

To my teachers

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PREFACE TO THE SECOND EDITION

The pace of discovery in biochemistry has been exceptionally rapid during the past several years. This progress has greatly enriched our understanding of the molecular basis of life and has opened many new areas of inquiry. The sequencing of DNA, the construction and cloning of new combinations of genes, the elucidation of metabolic control mechanisms, and the unraveling of membrane transport and transduction processes are some of the highlights of recent research. One of my aims in this edition has been to weave new knowledge into the fabric of the text. I have sought to enhance the book's teaching effectiveness by centering the exposition of new material on common themes wherever feasible and by citing recurring motifs. I have also tried to convey a sense of the intellectual power and beauty of the discipline of biochemistry.

I am indebted to Thomas Emery, Henry Epstein, Alexander Glazer, Roger Kornberg, Robert Martin, and Jeffrey Sklar for their counsel, criticism, and encouragement in the preparation of this edition. Robert Baldwin, Charles Cantor, Richard Caprioli, David Eisenberg, Alan Fersht, Robert Fletterick, Herbert Friedmann, Horace Jackson, Richard Keynes, Sung-Hou Kim, Aaron Klug, Arthur Kornberg, Daniel Koshland, Jr., Samuel Latt, Vincent Marchesi, David Nelson, Garth Nicolson, Vernon Oi, Robert Renthal, Carl Rhodes, Frederic Richards, James Rothman, Peter Sargent, Howard Schachman, Joachim Seelig, Eric Shooter, Elizabeth Simons, James Spudich, Theodore Steck, Thomas Steitz, Judit C.-P. Stenn, Robert Trelstad, Christopher Walsh, Simon Whitney, and Bernhard Witkop also gave valuable advice.

Patricia Mittelstadt edited both editions of this text. I deeply appreciate her critical and sustained contributions. I am indebted to Donna Salmon for her outstanding drawings. David Clayton,

David Dressler, John Heuser, Lynne Mercer, Kenneth Miller, George Palade, Nigel Unwin, and Robley Williams generously provided many fine electron micrographs. Betty Hogan typed the manuscript and played an indispensable role in its preparation. Cary Leiden and Karen Marzotto carefully read the proofs. I also wish to thank Michael Graves for his excellent photographic work.

My wife, Andrea, and my sons, Michael and Daniel, have cheerfully allowed this text to become a member of the family. I am deeply grateful to them for their patience and buoyancy. Andrea provided much advice on style and design, as she did for the first edition.

I have been heartened by the many letters that I have received from readers of the first edition. Their comments and criticisms have enlightened, stimulated, and encouraged me. I look forward to a continuing dialogue with readers in the years ahead.

August 1980

Lubert Stryer

PREFACE TO THE FIRST EDITION

This book is an outgrowth of my teaching of biochemistry to undergraduates, graduate students, and medical students at Yale and Stanford. My aim is to provide an introduction to the principles of biochemistry that gives the reader a command of its concepts and language. I also seek to give an appreciation of the process of discovery in biochemistry. My exposition of the principles of biochemistry is organized around several major themes:

1. Conformation—exemplified by the relationship between the three-dimensional structure of proteins and their biological activity
2. Generation and storage of metabolic energy
3. Biosynthesis of macromolecular precursors
4. Information—storage, transmission, and expression of genetic information
5. Molecular physiology—interaction of information, conformation, and metabolism in physiological processes

The elucidation of the three-dimensional structure of proteins, nucleic acids, and other biomolecules has contributed much in recent years to our understanding of the molecular basis of life. I have emphasized this aspect of biochemistry by making extensive use of molecular models to give a vivid picture of architecture and dynamics at the molecular level. Another stimulating and heartening aspect of contemporary biochemistry is its increasing interaction with medicine. I have presented many examples of this interplay. Discussions of molecular diseases such as sickle-cell anemia and of the mechanism of action of drugs such as penicillin enrich the teaching of biochemistry. Finally, I have tried to define several

challenging areas of inquiry in biochemistry today, such as the molecular basis of excitability.

In writing this book, I have benefitted greatly from the advice, criticism, and encouragement of many colleagues and students. Leroy Hood, Arthur Kornberg, Jeffrey Sklar, and William Wood gave me invaluable counsel on its overall structure. Richard Caprioli, David Cole, Alexander Glazer, Robert Lehman, and Peter Lengyel read much of the manuscript and made many very helpful suggestions. I am indebted to Frederic Richards for sharing his thoughts on macromolecular conformation and for extensive advice on how to depict three-dimensional structures. Deric Bownds, Thomas Broker, Jack Griffith, Hugh Huxley, and George Palade made available to me many striking electron micrographs. I am also very thankful for the advice and criticism that were given at various times in the preparation of this book by Richard Dickerson, David Eisenberg, Moises Eisenberg, Henry Epstein, Joseph Fruton, Michel Goldberg, James Grisolia, Richard Henderson, Harvey Himel, David Hogness, Dale Kaiser, Samuel Latt, Susan Lowey, Vincent Marchesi, Peter Moore, Allan Oseroff, Jordan Pober, Russell Ross, Edward Reich, Mark Smith, James Spudich, Joan Steitz, Thomas Steitz, and Alan Waggoner.

I am grateful to the Commonwealth Fund for a grant that enabled me to initiate the writing of this book. The interest and support of Robert Glaser, Terrance Keenan, and Quigg Newton came at a critical time. One of my aims in writing this book has been to achieve a close integration of word and picture and to illustrate chemical transformations and three-dimensional structures vividly. I am especially grateful to Donna Salmon, John Foster, and Jean Foster for their work on the drawings, diagrams, and graphs. Many individuals at Yale helped to bring this project to fruition. I particularly wish to thank Margaret Banton and Sharen Westin for typing the manuscript, William Pollard for photographing space-filling models, and Martha Scarf for generating the computer drawings of molecular structures on which many of the illustrations in this book are based. John Harrison and his staff at the Kline Science Library helped in many ways.

Much of this book was written in Aspen. I wish to thank the Aspen Center of Physics and the Given Institute of Pathobiology for their kind hospitality during several summers. I have warm memories of many stimulating discussions about biochemistry and molecular aspects of medicine that took place in the lovely garden of the Given Institute and while hiking in the surrounding wilderness areas. The concerts in Aspen were another source of delight, especially after an intensive day of writing.

I am deeply grateful to my wife, Andrea, and to my children, Michael and Daniel, for their encouragement, patience, and good spirit during the writing of this book. They have truly shared in its

gestation, which was much longer than expected. Andrea offered advice on style and design and also called my attention to the remark of the thirteenth-century Chinese scholar Tai T'ung (*The Six Scripts: Principles of Chinese Writing*): "Were I to await perfection, my book would never be finished."

I welcome comments and criticisms from readers.

October 1974

Lubert Stryer

BIOCHEMISTRY

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