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## Preface

When I was selecting my Honours project in 1970, Biophysics was my second choice after Solid State Physics. Looking back, this was a key decision in my life, which would have turned out very differently, if I got my first choice.

My Honours project was not particularly successful. I was trying to measure *Chara* membrane impedance with a bridge, which was far too slow to get meaningful results. John Smith took over the project and computerised the measurements and data collection (one of the first such experiments in Australia). Impedance measurements later became the main theme of Hans Coster's group (School of Physics, University of NSW). However, I did enjoy my Honours work and decided to do my Ph.D. on *Chara* action potential (AP). I applied the Nobel-Prize winning Hodgkin–Huxley equations that describe the squid axon AP to *Chara* excitation. My 6 years with Hans and other members of the group, John Smith, Terry Chillcott, David Bell, Bob Aschcroft and others, taught me practical basis of electrophysiology. I could make up circuits for voltage clamp and current sources, eliminate earth loops and electrical noise, match impedance of circuits and manufacture microelectrodes. The *Chara* membrane itself was seen as a region of fixed charges to be modelled by a circuit. The *Chara* AP was an interesting phenomenon to be explained, but we did not ponder what use it might be to the plant.

During my Ph. D. work, I did a lot of modelling of the experimental data. I experienced great satisfaction, when the models “fitted” and gave predictive insights into the process. On the other hand, I have also become aware of limitations of models and experimental and theoretical artefacts.

I got my first postdoctoral job by word of mouth with Alan Walker, School of Biological Sciences, Sydney University. I started getting more education in biology. We worked on amine transport and chloride/proton symporter, the former important in plant nutrition and the latter in turgor maintenance and salt tolerance. This was a great time to meet many important workers in electrophysiology and plant physiology (and future close associates): AB Hope, Geoff Findlay, FA Smith, Rob Reid, Mary Bisson, Steve Tyerman, Gunter Kirst, John Cram, and Tony Larkum.

My next postdoctoral job was with Enid MacRobbie at School of Botany, University of Cambridge, UK. I have learned in my Honours year that computer-controlled data logging can be a very powerful technique. I enlisted my husband Bruce's help and we built our first computer-controlled electrophysiology set-up.

The high speed (for plants) of current–voltage ( $I/V$ ) scans allowed us to record the sigmoidal *Chara* proton pump  $I/V$  characteristics, as well as the large conductance  $K^+$  channel  $I/V$  profile with typical negative conductance regions. We also tackled the tonoplast electrical characteristics, using the permeabilisation technique. These were really interesting years, meeting with new colleagues John Cork, Teruo Shimmen, Mike Blatt and Mark Tester. Our daughter Kiri was born in 1984.

After 6 years in Cambridge I have returned to Alan Walker's group at Sydney University. Bruce and I have built a second version of our computer-controlled experimental set-up. I have worked on  $Na^+/K^+$  transport with Alan Walker and Stephen McCulloch and mastered cell compartment manipulation with Virginia Shepherd and perfusion (especially after my trip to Japan visiting Teruo Shimmen and Tetsuro Mimura). Together with Alan Walker we further developed modelling of the  $I/V$  characteristics of both intact and modified cells. I joined Mary Bisson to investigate the high pH state, involving  $H^+/OH^-$  channels.

In 1992 I became a lecturer at School of Physics, University of NSW, Sydney. I have become interested in salt tolerance and sensitivity and compared the response to increased osmolarity and salinity of salt-sensitive *Chara australis* and very salt-tolerant *Lamprothamnium* sp. My group (Virginia Shepherd, later Alan Walker and Sabah Al Khazaaly) uses computer-controlled electrophysiological set-up, cell compartment modification and rigorous modelling of the data. Working with *Lamprothamnium*, we have characterised  $Cl^-$  and  $K^+$  channels in the hypotonic turgor regulation. We were the first to document the involvement of extracellular sulphated polysaccharide mucilage in ion transport and salt tolerance. In the hypertonic turgor adjustment the proton pump is activated by both decrease in turgor and increase in  $Na^+$  concentration. In contrast, the proton pump in *Chara* is inactivated by increase in  $Na^+$  concentration, cell undergoes spontaneous APs and putative activation of  $H^+/OH^-$  channels erodes the proton electromotive force needed to expel sodium from the cytoplasm.

With Mary Bisson and Virginia Shepherd I also started to work on sea algae *Ventricaria (Valonia) ventricosa* from the Chlorophyta branch of the phylogenetic tree. The enormous contrast in the Characeae and Valoniceae electrophysiology underlines the similarity of Characeae and higher plants and their value as simplified, easy-to-manipulate model.

In the last decade I joined the International Research Group on Charophytes and Plant Signaling and Behaviour society, completing my evolution from seeing the cell membrane just as a circuit, to appreciating the beauty and complexity of the whole Characeae cells and plants and their survival strategies. The first chapter of the book by Michelle Casanova introduces the morphology, systematics and ecology of the Characeae. If I only had this chapter when I started my work on Characeae! The Chaps. 2 and 3 summarise electrophysiology and transport in single cells in steady state and under stress. Chapter 4 shows that specialised cells, joined cells and whole Characeae plants also provide excellent model systems. The book is aimed at research students and researchers who want to use the Characeae system. It will also be useful for electrophysiologists working on higher plants.

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I want to thank all my colleagues for teaching me so much and for enthusiastic collaborations, my husband Bruce for providing such great computer set-up, and my daughter for putting up with me, while preoccupied with research. I would like to dedicate this book to my three mentors: Hans Coster, Alan Walker and Enid MacRobbie.

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The Physiology of Characean Cells

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2014, XIX, 205 p. 80 illus., 8 illus. in color., Hardcover

ISBN: 978-3-642-40287-6