

ARTHUR C. GIESE, Ph.D.

# CELL PHYSIOLOGY

FOURTH EDITION

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# PREFACE TO THE FOURTH EDITION

In the present, fourth edition of *Cell Physiology*, an effort was made to maintain the simplicity of the original conception of the textbook. This was no easy task in view of the volume of research at the cell and molecular level which is published daily all over the world. It is questionable whether one individual can any longer cope with it. Perhaps it is for this reason that some books on the physiology of the cell are more circumscribed, and cell biology, one aspect of cell physiology, is the topic of many. I found it necessary to rely on the many excellent reviews which have appeared on special topics. Reference to these is given in the text. If any pertinent new material has been omitted, it was not intentional.

It was thought of interest to include a chapter on the temporal organization of the cell because it has become evident that this parameter must always be taken into account—the cell is not only changing with time but it is also changing in a predictable way. The section on permeability was reorganized to include topics of current interest in membrane biology, especially the structure of cell membranes and active transport. The chapter on bulk transport through the cell membrane was given a wider framework.

An effort was also made to keep the book, as far as possible, to a reasonable size. Accordingly, some of the material in chapters of the previous edition (e.g., colloids and various topics now only of historical interest) had to be abbreviated or eliminated. References to older literature also had to be omitted to make room for newer ones.

I am indebted to Dr. M. Allen of Stanford University for a critique on topics in the book bearing on molecular biology, to Dr. R. M. Dowben of Brown University for a critique of the chapters on contractility, to Dr. A. Farmanfarmaian of Rutgers University for a critique of the chapters on permeability, to Dr. Franz Halberg of the University of Minnesota for his strong advocacy of cellular temporal rhythms, to Dr. R. M. Iverson of Florida Atlantic University for a critique of cell division, to Dr. Michael Mellon of the University of Miami for a critique of the chapters on excitability, to Mrs. Anne Muller Smith for a critical reading of the page proofs, to many readers who sent in suggestions, and to authors and publishers for making available tables and figures from their publications.

ARTHUR C. GIESE

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# PREFACE TO THE FIRST EDITION

"Cell Physiology" as presented here is patterned after a set of lectures as they are given in my class at Stanford University. Although several excellent textbooks in cellular physiology are available and a number of good books bordering on the field have appeared, there exists no single book which gives a brief account of the subject. Students have asked repeatedly that this need be fulfilled; that a book be written which describes in simple language and in bold outline the major problems of cellular physiology, explaining their interrelationships and the current status of each of them without confusing the beginner with details or taking him into controversies upon which even the experts cannot agree.

Introducing a topic in cellular physiology by presenting controversial issues has often left students without an anchorage of fact by which to evaluate anything at all. On the other hand, I have been impressed by the tendency of many students to accept uncritically and to memorize anything written in a textbook. It is certainly not possible to avoid conflicting information on some subjects, since an open mind must be maintained on all real issues; but controversies on less important points can be minimized so that the major achievements in cellular physiology are not completely obscured. To help the student understand the scientific approach and develop an attitude of critical evaluation, I have found it extremely useful to include fundamental laboratory work and to conduct weekly discussions focusing on more specific controversial problems. And it is expected that after this primary orientation in the subject, students may become interested enough to turn to the more complete and analytical studies cited in references at the end of each chapter.

I have, moreover, confined the subject matter in this book to that dealing primarily with the cell, since this is basic to studies on multicellular organisms. By avoiding treatment of problems which relate to the organization of cells into organisms, it is possible to develop a more closely-knit body of information, such as could be presented to a class in the course of a quarter or a semester. Classes in plant physiology, comparative animal physiology, mammalian physiology and bacterial physiology are logical sequels to the course in cellular physiology.

At Stanford a one quarter course in cellular physiology is required of biology majors, most of whom take it at the junior or senior level. The student will have taken elementary botany, zoology, physics and introductory and organic chemistry. He is, therefore, unprepared for a rigorous physical-chemical treatment of the subject. However, the experience of the department over the years seems to have justified the premise that an introduction to cellular physiology at the elementary level is more beneficial than restriction of the course to a handful of graduate students with a broader background. Consequently

derivations of equations on physical-chemical principles or more extended discussions, if included at all, are put in appendices because this makes the material available to those students who are really interested without impeding the flow of the subject for those who are not.

I am indebted to Miss Ruth Ogren, scientific illustrator, for preparing many of the illustrations, and to Professor Hadley Kirkman of Stanford University, Professor David Waugh of Massachusetts Institute of Technology, and Dr. Richard Boolootian for use of some photographs. The courtesy of numerous publishers who have permitted copying of figures from books or periodicals is also acknowledged with gratitude. I am also indebted to Dr. George Palade of the Rockefeller University for electron micrographs used in the frontispiece, and to Dr. John Bennett, for the figure of the metabolic mill.

I wish to express my appreciation for many helpful comments and criticisms made by my colleagues and assistants, and especially to Professor J. P. Baumberger of Stanford University, Professor Jack Myers of the University of Texas, Professor John Spikes of the University of Utah, and to my students, Dr. Ray Iverson, Dr. David Shepard and Dr. Raymond Sanders, for a critical reading of the manuscript or parts of it. However, I must assume responsibility for opinions expressed and for omissions or errors which may still remain after proofreading. My main hope is that students will find this account interesting and stimulating.

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