BOOK REVIEW

The Synapse: Structure and Function

Edited by Virginia Pickel and Menahem Segal
2014 Academic Press, 513 pages

Reviewed by Neal R. Melvin
Division of Life Sciences, Quest University Canada, Squamish, British Columbia, Canada V8B 0N8.

Neuroscience has come a long way since Sherrington summarized early work on the synapse in *The Integrative Action of the Nervous System* (Sherrington, 1906). Indeed, we are light years beyond the first ultrastructural evidence for their existence in the 1950s (Palade and Palay, 1954; Palay and Palade, 1955). The authors of these early studies would no doubt be pleased with the tremendous progress that has been made on the structure and function of the synapse, and certainly stunned by their molecular complexity and degree of regulation.

The Synapse: Structure and Function (edited by Virginia Pickel and Menahem Segal) provides a comprehensive account of our current conception of the synapse. Through its richly illustrated 15 chapters, this volume covers several major topics of synaptic research, from the ultrastructural and molecular level, to the behavioral manifestations of synaptic function. The focus of the book is exclusively on chemical (as opposed to electrical) synapses and, even though the primary emphasis throughout is on glutamatergic synapses, there are also chapters on dopaminergic and cholinergic synapses as well.

The book provides several chapters to be expected in a volume with this title, including detailed chapters on the pre- and post-synaptic specializations associated with the synapse and chapters on the synapse across the life span, from their initial development during nervous system formation, to the effects of aging on their structure and function. There are also several chapters on more specialized aspects of synaptic function, such as the effects of estrogen on hippocampal synapses, as well as a chapter on synaptic alterations associated with brain disorders such as Alzheimer's, autism spectrum disorders, and schizophrenia. Future editions of this volume might consider adding chapters on more emerging areas of research, such as the synaptic alterations underlying memory, and the effects of exercise and drugs of abuse on synaptic plasticity.

Particularly useful aspects of this volume are the multiple full color figures, images and informative tables throughout. For example, in the chapter entitled "Trafficking of Glutamate Receptors and Associated Proteins in Synaptic Plasticity," there is a table that lists the common names of ionotropic glutamate receptor subunits along with the International Union of Basic and Clinical Pharmacology names. In addition, the chapter entitled "The Molecular Mechanisms Underlying Synaptic Transmission: A View of the Presynaptic Terminal," contains a very handy list of major synaptic proteins along with a brief description of their principle functions. These types of additions provide great quick reference resources.

In my undergraduate neuroscience courses, I place a heavy emphasis on students learning the limitations of various approaches and techniques, stating that "The conclusions you come to in a given study are only as strong as the weakest experimental method used to obtain the data." One chapter ("Activity-Induced Fine Structural Changes of Synapses in the Mammalian Central Nervous System") includes a very useful section discussing the limitations of various experimental preparations used to study synapses. This is something that would make each chapter in the text more useful to a broader audience (specifically, readers that do not work in this immediate field). This provides a nice example of an observation made by Cajal in *Advice for a Young Investigator*: "Mastery of technique is so important that without fear of contradiction it may be stated that great discoveries are in the hands of the finest and most knowledgeable experts on one or more of the analytical methods." (Cajal, 1916, p. 65, translation by Neely Swanson and Larry W. Swanson).

Though not essential for a professional audience, a nice addition to this book for educational purposes would have been an introductory chapter on the history of the concept of the synapse and the initial physiological and structural studies. In my experience, undergraduate students in particular benefit from learning neuroscience material with an over-arching historical context to guide them.

Though each chapter is dense with respect to the amount of detailed information it contains, it is certainly understandable by someone with a reasonable knowledge of cellular and molecular neurobiology. Without some previous knowledge of synaptic structure and function, this book would certainly be a tough read. As such, it would be appropriate as a course textbook for upper level undergraduate or graduate level courses in neurobiology, or for professional neuroscientists as a very informative reference text.

REFERENCES

Cajal SR (1916) Advice for a young investigator (Translation by Neely Swanson and Larry W. Swanson). Cambridge, Mass: MIT Press.

Palade GE, Palay SL (1954) Electron microscope observations of interneuronal and neuromuscular synapses. Anat Rec 118:335–336.

Palay SL, Palade GE (1955) The fine structure of neurons. J Biophys Biochem Cytol 1:69–88.

Pickel V, Segal M (2014) The synapse: structure and function. (Pickel and Segal, eds) Oxford, UK: Academic Press.

Sherrington CD (1906) The integrative action of the nervous system. New Haven, CT: Yale University Press.

Address correspondence to: Dr. Neal Melvin, Division of Life Sciences, Quest University Canada, 3200 University Boulevard, V8B0R7. Email: neal.melvin@questu.ca.