

英文影印版

# 神经科学原理

# PRINCIPLES OF NEURAL SCIENCE

Fourth Edition

(第4版)

Eric R. Kandel  
James H. Schwartz  
Thomas M. Jessell

 科学出版社

 McGraw Hill

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2001

Eric R. Kandel, James H. Schwartz & Thomas M. Jessell: Principles of Neural Science, 4<sup>th</sup> Edition  
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IE ISBN 0-07-1189912

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北京市版权局版权登记号:01-2001-0664

#### 图书在版编目(CIP)数据

神经科学原理 = Principles of Neural Science: 英文影印版 / (美)卡德尔(Kandel, E. R.)

主编. —4版. —北京:科学出版社,2001.3

据麦格劳-希尔出版公司原版影印

ISBN 7-03-009148-5

I. 神... II. 卡... III. 神经科学-英文 IV. R74

中国版本图书馆 CIP 数据核字(2001)第 02129 号

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**科学出版社** 出版

北京东黄城根北街16号

邮政编码:100717

**中国科学院印刷厂** 印刷

科学出版社发行 各地新华书店经销

\*

2001年3月第一版 开本:889×1194 1/16

2001年3月第一次印刷 印张:91

印数:1-2000 字数:3200000

**定价:296.00元**

(如有印装质量问题,我社负责调换(科印))

# Preface

The goal of neural science is to understand the mind—how we perceive, move, think, and remember. As in the earlier editions of this book, in this fourth edition we emphasize that behavior can be examined at the level of individual nerve cells by seeking answers to five basic questions: How does the brain develop? How do nerve cells in the brain communicate with one another? How do different patterns of interconnections give rise to different perceptions and motor acts? How is communication between neurons modified by experience? How is that communication altered by diseases?

When we published the first edition of this book in 1981, these questions could be addressed only in cell biological terms. By the time of the third edition in 1991, however, these same problems were being explored effectively at the molecular level.

In the eight years intervening between the third and the present edition, molecular biology has continued to facilitate the analysis of neurobiological problems. Initially molecular biology enriched our understanding of ion channels and receptors important for signaling. We now have obtained the first molecular structure of an ion channel, providing us with a three-dimensional understanding of the ion channel pore. Structural studies also have deepened our understanding of the membrane receptors coupled to intracellular second-messenger systems and of the role of these systems in modulating the physiological responses of nerve cells.

Molecular biology also has greatly expanded our understanding of how the brain develops and how it generates behavior. Characterizations of the genes encoding growth factors and their receptors, transcriptional regulatory factors, and cell and substrate adhesion molecules have changed the study of neural development from a descriptive discipline into a mechanistic one. We have even begun to define the molecular mechanisms underlying the developmental processes responsible for assembling functional neural circuits. These processes include the specification of cell fate, cell

migration, axon growth, target recognition, and synapse formation.

In addition, the ability to develop genetically modified mice has allowed us to relate single genes to signaling in nerve cells and to relate both of these to an organism's behavior. Ultimately, these experiments will make it possible to study emotion, perception, learning, memory, and other cognitive processes on both a cellular and a molecular level. Molecular biology has also made it possible to probe the pathogenesis of many diseases that affect neural function, including several devastating genetic disorders: muscular dystrophy, retinoblastoma, neurofibromatosis, Huntington disease, and certain forms of Alzheimer disease.

Finally, the 80,000 genes of the human genome are nearly sequenced. With the possible exception of trauma, every disease that affects the nervous system has some inherited component. Information about the human genome is making it possible to identify which genes contribute to these disorders and thus to predict an individual's susceptibility to particular illnesses. In the long term, finding these genes will radically transform the practice of medicine. Thus we again stress vigorously our view, advocated since the first edition of this book, that the future of clinical neurology and psychiatry depends on the progress of molecular neural science.

Advances in molecular neural science have been matched by advances in our understanding of the biology of higher brain functions. The present-day study of visual perception, emotion, motivation, thought, language, and memory owes much to the collaboration of cognitive psychology and neural science, a collaboration at the core of the new cognitive neural science. Not long ago, ascribing a particular aspect of behavior to an unobservable mental process—such as planning a movement or remembering an event—was thought to be reason for removing the problem from experimental analysis. Today our ability to visualize functional

changes in the brain during normal and abnormal mental activity permits even complex cognitive processes to be studied directly. No longer are we constrained simply to infer mental functions from observable behavior. As a result, neural science during the next several decades may develop the tools needed to probe the deepest of biological mysteries—the biological basis of mind and consciousness.

