particle electron microscopic studies, biochemical studies, fluorescence and FRET have also been used to make important contributions to understanding ion channels. In the early 1990s, a small number of us at Leeds University developed the theme of ion channel research in the Faculty; this area of research at Leeds indeed grew and further developed successfully so that now the Faculty of Biological Sciences is recognised internationally for its important contributions in ion channel research. So it was natural for us to hold at Leeds a Satellite Symposium of the 2007 European Biophysics Congress, entitled “Structure and Function of Ion Channels”. This special issue of the European Biophysics Journal assembles papers from the speakers who wished to contribute to this follow-up of

the Symposium. The themes of the Symposium were chosen so as to align with some of the ion channel research areas also being investigated at Leeds, with 18 talks and numerous posters. There were some 75 participants at this international meeting; besides the UK, from Spain, France, Germany, Hungary, USA and Australia. The meeting took place in the elegant rooms of Leeds Town Hall.

The first session was on ether-a-go-go channels. Craig January reviews the field of inherited and acquired ion channel arrhythmias that involve the *herg* channel, in particular reviewing the role of impaired *herg* protein trafficking in cardiac ion channel disorders. Arthur Brown describes how the setting-up of a large collection of ion-channel expressing lines, together with automated patch-clamp recording, will serve as a useful system for assessment of cardiac risk for drugs acting on cardiac channels such as *herg*. The paper by Luis Pardo presents evidence that non-membrane-spanning regions are involved in differences in behaviour of *heag1* and *heag2* channels. The role of intracellular regions of *Kv2.1* and *heag* channels is discussed in a review by Dennis Wray; interacting residues in the N- and C-terminal intracellular regions contribute to conformational changes involved in activation properties of these channels. The second session was on the theme of 2P domain channels. Eric Honore reviews information about the lipid-sensitive mechano-gated K2P channel TREK-1 and its polymodal function. Alison Gurney and Boris Manoury review current knowledge about the involvement of members of the K2P channel family in heart and arterial cells. The last session was on the subject of ATP-gated P2X Receptor Channels. A paper by Richard Evans provides an overview of residues involved in ATP action and allosteric regulation of the P2X receptor channel, while a contribution by Annette Nicke gives a detailed study of inter-subunit cross-linking in P2X receptors using a mutational

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approach. Finally, Lin-Hua Jiang presents a review of the properties of the P2X7 receptor, in particular concentrating on the phenomenon of inhibition of the channel by divalent cations.

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