TEXTBOOK OF IMMUNOLOGY

AN INTRODUCTION TO IMMUNOCHEMISTRY AND IMMUNOBIOLOGY

JAMES T. BARRETT, Ph.D.

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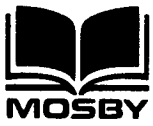

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PREFACE to fourth edition

In reviewing the literature during the preparation of this volume, I was impressed by two things: the breadth of subject matter to be included and its recency. Both of these tend to make instruction of immunology more difficult, whether it be in the lecture hall or in the development of a text. Present day immunologists are expected to show competence in basic genetics (the inheritance of transplantation antigens, blood group antigens, and the relationship of these to immunity and autoimmunity), to understand genetic engineering and molecular cloning (the techniques used to locate the genes used in immunoglobulin synthesis and interferon production), to demonstrate biochemical expertise (immunoglobulin structure, the mode of action of immunosuppressive drugs, the chemistry of the inorganic forms of oxygen used by phagocytic cells, and the place of lipids and arachidonic acid derivatives in chemotaxis and anaphylaxis), to understand the structure and behavior of several cell types, and, of course, to be expert immunologists. This required versatility illustrates the impact immunology has on its sister sciences, and vice versa—a matter of pride for all immunologists but a difficult task to master.

Instructors of immunology are simultaneously faced with this broad subject to impart and a broad audience of students from numerous disciplines, most of whom are only partially informed about the biochemical, genetic, cytologic, or other disciplines aside from their own that they need to understand before they can master the subject of their primary interest: immunology. This challenge and the success of most instructors in meeting it in company with the application of immunology to so many different sciences have sustained immunology as a topic of wide interest.

In addition, whereas a decade ago one could write a text and use fully viable references that were themselves a decade old, this is no longer possible. The dynamic pace and expansion of immunologic research now make it inadvisable in many instances to use references published more than 5 years previously. Consequently many instructors rely more on texts now than they did before, trusting that the text will present the vastness of modern-day immunology in an intelligible manner.

It has been the central idea in the design of this text since its first edition to provide a complete coverage of immunology. Rather than present cellular immunology and omit allergy, present immunochemistry and omit serology, or establish other arbitrary limits, it was the goal to generate an introductory text that fairly presents the scope of immunology in a style that a student with a limited background can still comprehend and appreciate. And although in each edition the factual base of this science has been updated and expanded, it seldom has been done so extensively as in this edition.

In this process I have had considerable assis-

tance from a number of my colleagues who have provided beautiful illustrative material. Of those, Professor Edward Adelstein of our Department of Pathology should be mentioned for his contribution of many electron micrographs. Additional illustrations by my wife, Barbro, and by commercial artists have improved this edition. Karen Ehlert did virtually all the typing, and an excellent job it was. Now the pages are in the hands of The C.V. Mosby Company staff. I have always admired their ability to create a good product, but perhaps even more I appreciate their continued friendship, their cooperation, and their encouragement.

J.T.B.

PREFACE to first edition

In its most recent growth, immunology has expanded from its origins in the medical sciences to permeate all of biology. The recognition by biologists of immunologic methods as important and sensitive research weapons has been responsible in a large measure for this rebirth of immunology. At the same time the utilization of modern biochemical knowledge and technology has given immunologists a new insight into their own science. These developments have presented additional problems to both students and teachers of immunology. On the one hand, undergraduate students who have had little opportunity to master complex chemical and biologic problems are drawn early to immunology as an exciting and "new" science. On the other hand, students who might have been content to continue in their chosen specialty now see a need to include immunology in their curriculum. The teacher is thus presented with a more varied audience than ever before. A partial solution to this dilemma is a textbook of immunology that will be equally useful to undergraduate and graduate students. This does not necessarily mean that the interests of students in the health sciences have been ignored, as is pointed out below.

To meet the demands of a broad audience the contents of this book have been tailored in several ways. First, the book is intended as a general textbook of immunology—one that overemphasizes neither immunochemistry nor immunobiology. Consequently complementary sections on the chemistry of the immunoglobulins and immunochemistry are balanced by sections on the phylogeny of the immune response and cellular aspects of the immunoglobulin response. A similar balance has been attempted in other sections. For example, the chapters on immunity and hypersensitivity, subjects of considerable interest to students in the medical and paramedical sciences, have been developed from the viewpoint that the fundamentals of these topics are essential to all students of immunology. Second, the references have been limited and chosen to emphasize reviews and specialty books. Several excellent immunologic review series are now available. These provide extended discussions of various items and lengthy bibliographies. In this way a broad base of additional readings has been provided without the necessity of a voluminous and, all too soon, outdated bibliography in this volume. Only a few students have the time for extensive outside reading during their course work in any case. Third, a brief appendix, which summarizes the highlights of macromolecular biochemistry, is included for those who are as yet uninitiated or need a quick refresher on the subject. Fourth, a genuine effort has been made to use a concise and intelligible writing style.

Introspection is an unreliable witness to the origin of ideas, and this is no more evident than in authorship. Many of the concepts incorporated

here were derived from my past professors, current colleagues, and perhaps, most vitally, interested students. To this legion, I give a salute of gratitude, with the hope that my efforts have in some small measure been worthy of them. Of those persons whom I wish to name, that of my wife, Barbro, must come first, both for her many hours of silent support and her active participation as an artist. To those wonderful girls at the typewriters, especially Anne, Carol, Linda, and Vera, I give my thanks for a job well done.

J.T.B.

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GLOSSARY

antitoxin An antibody (or antiserum) prepared in response to a toxin or toxoid.

attenuation Weakening the virulence of a pathogenic organism while retaining its viability.

immunity Condition of being resistant to an infection.

toxoid A toxin treated to preserve its native antigenicity but to eliminate its toxicity.

Within the last 15 years immunology has emerged as an individual science, and, like all modern sciences, it draws from and contributes to many other closely related biologic and chemical sciences, including microbiology, biochemistry, genetics, medicine, zoology, and pathology. The recent outburst of advances in immunology has followed very closely and in some instances has been responsible for notable progress in these other sciences. Virtually the entire history of immunology has been recorded in the past 100 years; even if we calculate the origin of immunology from the time of the introduction of smallpox vaccination into the western world, immunology has existed for only about 150 years. During that time the development of immunology and the sciences on which it has depended has been gradual and uneven. Consequently it is only within the past century that the growth of subdisciplines within the area of immunology has become apparent.

The first of the subdivisions of immunology to emerge was *immunity*. In its infancy immunology was devoted almost exclusively to the prevention of infectious diseases by vaccination and immunization. In the 1880s immunology and immunity were synonymous, but this is no longer true. Even though considerable effort still is being directed toward the improvement of old and the development of new vaccines and toward the improvement of immunizing techniques, new subjects of study such as autoimmunity, tumor immunity, interferon induction, transplantation immunity, and the fantastic recent advances in cell-mediated immunity, the mechanism of phagocytosis, and the role of complement have magnified immunity as a distinct discipline within the broader subject of immunology. This health-related component of immunology is closely bonded to the subjects of virology, genetics, immunochemistry, and serology, sometimes clouding immunity as the principal subject under study.

Serology, then, also could be thought of as a subdivision of immunity, but it is such a vast subject that it deserves an equal status. Like immunity, serology has obvious practical implications for human and veterinary medicine, but as a diagnostic rather than a preventive aid. Today's serologists seek not only to discover new specific serologic tests for disease, such as those employ-