

Preface to the Second Edition

Early obsolescence of the first edition and drift into obesity of later, updated editions appear to be generic traits of genetics texts. For instance, the first edition of the very prototype of the genre, W. Johannsen's *Elemente der exakten Erblchkeitslehre*, in which the word *gene* made its debut, was out of date and out of print within two years of its publication in 1909. By 1913 Johannsen had brought out a second edition, in which the original 515 pages had grown to 723 pages. Half a century later, J. D. Watson's *Molecular Biology of the Gene*, whose first edition in 1965 consisted of 494 pages, had grown to 739 pages by its third edition in 1976. So also has *this* genetics text not managed to escape the common destiny of its kind: seven years after its first appearance we now present an overdue, updated, and fattened second edition.

The narrative style of this text turned out to present special difficulties for the project of updating it in the light of recent advances in understanding the function of the hereditary substance. Because of the initial conception of the corpus of molecular genetics as a story, major alterations—not to speak of deletions—seemed to threaten the literary integrity of the text. Obviously, Margaret Mitchell could not very well have revised *Gone with the Wind* in the light of later insights into the conditions of antebellum Southern plantation society and compensated for an expanded, updated rendition of the O'Hara household by dropping the Atlanta-in-flames episode. Hence we had to treat the material to be presented in this second edition mainly as a sequel to rather than as a revision of the narrative begun in the first edition. In any case, this updated story is still based on the Berkeley undergraduate molecular genetics course, whose original stewardship was relinquished by G. S. Stent at the time of publication of the first edition and of which R. Calendar has taken charge in recent years.

The bibliographies of pertinent literature provided at the end of each chapter have been extensively revised, particularly those providing guidance to specialized texts, monographs, and reviews. Moreover, pertinent references have been added to a pedagogically most useful book, namely, *Biochemistry: A Problems Approach* by W. B. Wood, J. H. Wilson, R. M. Benbow, and L. E. Hood (W. A. Benjamin, Menlo Park, Cal., 1974). This book is abbreviated as wood in the bibliographies.

We are indebted to the many colleagues who have drawn our attention to errors and deficiencies in the first edition and offered valuable suggestions for improvements, particularly F. W. Stahl and W. D. Stansfield. We thank Laura Davis and Lawrence Honig for their careful scrutiny of the manuscript. Finally, this second edition, like the first edition, has benefited greatly from Charles Yanofsky's critical reading of the entire text and from Margery Hoogs' excellent editorial assistance.

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Gunther S. Stent
Richard Calendar

Preface to the First Edition

In the winter of 1954, Edward H. Adelberg and I began teaching an undergraduate course at the University of California that was supposed to bring the latter-day gospel of molecular genetics to the Berkeley students. It was an extraordinarily gratifying pedagogical undertaking to face an audience of innocents, who had not yet heard of the DNA double helix, and preach to them that a new era was dawning for the understanding of heredity. So enthusiastic were we in those days that we managed to give thirty lectures on what comparatively little was then known about mutation and genetic recombination in bacteria and their viruses. How times have changed! Molecular genetics has since grown from the esoteric specialty of a small, tightly knit vanguard into an elephantine academic discipline whose basic doctrines today form part of the primary-school science curriculum. Throughout the period of the well-nigh explosive development of its subject, I have continued to teach this course, and had I not undertaken an annual pruning of the material, the number of lectures necessary to present it would by now have grown at least tenfold. This text presents the present scope and content of that course.

The evolutionary origin and essentially pedagogic purpose of this book are reflected in the narrative presentation of the material in the historical sequence in which it actually came to be known (and in the occasional burdening of the reader with long-abandoned theories). Not only did the text simply grow in this way, but also I happen to believe that an understanding of the essentials of molecular genetics can best be taught in an organic (rather than logical) manner. But in case my presentation should give the erroneous impression that it is an attempt at historiography, I must warn the reader that my "streamlined" account of past developments is intended to be neither a scholarly history nor a hagiography of molecular genetics.

