swers currently available are rather poorly supported by the evidence of the morphology should not derogate from the attempt to seek them. One hopes this volume will stimulate a lot more work on such an interesting group of animals.

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Cellular Neurobiology

Neuromodulation. The Biochemical Control of Neuronal Excitability. LEONARD K. KACZMAREK and IRWIN B. LEVITAN, Eds. Oxford University Press, New York, 1987. xii, 286 pp., illus. $29.95.

In recent years it has become evident that neurons are subject to an extraordinary degree of modulation of diverse kinds. Neuronal properties can be modulated not only during long-term learning and development but also over a relatively short term as a function of motivational state and even during basic sensory and motor activities. This book attempts to explain some of the fundamentals of neuromodulation at the cellular level.

In the preface and chapter 1, the editors of this volume define neuromodulation as the capacity of neurons to change their electrical properties as a function of intracellular biochemical events that are evoked by synaptic or hormonal input. This simple and useful definition is broad enough to encompass most of the phenomena that researchers have called neuromodulatory, but narrow enough to avoid including so much that the concept becomes meaningless. The preface explains that the goal of the book is to introduce graduate students and researchers who do not directly work in the area to "the way one thinks about and studies neuromodulatory phenomena at the cellular and molecular level." In addition the book attempts to foster communication between biochemists and physiologists, the two main groups that study neuromodulation.

The first five chapters introduce general principles, with particular emphasis on ion channels and mechanisms of protein phosphorylation. The remaining eight chapters provide more detailed discussions of specific examples of neuromodulation. Benson and Adams discuss the control of rhythmic neuronal firing, with reference to studies of identified neuron R15 of *Aplysia*. Three chapters are devoted to the regulation of potassium currents, using as examples the firing of the bag cell neurons of *Aplysia* (Strong and Kaczmarek), the serotonin-regulated current of *Aplysia* (Siegelbaum), and the muscarine-regulated current of vertebrate neurons (Jones and Adams). Papers by Ewald and Levitan and by Tsien discuss modulation of calcium channels in vertebrate and invertebrate neurons and in vertebrate heart cells. Zucker provides a general discussion of synaptic plasticity, with emphasis on the role of calcium. Finally, Gribkoff and Dudek review examples of neuromodulation in the mammalian brain, with specific treatments of long-term potentiation and modulation of neuronal burst activity. The chapters are liberally illustrated with line drawings. Literature citations have been purposely kept to a minimum.

On the whole, the book achieves what it aims to accomplish, but it has a few weaknesses, most of which stem from the fact that it is multiauthored. This results in some unevenness in style and unneeded redundancy. For example, calcium-activated potassium channels are discussed in at least six different places, and the relationship of different nomenclatures is not always made explicit. However, this is not a collection of self-serving minireviews. The chapters have been written and edited to teach and explain, and as a focused textbook *Neuromodulation* is generally successful. With few exceptions, the topics are treated in a straightforward manner, with a minimum of jargon. Although both of the editors work with invertebrate preparations, the book does not lay undue emphasis on invertebrate work, considering that the editors wished to restrict the discussions primarily to analytic cellular studies.

This volume should prove useful not only to the novice but to virtually any investigator interested in cellular neurobiology. It certainly should be examined by individuals who teach neuroscience-related courses. The book is generally up to date, but because of the present ferment in the field I recommend that if you are going to read it, you do so quickly.

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