This treatment of neurophysiology was developed, in part, from lectures given to the medical students at the University of Nebraska College of Medicine. An attempt has been made to integrate clinical material throughout the presentation mainly as examples to illustrate the principles of normal operation of the nervous system. It was never the intention of the author to make this a textbook of clinical neurology, a compendium of diseases of the nervous system, or a "how-to" book for the neurological exam. The pattern recognition aspect of neurology, the recognition of frequently encountered syndromes, is best learned in the clinic or at the bedside, and it is perhaps best taught by the clinician. It was the author's intention to present the normally functioning nervous system to the student to give her or him a "feeling" for how the nervous system works and what it can and cannot do, and to equip him or her with basic concepts to be used in dealing with newly recognized disease processes involving the nervous system.

This book incorporates new and, to some extent, controversial concepts of the nervous system based upon recent data. The classical viewpoint (what most textbooks present) is presented, but in many cases the discussions are elaborated in order to give the student a better idea of how the system works. Not every controversy involves new ideas; many currently "new ideas" were actually espoused by the great physiologists, like Claude Bernard (1813-1878), Henry Head (1861-1940) and John Hughlings Jackson (1835-1911). The author's view is that it serves medicine no benefit to repeat (and perpetuate) concepts that most of recent experience with the nervous system repudiates. Rather, the benefit for medicine is derived from making it possible for the medical student to be amongst the leaders in the changing clinical world. A knowledge of basic concepts and a "feel" for the nervous system are necessary in promoting innovation in patient care. Because a good deal of the scientific controversy in modern neurophysiology is included in this treatment, it may also serve as an introductory textbook for graduate students provided it is supplemented by readings in the literature. References are supplied to get the curious student started in further study.

It is assumed that the reader of this book has an understanding of basic physics or, at least, basic electricity. The electrophysiology of nerve and muscle cells is presented in enough detail that even a student with a weak background should be able to master this material if he applies himself(1). It is also assumed that the student has studied neuroanatomy. The anatomy of various systems and structures is reviewed briefly, but not in sufficient detail to achieve a full understanding. There are a number of good textbooks of neuroanatomy available to the student. Good treatments for the medical student can be found in Kieman JA: Barr's The Human Nervous System, An Anatomical Viewpoint, 7th ed. Philadelphia, J.B. Lippincott Co., 1998; Nolte, J: The Human Brain. An Introduction to Its Functional Anatomy, 4th ed. St. Louis, MO, Mosby, 1999; and Martin, JH: Neuroanatomy. Text and Atlas, 2nd ed. Stamford, CT, Appleton and Lange, 1996. The student who wants more detailed treatment or a bit more of the "flavor" of neuroanatomical research can consult Brodal A: Neurological Anatomy In Relation to Clinical Medicine, 2nd ed. New York, Oxford Univ. Press, 1969. (Though the publication date of this volume is old, its treatment is mostly up-to-date.)

The organization of the book is a bit different from most neurophysiology textbooks. The text begins with an overview of the nervous system and its roles in an organism and a preview of the topics in the remainder of the book. Instead of launching then immediately
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into a discussion of the properties of excitable membranes, the text discusses human behavior as the entity neurophysiology attempts to explain. Chapter II is a presentation of psychophysics and movement. The properties of excitable membranes are discussed in Chapter 3. Included are discussions of the structure and properties of excitable membranes, the origins and characteristics of the membrane potential and the action potential, and nerve conduction. Chapter 4 is a general discussion of receptor mechanisms and information coding that is elaborated for each specific sensory system in Chapters 5-11.

Chapters 12-14 present discussions of the properties of peripheral nerves, the mechanisms of synaptic transmission, and the mechanisms of muscle contraction, partly for their own intrinsic interest and partly as building blocks for the discussions of reflex activity in the nervous system (Chapter 15) and of the initiation and control of movement (Chapter 16).

The role of the cerebral cortex in relationship to subcortical structures in learning, emotion, consciousness, and personality and the divergence of function of the two hemispheres are the subject of Chapter 17. A new chapter, Chapter 18, has been added in this edition to discuss the process of learning. This topic was notably missing from earlier treatments, a shortcoming now remedied. Chapter 19 ties the textbook together, harkening back to the overview, and presenting reasons for a more optimistic view of the possibilities of successfully treating neurological problems. It is emphasized that the clinician's view of how the nervous system works determines what he will do for the patient.

One major goal of any introductory course is to familiarize the student with the vocabulary of the field. An extended glossary, presented at the end of the text, gives a quick reference to that vocabulary. Most of the terms are presented bold faced when they are first introduced in the text. In many cases, a student who can define and properly use every term in this glossary will have mastered the subject matter of this book.

The nervous system is composed of billions of neurons, and any graphic representation of neural circuitry is necessarily a simplification. Throughout this text a kind of graphic shorthand is used: one cell is drawn when many are implied, dendrites or other parts of a cell are often omitted, and relative lengths of pathways are not represented accurately. This kind of "wiring diagram" is meant to be a conceptual model, not an accurate representation of actual physical arrangements of neurons. It is a good idea to keep this in mind.

Neurophysiology is a developing field and currently undergoing a metamorphosis. In the history of the field, the period from 1920-1975 can be characterized as one of intense interest in electrophysiology, but the recent history is dominated by neurochemical and neurogenetic approaches. One reason for this shift is the inability of electrophysiology to provide all of the answers to questions about the nervous system. It is doubtful that either neurochemistry or neurogenetics, by itself, can provide them either. What is certain is that there are more questions unanswered than answered! The student may be struck by the frequency of occurrence of phrases like "we don't know" in this text. He must understand that the nervous system is very complex. There are those who doubt that the human brain can ever understand itself. Whereas the author does not share this opinion, he must frequently say "we don't know what the answer is"!


Footnotes

1. From this point on, I will not attempt to use non-sexist language. Whereas I understand and am sympathetic with feminist concerns, I am more concerned here with concise and
uncluttered exposition. Therefore, I will henceforth use the generic "he" to mean "she or he."

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