

Stanley Jacobson
Elliott M. Marcus
Stanley Pugsley

Neuroanatomy for the Neuroscientist

Third Edition

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Stanley Jacobson
Boston, MA, USA

Elliott M. Marcus
Jamaica Plain, MA, USA

Stanley Pugsley
South Abington Twp., PA, USA

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*To Elliott M. Marcus, colleague,
friend, collaborator, superb neurologist,
and developer of neurosciences at Tufts
Medical School*

*To our wives: Avis Jacobson, Nuran Turksoy,
and Tricia Pugsley*

*To our children: Arthur Jacobson,
Robin Seidman, Erin Marcus, Robert Letson,
Gerard Pugsley, David Pugsley,
and Mark Pugsley*

*To our grandchildren: Ross Jacobson,
Jase Jacobson, Zachary Letson,
and Amelia Letson*

To our teachers, students, and colleagues

Preface

Elliott M. Marcus, M.D., was a friend and colleague for over 40 years, and he was the father of neurosciences at the Tufts University School of Medicine, and with his passing in 2011, we lost a dear friend, colleague, dynamic teacher, and an outstanding neurologist. This textbook is dedicated to his memory.

The purpose of this textbook is to enable a neuroscientist to discuss the structure and functions of the brain at a level appropriate for students at many levels of study including undergraduate, graduate, dental, or medical school level. It is truer in neurology than in any other system of medicine that a firm knowledge of basic science material, that is, the anatomy, physiology, and pathology of the nervous system, enables one to readily arrive at the diagnosis of where the disease process is located and to apply their knowledge at solving problems in clinical situations. The authors have a long experience in teaching neuroscience courses at the first- or second-year level to medical and dental students and to residents in which clinical information and clinical problem-solving are integral to the course.

Dr. Jacobson has taught neuroanatomy and gross anatomy for many years to medical and dental students at the Tufts University School of Medicine and an upper-level biology course on the central nervous system to undergraduates at Tufts University in Medford, MA, utilizing many of Dr. Marcus' cases to engage students. He also has used several movies on the brain developed in Hollywood to further involve students.

Dr. Marcus practiced neurology for 40 years, and he developed a case history of problem-solving sessions in the recent book *Integrated Neurosciences* by E.M. Marcus, S. Jacobson, and T. Sabin (Oxford University Press, 2014), and he also conducted a problem-solving seminar in which all medical students at the University of Massachusetts participate during their clinical neurology clerkship rotation. This provides students an opportunity to refresh their problem-solving skills and to review and update that basic science material essential for clinical neurology.

Dr. Pugsley is a senior neurosurgeon with extensive clinical and teaching experience. He trained in neurosurgery at the Tufts University School of Medicine. He observed that the inclusion of case history materials reinforces the basic science

subject matter learned by markedly increasing the interest of students in both basic and clinical science material. He has added many new cases and a neurosurgeon's prospective to disease.

In this third edition, decisions had to be made so that the size of the textbook remained within reasonable limits. Throughout this book, we have utilized clinical illustration and integrated the anatomical, neurological, and neurosurgery managed in most of today's neuroscience courses, and we have responded to many of the very worthwhile suggestions from our colleagues. The book contains the core topics concerned with the central nervous system and all chapters have been updated. We have divided this edition into five parts: (I) Introduction to the Central Nervous System (Chaps. 1–10); (II) The Systems (Chaps. 11–17); (III) Neuropathology, (Chap. 18) Vascular Diseases and (Chap. 19) Nonvascular Diseases; (IV) The Nonnervous Elements, (Chap. 20) Meninges, Blood Supply, Ventricular System, (Chap. 21) General Case Histories, Problem-Solving, and (Chap. 22) Movies on the Brain; and (V) Descriptive Atlas of the Brain and Spinal Cord (Chap. 23).

We have added in several chapters, in Chap. 19, representative cases of trauma and infectious diseases within the CNS to aid students in understanding disease processes with the central nervous system and, in Chap. 20, the meninges, blood supply, and ventricular system. We have included an atlas at the end of the spinal cord (Chap. 3), brain stem (Chap. 6), and diencephalon chapters (Chap. 8). We have maintained the atlas chapter 23 and 24 with Chapter 23 Descriptive Atlas of Gross Brain and Chapter 24-Descriptive Atlas –Myelin stained sections.

