Preface

In 1975 I was introduced to the pleasures and agonies of writing a textbook. When I finished that book, I vowed never to undertake another one; but somehow five other books were conceived and then brought to fruition in the next five years. In 1980 I acceded to the insistence of my undergraduate students, who for several years had been asking me why I did not write an undergraduate molecular biology text, and decided to do just that.

Molecular Biology, A Comprehensive Introduction to Prokaryotes and Eukaryotes is the result of this most recent effort. A multipurpose college textbook in molecular biology, it is based, in part, on a course that I taught for many years at Brandeis University. Its primary use will be in undergraduate courses emphasizing basic molecular processes (such as the synthesis of DNA, RNA, and protein) and genetic phenomena in both prokaryotic and eukaryotic cells. Students who wish to make full use of the text should have knowledge of basic biology and general chemistry and have completed or be enrolled in a course in organic chemistry.

Because of the variety of subjects treated and the detailed presentation in some chapters, the book can also be used in other courses. For example, fairly complete coverage of the structure of macromolecules enables the book to serve as a text for a short course in structural biology. (An advanced course in this subject would require an additional book on physical biochemistry.) The material contained in the

rather lengthy chapters on the chemical and physical properties of DNA and on nucleic acid synthesis has been used in a one-semester course in nucleic acids that I taught several years ago. Classical genetics, microbial genetics, and general features of genetic recombination are likewise treated in detail; my experience has been that when supplemented with sets of problems these topics can serve as a core for a molecular genetics course. (A separate problems book is available to make this application possible.) I expect that the book will be useful in advanced genetics courses, also. Finally, reviewers of the text who teach in medical schools have pointed out to me that the text can be used as a component of medical biochemistry and cell biology courses, in keeping with the current trend of emphasizing molecular processes in such courses. Before writing my text, I made a survey to determine the college year in which molecular biology and molecular genetics are usually taught. This was found to range from the sophomore year to the first year of graduate school. Thus, in an effort to accommodate various curricula, I have included in each chapter of my book basic information (sometimes in the form of a review or an overview), advanced topics, and discussion of many specific systems.

Molecular Biology differs in organization from other molecular biology texts: it follows my philosophy that molecular biology must emphasize both molecules and biology, and that to be molecular, it must also be chemical and physical—quite a tall order for a single book. With this goal in mind, I chose to present a biological introduction to the subject first (Chapter 1) before getting into the complexity of molecular detail, so that the student will know the phenomena that molecular biologists would at present like to explain and will be familiar with the biological systems used in research. A second introductory discussion, Chapter 2, reviews those aspects of organic chemistry needed by the reader and provides some basic biochemical concepts. The first major discussion following the introductory material is concerned with physical biochemistry; hence, there is extensive early coverage of the properties of macromolecules; this is a notable feature of the organization of this book. Early presentation of this material is based on my teaching experience, in which I have concluded that students have an easier time understanding the great variety of phenomena in which macromolecular interactions play a role if they have first acquired a thorough understanding of macromolecular structure. For example, the student should have a clear understanding of the significance of molecular shape and the interactions that give rise to the shape of a particular molecule; how, otherwise, can the concepts of templates, active sites, specificity of binding, and mutation be understood?

Following the treatment of macromolecules, the text turns to what is traditionally thought of as molecular biology—namely, DNA, RNA, and protein synthesis. In each case, both prokaryotic and eukaryotic

systems are described in the same chapter; the prokaryotic systems are given in greater detail, as more is understood about these systems, and the similarities and differences between prokaryotes and eukaryotes are pointed out.

The next major unit of the book is concerned with how the basic synthetic processes are integrated to enable a prokaryotic cell or particle to function efficiently and to respond to a changing environment; here, the text examines in some detail metabolic regulation in bacteria and phages, stressing the notion of efficiency.

Features of genetic exchange—natural systems such as plasmids, transposons, and homologous recombination, and the artificial process of genetic engineering—form the next unit; parts of each chapter are presented as a survey, for a beginning course, but discussions of particular models are provided for use in courses of greater depth.

The final unit of the book is concerned exclusively with eukaryotic systems. It is divided into two parts, the first on animal and plant viruses—their basic biology and how they are regulated—the second on regulation in numerous eukaryotic systems, in both unicells and animal tissue.

A problems book (*Problems for Molecular Biology*, Jones and Bartlett Publishers, Inc., 1983), containing more than 800 problems with complete and detailed solutions, is also available as a supplement to this text and is matched to the text chapter by chapter. Drill questions to test a student's mastery of facts are given for each major topic and many problems of a more substantive and sometimes difficult nature are also included. These problems have all been used in prior courses and have been extensively checked for ambiguities and correctness of solutions by undergraduate students at Brandeis University and graduate students and faculty at the University of California, Berkeley.

Inasmuch as *Molecular Biology* can be used in its entirety in either a condensed one-semester course, such as I have taught, or a more relaxed full-year course, instructors will have to be selective of the material for one-semester courses. To aid in this selection, summaries of the chapters—and especially of the points of view taken in the chapters—are presented in the following paragraphs.

Since the *modus operandi* of molecular biologists requires knowledge of phage biology, bacteriology, cell biology, and classical and microbial genetics, these topics are presented in Chapter 1 in a phenomenological way. Commonly used genetic tools such as recombinational mapping and complementation are reviewed. A brief discussion is also given of the logical approach taken in molecular biology that distinguishes it from the biology of the earlier part of the century. The basic life cycles of particular biological systems used by molecular biologists—namely, *E. coli*, phage, viruses, yeasts, and animal cells—