Despite the growing richness of neural science, we have striven to write a coherent introduction to the nervous system for students of behavior, biology, and medicine. Indeed, we think this information is even more necessary now than it was two decades ago. Today neurobiology is central to the biological sciences—students of biology increasingly want to become familiar with neural science, and more students of psychology are interested in the biological basis of behavior. At the same time, progress in neural science is providing clearer guidance to clinicians, particularly in the treatment of behavioral disorders. Therefore we believe it is particularly important to clarify the major principles and mechanisms governing the functions of the nervous system without becoming lost in details. Thus this book provides the detail necessary to meet the interests of students in particular fields. It is organized in such a way,

however, that excursions into special topics are not necessary for grasping the major principles of neural science. Toward that end, we have completely redesigned the illustrations in the book to provide accurate, yet vividly graphic, diagrams that allow the reader to understand the fundamental concepts of neural science.

With this fourth and millennial edition, we hope to encourage the next generation of undergraduate, graduate, and medical students to approach the study of behavior in a way that unites its social and its biological dimensions. From ancient times, understanding human behavior has been central to civilized cultures. Engraved at the entrance to the Temple of Apollo at Delphi was the famous maxim “Know thyself.” For us, the study of the mind and consciousness defines the frontier of biology. Throughout this book we both document the central principle that all behavior is an expression of neural activity and illustrate the insights into behavior that neural science provides.

Eric R. Kandel  
James H. Schwartz  
Thomas M. Jessell

# Acknowledgments

We are again fortunate to have had the creative editorial assistance of Howard Beckman, who read several versions of the text, demanding clarity of style and logic of argument. We owe a special debt to Sarah Mack, who rethought the whole art program and converted it to color. With her extraordinary insights into science, she produced remarkably clear diagrams and figures. In this task, she was aided by our colleague Jane Dodd, who as art editor supervised the program both scientifically and artistically.

We again owe much to Seta Izmirly: she undertook the demanding task of coordinating the production of this book at Columbia as she did its predecessor. We thank Harriet Ayers and Millie Pellan, who typed the many versions of the manuscript; Veronica Winder and Theodore Moallem, who checked the bibliography; Charles Lam, who helped with the art program; Lalita Hedge who obtained permissions for figures; and Judy Cuddihy, who prepared the index. We also are indebted to Amanda Suver and Harriet Lebowitz, our development editors, and to the manager of art services, Eve Siegel, for their help in producing this edition. Finally we want to thank John Butler, for his consistent and thoughtful support of this project throughout the work on this fourth edition.

Many colleagues have read portions of the manuscript critically. We are especially indebted to John H.

Martin for helping us, once again, with the anatomical drawings. In addition, we thank the following colleagues, who made constructive comments on various chapters: George Aghajanian, Roger Bannister, Robert Barchi, Cornelia Bargmann, Samuel Barondes, Elizabeth Bates, Dennis Baylor, Ursula Bellugi, Michael V.L. Bennett, Louis Caplan, Dennis Choi, Patricia Churchland, Bernard Cohen, Barry Connors, W. Maxwell Cowan, Hanna Damasio, Michael Davis, Vincent Ferrera, Hans Christian Fibinger, Mark Fishman, Jeff Friedman, Joaquin M. Fuster, Daniel Gardner, Charles Gilbert, Mirchell Glickstein, Corey Goodman, Jack Gorman, Robert Griggs, Kristen Harris, Allan Hobson, Steven Hyman, Kenneth Johnson, Edward Jones, John Kalaska, Maria Karayiorgou, Frederic Kass, Doreen Kimura, Donald Klein, Arnold Kriegstein, Robert LaMotte, Peretz Lavie, Joseph LeDoux, Alan Light, Rodolfo Llinas, Shawn Lockery, John Mann, Eve Marder, C.D. Marsden, Richard Masland, John Maunsell, Robert McCarley, David McCormick, Chris Miller, George Miller, Adrian Morrison, Thomas Nagel, William Newsome, Roger Nicoll, Donata Oertel, Richard Palmiter, Michael Posner, V.S. Ramachandran, Elliott Ross, John R. Searle, Dennis Selkoe, Carla Shatz, David Sparks, Robert Spitzer, Mircea Steriade, Peter Sterling, Larry Swanson, Paula Tallal, Endel Tulving, Daniel Weinberger, and Michael Young.

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