PREFACE

The past three decades have seen extraordinarily productive investigations of the body's immune mechanism, particularly the development of molecular biochemical techniques to identify and characterize the "gene stuff," DNA. Because knowledge of the immune system accumulates so rapidly, it is impossible for even the most dedicated researcher/instructor, let alone a student, to be familiar with all the advances in this field. The next few years will probably witness an even quicker pace, partly because of the need to halt the AIDS epidemic. The consequence is that a one-semester immunology course taught at the advanced undergraduate level (consisting of accelerated juniors, seniors, and some graduate students) is becoming a staple curricular offering at virtually every college and university. The extraordinary growth of immunology as an academic discipline is unrivaled by any other field. *Immunology: Understanding the Immune System* is an introductory text that grew out of the shared interests of former students and the author in examining ways to answer four frustrating complaints: (1) "I don't know the direction the chapter is taking me"; (2) "What am I expected to learn from the reading?"; (3) "This new information is overwhelming me; I need *mental breathers* within the chapter to reassess the material just covered"; (4) "I need to know if I comprehend the material and be able to test my knowledge of the material *before* an exam!" This text remedies these problems. *Immunology: Understanding the Immune System* assumes that the reader or student has a working knowledge of organic chemistry and microbiology, and so at times concentrates on the presentation of experimental data/foundations and on discussions of the concepts that led to these experiments, particularly for topics that explain the basic principles of how the immune system works. It should be useful both to students with only a passing interest and to those planning further study.

The first chapter (especially the later part) is a mini-version of the book. Once students finish this chapter, they will have an overall view of immunology as each new topic is introduced. The remaining 18 chapters are organized into the following sequence: Chapters 2 through 6 discuss the immune system's cells and organs, and antigens and antibodies—where and how the participants of the immune system work, the substances that induce an immune response, the immune substances that are induced, the interactions between the two (serology: methods used to test for the immune substances that are induced), and the genes that encode antibodies. Chapters 7 through 14 discuss immunobiology—the location of genes that control the immune response, how these genes allow immune cells to communicate with each other, how T cells recognize antigen, what molecules immune cells release once they are activated by antigen, what events are involved in an immune response at the intact animal level and the cellular interactions required for the response, how the immune response is downregulated, how the immune response tolerates self-constituents, and how antigen-antibody interactions start the complement system that leads to enhanced protective events and destruction of antigen. Chapters 15 through 19 discuss immunopathology (the immune system is not infallible)—problems encountered due to antibodies, T cells, reactions against innocuous substances or intracellular organisms, reactions against self, and reactions against helpful nonself tissues and organs. Also discussed is the failure of the immune system to respond to harmful self; lastly, how the immune response can be modulated, both from within and by clinical methods.

In particular chapters, such as those dealing with genetics, cellular interactions, and tumor immunology, but also generally throughout the text, emphasis is placed on the experimental basis for our acceptance of important concepts. Describing a moderate amount of experimental evidence greatly deepens our appreciation of the concepts presented.

The reference value of the book is further enhanced by a selected list of further readings presented at the end of each chapter. Rather than simply listing the readings, a few words about why each was chosen are included. This book's value as a reference also is heightened by the material at the end: a glossary, an abbreviations and acronyms section, appendixes, and particularly the lengthy index.