In the first place, I have deliberately chosen to mention only a part of the diverse experimental materials that actually figured in the development of my subject. Without doing too much violence to what I believe to have been the actual sequence of events, I have for the most part tried to present the basic findings of molecular genetics as they came to be revealed through work done with the hemoglobins of humans and rabbits, with the tryptophan synthetase, the betagalactosidase, and the DNA-, RNA-, and protein-synthesizing machinery of the intestinal bacterium *Escherichia coli*, and with three or four viruses that grow on *E. coli*. Thus there are vast lacunae in my account: for instance, the two eukaryotic microbes that were the subjects of much intensive molecular genetic study, the bread mold *Neurospora crassa* and the yeast *Saccharomyces*, are mentioned only in passing; the bacterial enzymes active in the synthesis of arginine, histidine, and leucine and in the hydrolysis of organic phosphates, whose study contributed in a very important way to the understanding of the mechanics and regulation of protein synthesis, are given short shrift; and animal viruses, the study of whose reproduction paid enormous benefits in both practical and theoretical realms, have been passed over in near total silence.

In the second place my story is historiographically defective as far as its mentioning of persons' names is concerned. The many investigators who happen to have worked with experimental material that I did not choose for presentation are completely missing from this account. Even the names of most of those who labored to bring forth the body of knowledge on which I do report have been left unmentioned, for I feared that providing a complete *dramatis personae* would prove tiresome for my readers. But neither did I want to opt for the other alternative of equitable scientific historiography—if you don't cite everybody, cite nobody—since I thought that every student ought to know the identity of at least *some* of the protagonists of the theater of molecular genetics. And so I have made an undoubtedly invidious selection of names, among which my own friends are probably over-represented.

I have attempted to present my material in such a manner that it is within the intellectual horizon of a reader who has completed two years of undergraduate science training. The only formal preparation that I have taken for granted is a year's study of general college chemistry, so that I am presuming at least a superficial familiarity with such concepts as atoms and molecules, weak and strong chemical bonds, chemical equilibrium, and oxidation-reduction and solution chemistry. I am not presuming prior college study in biology, and particularly not in genetics, although a command of these subjects, as well as of organic chemistry, should certainly help in the understanding of this text. Unfortunately, the undertaking to make the story of molecular genetics accessible to such a broad audience entailed the unavoidable drawback that some of the material presented here must be familiar to readers with prior college training in the life sciences. Although in composing my narrative I did have in mind a devoted reader who sticks with it from beginning to end, most veterans

of a modern general biology course might prefer to begin their study of this text with Chapter 3, and readers in possession of the basic facts and terminology of biochemistry might even proceed directly to Chapter 5.

In order to open avenues to further and deeper study of molecular genetics, I have provided each chapter with a bibliography of pertinent literature. These bibliographies include three categories of references. The first category indicates the relevant chapters of three other books, which between them cover in greater detail much of the ground of this text. One is the collection of autobiographical and retrospective essays *Phage and the Origins of Molecular Biology* (J. Cairns, G. S. Stent, and J. D. Watson, eds., Cold Spring Harbor Laboratory of Quantitative Biology, New York, 1966), abbreviated as PATOOMB in the bibliographies. These essays, which were written by members of the Phage Group of which Max Delbrück was the central figure, trace out the intellectual, experimental, and personal developments that led to some of the main happenings of this story. The other two books are William Hayes' definitive text, *The Genetics of Bacteria and Their Viruses* (2nd edition, John Wiley & Sons, New York, 1968), and my own earlier text, *Molecular Biology of Bacterial Viruses* (W. H. Freeman and Company, San Francisco, 1963). These books are abbreviated as HAYES and MOBIBAV, respectively, in the bibliographies. The second category includes references to some of the original research papers in which the results of key experiments were first reported. The third category includes specialized texts, reviews, and monographs, in which the reader can find both further information and more extensive bibliographies.

Finally, I ought to mention here an outstanding book that covers more or less the same ground as this text: J. D. Watson's *Molecular Biology of the Gene* (2nd edition, W. A. Benjamin, New York, 1970). I have the highest regard for this deservedly successful introductory presentation; in my opinion, it has no peer in the literature of molecular genetics. Indeed, the only reason why I persevered in completing my own treatment of the same material is that I thought that some readers might profit more from my narrative approach than from Watson's sovereign didactics. But it is according to the high standards set by *Molecular Biology of the Gene* that I wish my own effort to be judged.

This text was completed during a sabbatical leave from the University of California, Berkeley. I thank the John Simon Guggenheim Memorial Foundation for its grant of a fellowship and Stephen W. Kuffler and John Nicholls of the Department of Neurobiology, Harvard Medical School, for hospitable accommodation in their laboratories. I am grateful to Robert S. Edgar, A. Dale Kaiser, and Charles Yanofsky for their critical readings of the manuscript and to Mrs. Margery Hoogs for her efforts to rectify its prose style.

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Gunther S. Stent