

Preface

Virtually all biological processes are in some fashion involved with membranes. However, despite their unquestioned importance, many aspects of complex membrane structure and function remain unresolved. Often not only are the answers not available, but even formulating the appropriate questions is difficult. A single membrane is composed of hundreds of proteins and thousands of lipids, all in constant flux. Methodologies to study membranes must span time and size domains that range over a million fold! A good case can be made that understanding membranes will be the next great frontier in the life sciences.

From the inception, it became obvious to me that trying to write a book on membranes is a near hopeless endeavor. No-one can possibly be an expert in all aspects of membrane science. Membrane studies range from structural and theoretical biophysics at one extreme to nutritional, cell biology, and membrane metabolic studies at the other. Bridging the two extremes are countless highly technical methodologies that are difficult to explain without getting hopelessly bogged down in technical minutia. Choosing what should be included and what excluded from this book reflects my personal 40 years of research experience on the biophysics and biochemistry of model membrane systems.

Through the years there have been a large number of books written about membranes. Most of these have been multi-authored, highly technical compendiums that are essentially "preaching to the choir". They are indecipherable to anyone who is not already an expert in the narrow topic covered in the

book. While these multi-authored books have their place in membrane studies, they are essentially a non-cohesive collection of loosely related review articles that are written by experts from very different backgrounds and writing styles. As a result they are comprehensive, but very hard to read. In sharp contrast, excellent general discussions covering membranes can now be found in very well written chapters in almost all current biochemistry, cell and molecular biology, and physiology textbooks. These brief chapters are of necessity too abbreviated to adequately cover a field as expansive as membranes. The multi-authored compendiums are too detailed while the chapters from general textbooks lack sufficient detail.

Between the extremes of edited compendiums and general textbook chapters are a smaller number of general membrane books that have the advantage of being written by a single (or at most a few) authors. *An Introduction to Biological Membranes: From Bilayers to Rafts* is such a book. This book is an attempt to write a broad textbook covering many aspects of membrane structure/function that bridges membrane biophysics and cell biology. It was my basic contention that it is not necessary to understand the intricacies of NMR, single particle tracking, X-ray crystallography and so on, to appreciate the contributions that these techniques have made to membrane studies. The book primarily targets advanced undergraduates and beginning graduate students. However, even membranologists with a good knowledge of contributions by their contemporaries often have very limited

knowledge of fundamental contributions by early membrane pioneers, a recurring theme of this book. The appendix to this book is a time line of 100 of the most important discoveries in membrane science dating from ~540 BC to present.

In the process of cleaning out my office before fading into retirement in 2010, I found that I had accumulated about 60 membrane books, and this is only a fraction of what is available. For 30 years I taught a beginning graduate level course entitled *Biological Membranes*. For most of those years I could not find a suitable textbook for the course. In 1988 Robert B. Gennis published his book *Biomembranes: Molecular Structure and Function*. To this day I consider Gennis' book to be the best membrane structure book ever written and for about 10 years I adopted this book for my course. Unfortunately, after 25 years, a second edition of this book has yet to be published. Something is needed to fill this gap. From my perspective, the new book should be a single-authored, broad book that covers many aspects of membrane structure and function without getting lost in unnecessary details – in other words, 'membrane biophysics light'. It is clear that each topic covered in *An Introduction to Biological Membranes: From Bilayers to Rafts* could be greatly expanded, but this will have to wait for another day.

Through the years other single-authored general membrane books have appeared, each of which has its advantages and disadvantages. A few examples are listed below:

- Gennis, R.B. 1988. *Biomembranes: Molecular Structure and Function*. Springer-Verlag. New York, NY. 533 pp.

- Luckey, M. 2008. *Membrane Structural Biology*. With Biochemical and Biophysical Foundations. Cambridge University Press, New York, NY, 332 pp.

- Mouritsen, O.G. 2005. *Life as a Matter of Fat. The Emerging Science of Lipidomics*. Springer, Berlin, Heidelberg, 276 pp.

- Jones, M.N. and Chapman, D. 1995. *Micelles, Monolayers and Biomembranes*. John Wiley and Sons, New York. 252 pp.

- Yeagle, P.L. 1993. *The Membranes of Cells*, 2nd Edition. Academic Press, New York. 349 pp.

- Jain, M.K. 1988. *Introduction to Biological Membranes*, 2nd Edition. John Wiley & Sons, New York. 423 pp.

- Finean, J.B., Coleman, R. and Michell, R.H. 1984. *Membranes and Their Cellular Functions*, 3rd Ed. Blackwell Scientific Publications, Oxford, New York. 227 pp.

- Malhotra, S.K. 1983. *The Plasma Membrane*. John Wiley and Sons, New York. 209 pp.

- Houslay, M.D. and Stanley, K.K. 1982. *Dynamics of Biological Membranes: Influence on Synthesis, Structure and Function*. John Wiley & Sons, New York. 330 pp.

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January, 2013