Any endeavor of this magnitude is never done alone, and this book is no exception. The exception will be my inability to articulate my indebtedness to all who contributed. Beyond simply a sincere thank you, here goes the rest. Throughout the preparation of this book, I have become deeply indebted to many friends and colleagues for discussing the book with me and for their invaluable constructive criticisms and information. First, to Dr. Carol J. Burger, who graciously undertook the task, not once but several times, of reviewing the entire manuscript and individual chapters. Then to Dr. Kevin M. Connolly, who had the misfortune of my knowing that he had graduated from Johns Hopkins University with a double major, English and biology, and that he had received his masters and doctorate in immunology with an eminent immunologist. Thus, I was able to persuade him to suffer through several reviews of the entire text. His conceptual contributions were excellent. Dr. Thomas M. Walker, whom I have dubbed the "surgeon," was able to cut out the fat from the original manuscript, while expertly leaving all the vital organs intact. I am happy to say that these individuals, who devoted many hours to the book in order to provide extensive technical advice, are still my friends. For advice on specific points, I thank Dr. Noel R. Krieg, Alumni Distinguished Professor, American Society for Microbiology Carski Awardee, and fellow author, who demonstrated his long experience of teaching and book authorship by showing me how to remove some of the book's faults and how to draw using a computer. A gold medal and hard-earned payment go to Ms. Mary C. Holliman for developmental editing. I also thank Ms. Geriann P. Park, a former undergraduate student of mine, who volunteered (can you believe it?) to proofread the original manuscript. To say the least, I received valuable help from many sources, the too-many-to-count reviewers, who shared their expertise with me by critically reviewing chapters of the book; the staff of John Wiley & Sons, Inc., who kept it a pleasurable experience; and particularly Dr. Susan King (not only an editor but also, what luck, an immunologist), the responsible editor through most of the writing of the book also, Ms. Colette E. Bean, and Ms. Shirley Thomas, who expertly took it to the finish line and kept the devil out of the details. To Virginia Polytechnic Institute and State University, appropriately called *Virginia Tech*, its computer facilities (You want 200 plus pages printed per minute, you got it!), and the many individuals who directly or indirectly furthered this project, thanks. Appreciation is extended to the students who have passed through 20 years of my classes, not realizing that I would take to heart their complaints about the difficulty of learning immunology. This book was inspired by them and was created in an attempt to make learning this field more palatable for beginners. My hope is that the book will provide a solid foundation and, in turn, inspire students to continue their studies of immunology. To the graduate students in my laboratory at the time of this writing, particularly David W. Mullins, whose critical eye imprinted a student's view on many of the figures, special thanks for tolerating this interruption of my usual compulsive laboratory involvement. A big thanks to the *G*enerator *O*f *D*iversity for bringing me through this project. Let me end with a tribute to my wife, Kathleen, to whom this work is dedicated as a small expression of my gratitude for her love and acute criticism, which were always encouraging, and to my two girls, Heather and Colleen, whose favorite four words, "Are you *still* writing?", would always get me to stop and pay attention to them.

Klaus D. Elgert

Blacksburg, Virginia

NOTE TO READER

Immunology is not an easy discipline. It is as complex as the natural system it scrutinizes. However, just a brief dose of the basics of immunology will prepare you for the many upcoming, seemingly formidable concepts that you will be required to understand. The way to this "dose" is through the (highly recommended) reading of the first chapter and especially the ***Overview*** starting on page 13, which represents an expanded outline that emphasizes the basics, or the big picture. The *Overview* is a mini-version of the book and is written in less technical language. The prudent reader will find that *the time invested early avoids the need to invest a disproportionately large amount of time later.* One chapter cannot describe *all* the interrelationships of immunology that influence a topic. If the reader, however, first views immunology on the *Overview* big screen, how the "star" (the topic under discussion) fits into the surrounding act becomes apparent.

Reading an immunology text for the first time, you might be overwhelmed by the bewildering array of unknown terms and complex abbreviations. This book will help you move yourself into the land of immunology. By learning to speak the language, you begin to think in immunologic terms, and once you have managed the jargon, the learning comes easily. When first introduced, important terms are presented in **boldface** type and fully defined. Words that are to be focused on and remembered are presented in *italics.*

The book's brief *CONTENTS* expands as each chapter begins with a detailed ***Chapter Outline*** that serves as both a road map and a survey of things to come. The Chapter Outline is followed by a list of ***Objectives*** or "take-home" lessons that the reader should comprehend.

Other support systems are used within each chapter. *Footnotes* provide descriptive comments about specific passages in the text. **Fast Focus** comments are interspersed in boxes throughout the chapters and give the book a more interactive quality. These boxes may provide slanted extensions or present informed speculation on certain topics. Throughout every chapter at major breaks, ***Mini Summaries*** are offered that allow the reader to concisely reinforce the material and mentally "switch gears" to a new topic. Each chapter concludes with a ***Summary*** that contains highlighted terms. The summaries should help you recall and reinforce the information just covered; it should not be used as *the* tool to learn the material. If you read only certain parts of the chapter, the result may be reminiscent of the oft-told Hindu fable of the six blind men who examined an elephant from different parts, rather than examining the whole animal, and came up with six different descriptions.

To better prepare for an exam or comprehend the material just read, review questions are provided in the ***Self-Evaluation*** section at the end of each chapter. The Self-Evaluation section includes recalling key terms, multiple-choice questions, and short-answer essay questions. In lieu of answer keys, the page numbers for answers to the multiple-choice questions are provided. These page numbers will direct you to the correct section of the chapter when the answer to the question is not readily apparent.

Although immunology is still a young science, it has become vast and complex. To obtain greater clarification through additional study or to satisfy a desire to learn more about the chapter's topic, a section called ***Further Readings*** appears at the end of each chapter to point you in the right direction. Most of the

entries contain brief commentaries to further assist you in selection. The *Appendixes* (which include a Molecular Biology Refresher), an extensive *Glossary*, and an *Abbreviations and Acronyms* section are located at the back of the book.

As you progress from one chapter to the next, remember to be like the mythical Phoenix, *rising renewed and ready to begin again*.