In Chap. 22, Movies on the Brain, we have added in the film on Concussion which is an important discussion of the effects of contact sports. We have also used several of these movies as an adjunct to our teaching; (1) Young Frankenstein directed by Mel Brooks has a wonderful scene introducing the CNS and (2) Little Shop of Horrors directed by Frank Oz features Steve Martin as a dentist, and this is a great introduction to the trigeminal nerve). There are many movies in the science fiction genre that are also useful for discussion, and Star Trek and its many episodes and its medical manual are at the top of our list!

A number of other topics including cell biology, cell physiology, embryology, gross anatomy, nerve, and muscle are usually covered in other courses, and the student should examine these topics in those courses. The anatomy of the peripheral nervous system and autonomic nervous system has been touched on briefly here but should be reviewed in one of the standard gross anatomy texts.

Most of the case histories utilized in the chapters have been drawn from the files of Drs. Marcus and Pugsley. For a number of the cases, our associates at the Geisinger Medical Center in Danville, PA, Tufts Medical Center, St. Vincent Hospital, Fallon Clinic, and the University of Massachusetts School of Medicine either requested our opinion or brought a given case to our attention and provided information from their case files. These individual neurologists and neurosurgeons are identified in the specific case histories. We are also indebted to the many referring physicians of those institutions. Medical house officers at St Vincent Hospital presented some of the cases to Dr. Marcus during morning report. In particular, our thanks are due to our associates in Worcester: Drs. Bernard Stone, Alex Danylevich,

Robin Davidson, Harold Wilkinson, and Gerry McGillicuddy. Drs. Sandra Horowitz, Tom Mullins, Steve Donhowe, Martha Fehr, and Carl Rosenberg provided clinical information from their files for some of the case histories. Our associates at the New England Medical Center Drs. John Sullivan, Sam Brendler, Peter Carney, John Hills, Huntington Porter, Thomas Sabin, Bertram Selverstone, Thomas Twitchell, C. W. Watson, and Robert Yuan likewise provided some of the clinical material. Dr. Milton Weiner at St Vincent Hospital was particularly helpful in providing many of the modern neuroradiological images. Dr. Sam Wolpert and Dr. Bertram Selverstone provided this material for the earlier version of the text. Dr. Val Runge from the Imaging Center at Texas A&M provided the normal MRIs. Dr. Anja Bergman (left-handed) had the patience to be our normal case, and the images from her brain form the normal MRIs in basic science chapters and atlas. Dr. Tom Smith and his associates in pathology provided much of the recent neuropathological material. Drs. John Hills and Jose Segarra provided access to neuropathological material for the earlier version of the text. Drs. Sandra Horowitz and David Chad provided critic of particular chapters.

Dr. Sarah B. Cairo, M.D., M.P.H., while still a medical student at Tufts Medical School developed the illustrated drawings that were used throughout the second edition of this book, and they will be used in this edition to illustrate the retina, pathways, levels of the spinal cord, levels of the brain stem, and levels of the thalamus.

Dr. Samuel Giles, MD, while a student at Tufts University School of Medicine, developed the Malaria and HIV/AIDS cases. He has continued to help us while he is training in Neurology at the University of Florida in Jacksonville.

Dr. Mary Gauthier Delaplane while a medical student at Boston University School of Medicine provided anatomical drawings illustrating the cranial nerves and the neuroembryology. Anne Que, Paul Ning, Tiffany Mellott, Elizabeth Haskins, and Tal Delman aided Dr. Delaplane. Dr. Marc Bard provided drawings for an earlier text, *An Introduction to the Neurosciences*, 1972, while a student at the Tufts University School of Medicine, and we have continued to utilize or have modified some of these illustrations. We have also borrowed with permission from other published illustrations. We have attempted to contact these original sources for continued permissions. We will acknowledge subsequently any sources that have been inadvertently overlooked. In many of the clinical chapters, various medications are recorded. Before utilizing these medications, the reader should check dosage and indications with other sources.

It is with great pleasure we extend our thanks to our publishers and particularly our editor Simina Calin for all her help. Special thanks to Michael J. Lukus, PA-C; Steven Toms, M.D.; and Michel Lacroix, M.D., for the advice and support in this endeavor. Any faults or errors are those of the authors, and we would therefore appreciate any suggestions or comments from our colleagues.

Boston, MA, USA
Jamaica Plain, MA, USA
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