# INTRODUCTION TO PHYSIOLOGICAL AND PATHOLOGICAL CHEMISTRY

L. Earle Arnow NINTH EDITION

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# PHYSIOLOGICAL AND PATHOLOGICAL CHEMISTRY


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# PHYSIOLOGICAL AND PATHOLOGICAL CHEMISTRY

*To*

*Jennie and Pete*

*Who have encouraged me anew many times*
*during the writing of this book*

# Preface

It is true, I believe, that most teachers of a chemistry course uniquely choose the topics for their lectures, assignments, and quiz sessions. Thus, no textbook, unless written by the teacher, is likely to contain only the material covered in the course. Under these circumstances, what type of textbook will be most useful to the teacher and to the student? I think the ideal general purpose textbook should meet the following criteria:

1. It should be constructed as a series of short discussions, identified by side titles. Some of these necessarily will contain information indispensable to a coherent, meaningful course of study. But others can be omitted, if the instructor chooses, without interrupting a logical flow of information. For example, discussion of the periodic table can be omitted if teaching time is limited. This particular suggestion will shock some teachers, because this topic is a cornerstone of the usual chemistry course. But, truthfully, it will be rare indeed for a practitioner in one of the health fields to have any need for it.

2. Many brief discussions illustrating the application of chemistry to health and medicine should be included. The teacher then can suggest that these paragraphs be read, perhaps even with the promise that questions about them will not appear on examinations. If they *are* read, they can be very useful in convincing a too often unbelieving student that chemistry really is useful and even essential in understanding the health and clinical problems arising daily in the work of professionals who deal with patients.

3. Some information taught in other courses, but logically a part of biochemistry, should be included because it serves as an instant source of reference. For example, kidney function and hormones will be studied in courses in physiology and pathology; vitamins and nutrition will be dealt with in nutrition and dietetics; and acid-base balance will be discussed in physiology and medicine. It is almost impossible to teach a course involving biochemistry without referring to these topics. Hence, curious students, especially the better ones, can and will use profitably accounts of these subjects, even if they are not discussed specifically in the teacher's lectures.

4. The writing style should be clear and explanations should be simple and understandable. Ideally, the discussions should be clear enough so that a student who misses a lecture, or who fails to record or remember parts of one, can gain the information easily by reading the text.

5. Finally, the information in the text should be pertinent and up to date. Recent controversial topics, however, should be omitted, or if their potential importance justifies including them, they should be clearly labeled as controversial.

I have attempted to meet these criteria ever since I wrote the first edition of this textbook, which appeared in 1939. The fact that it has been useful to teachers and students for more than a third of a century is evidence that I may have succeeded, certainly in part if not completely.

The major difficulty in generating enthusiasm for chemistry in students who wish to work in one of the health professions is their seemingly almost unanimous belief that the subject has little relationship to clinical medicine. As a freshman medical student I had the same belief, but as a senior medical student I wished, sometimes almost fervently, that I could then restudy the preclinical sciences, including biochemistry, because of my discovery of their fundamental importance and relationship to clinical science—and to the management of patients. That is why I have included so many clinical applications in this book.

Some topics not included in the previous edition have been added to this one. They include discussions of the three laws of thermodynamics; gases and the gas laws; bonding in metals; molecular orbitals and the isoelectronic principle; a classification of the hyperlipoproteinemias in terms of their possible role in coronary heart disease; prostaglandins; connective tissue proteins; copper deficiency in human infants; complement; neurohumeral transmitters; erythropoietin; and the new regulations for the labeling of packaged foods.

There is now much interest in acid-base balance, and an expanded discussion of this topic is included. Related to this are more lengthy accounts of water balance and electrolyte imbalances. The description of diabetes mellitus has been updated. The now recognized immediate role of the intestinal cells in digestion is explained. The table of chemical compounds of blood and their alterations in disease has been revised extensively.

All through the book there are new or revised brief discussions. The International System of Units (SI) is mentioned and the liter (which is not a fundamental unit of the SI system) is defined as 10 cubic decimeters. Only a few subatomic particles are discussed. Any attempt to describe the 300 or so other subatomic particles now known would be out of place. Some of the units of measurement used in radiology and in research with radioisotopes are defined.

In recent years many chemists have adopted a symbol for the benzene ring (  ) that differs from the classical one (  ). *Both* symbols are found in important chemical journals, such as the *Journal of the American Chemical Society*. But I have observed that important *medical* journals, including the *Journal of the American*

*Medical Association,* still publish the classical form. So, although many chemical texts now use the new symbol, I have retained the older one.

Carnitine and carnitine deficiency myopathy; the relationship of dipalmitoyllecithin to hyaline membrane disease of the newborn; mucopolysaccharides as exemplified by hyaluronic acid and chondroitin sulfate; the extranuclear DNA found in mitochondria and chloroplasts; reverse transcription as a process utilized by the RNA viruses; new potential therapeutic uses of calcitonin; a completely rewritten discussion of proteins in muscular contraction; secondary hypoparathyroidism; aldosteronism; and the importance of T cells and B cells in immunology are examples of topics discussed for the first time or in rewritten form.

The discussions of vitamins D and E have been largely rewritten. The most active form of vitamin D (perhaps *the* active form), 1,25-hydroxycalciferol, is included, and renal rickets is explained. The complete lack of evidence for the present extravagant claims for the utility of vitamin E is emphasized.

The appendix has a revised table of atomic weights, numbers, and symbols, and a table giving the names and shorthand symbols for the naturally occurring amino acids.

Mrs. Jane G. Lenahan, a member of the staff of the General Diagnostics Division of Warner-Lambert Company, is an expert in the field of clinical laboratory procedures used in hematology. She has been kind enough to furnish recent information about blood clotting and I have used it to revise this section of the book. I am grateful to her.

Mr. James Skillman of the Warner-Lambert Research Institute drew the new diagrams illustrating the changes that occur in glycolysis and in muscular contraction.

Finally, I am grateful to my wife, Jennie, who has accepted without complaint the many hours devoted to revising this book—hours that otherwise would have been shared with her.

**L. Earle Arnow**

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