Preface

In this book we present a comprehensive account of the structures and physical chemical properties of the nucleic acids, with emphasis on implications for biological function. The level of presentation assumes that the reader has knowledge of physical chemistry and molecular biology that would be obtained from introductory courses in these subjects.

We have three intended audiences: molecular biologists, physical biochemists, and physical chemists. Molecular biologists and nucleic acid biochemists have made remarkable strides in defining the major classes of nucleic acids, determining their sequences, and proposing connections between sequence and biological function. Such connections pertain not just to the direct coding of amino acid sequences in proteins, but also to regulation of transcription, translation, replication, and molecular evolution. The next step, one that requires physical chemical approaches, is to understand the mechanism by which a sequence of nucleotides exerts its coding or regulatory function. For this, one must know how the structure and dynamics of that sequence differ from those of its neighbors, and how those properties are affected by interaction with other molecules. One of our goals is to present to the molecular biologist the results that have been obtained on these issues, the experimental basis of these results, and some idea of what may be expected from even closer collaboration between biologists and physical chemists in the future.

For those physical biochemists already working on nucleic acids, or beginning a research career in this area, our goal is to provide a comprehensive treatment of the major experimental and theoretical approaches to the structures and physical properties of the nucleic acids.

Physical chemists have developed a powerful set of experimental and theoretical techniques for determining the structural and dynamical properties of molecules. New methods in spectroscopy and diffraction, and new theoretical approaches to complex molecular systems are producing ever more sensitive and detailed insights into nucleic acid behavior. We hope in this book to give physical chemists an overview of the biological context in which their contributions are being used, and some perspectives on the challenges that remain.

To reach three such different audiences with the same book requires careful organization. We have adopted a uniform plan for each chapter, leading off with a statement of the biological significance of each topic, and following with a clear presentation of the basic physical ideas and major results. The quantitative details, which are important to the physical chemists and physical biochemists, are developed in special sections or appendices.

The main logic of organization is through a systematic consideration of techniques used in the study of nucleic acid structure and properties. This should maximize the book's utility as a textbook in physical biochemistry, and as a reference for techniques that may be encountered in the literature or in one's own work. Examples of the uses of the various techniques go from the simpler techniques to the more complex. Readers interested in applications to particular molecules will find cross-references in the index.

We hope that the book will serve a variety of functions: as a textbook in physical biochemistry and biophysical chemistry classes; as an aid to molecular biologists or biochemists trying to gain a better understanding of physical techniques they use or encounter in the literature; and as a reference work for physical chemists and physical biochemists.

We are grateful to our colleagues who have sent us reprints and original figures for reproduction, and who have commented on the various versions of this book. We give special thanks to David Draper, whose detailed comments notably improved our efforts.