ADVANCED CELL BIOLOGY

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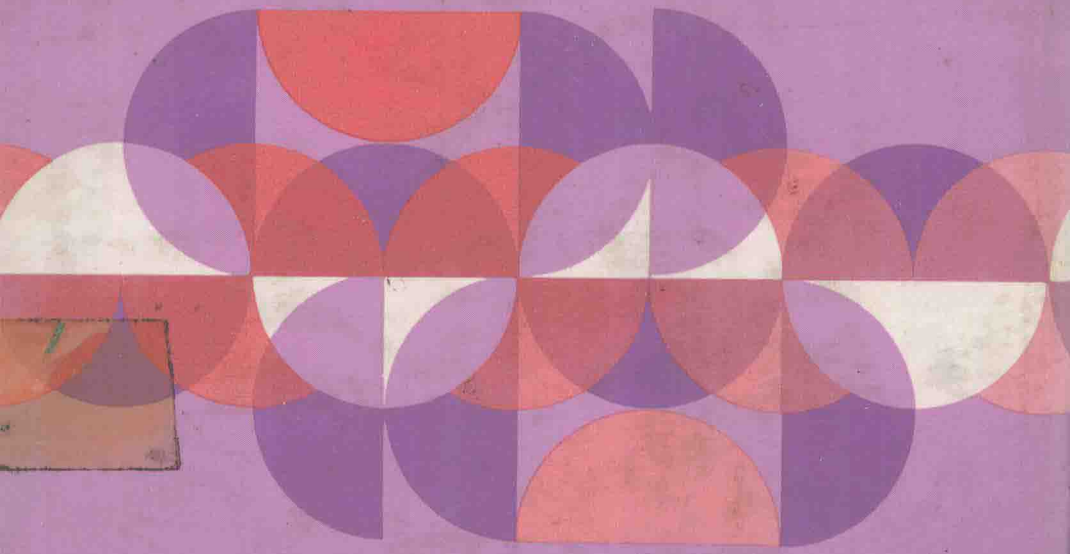

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Introduction

Miguel M. Azar

Cell biology is one of the youngest divisions of the life sciences. The term "cell" was first used by Robert Hooke in the latter half of the seventeenth century and derives from the Latin *cella,* which means a hollow space. The idea that living beings are composed of cells and their products was established more than a century ago by Schleiden and Schwann. With the contributions of Virchow, Flemming, Golgi, and others, it became increasingly apparent that the "hollow spaces" of living organisms were in fact not hollow at all, but, rather, structures composed of poorly understood parts that were capable of producing extraordinary changes under a variety of conditions. In 1892, Hertwig published *Die Zelle and das Gewebe,* which attempted to relate the structure and function of living cells in a coherent manner. With that, the branch of biological sciences then known as cytology and presently called cell biology came into being.

Professor Albert Claude, in the lecture he delivered in Stockholm in 1974, when he received the Nobel Prize for Physiology and Medicine, stated that "until 1930 or about then, biologists were in the same situation as astronomers and astrophysicists, who were permitted to see the objects of their interest, but not to touch them; the cell was as distant from us as the stars and galaxies were from them. More dramatic and frustrating was that we knew that the instrument was at our disposal; the microscope, so efficient in the nineteenth century, had ceased to be of any use, having reached, irremediably, the theoretical limit of its resolving power."

It is now 1980, and no longer are we unable to touch the objects of our scientific interest. No longer do we believe that the cell, that tiny unit of living matter, does not exert a great influence on the state of the whole organism. Biology and medicine have shown us the opposite, often with tragic clarity. Indeed, the cell is no longer as distant from us as the stars and galaxies. As the student of astronomy must learn to speak the language of his discipline, that is, to understand the concepts of measurement and interpretation of the structure and function of the physical universe, so must the student of cell biology learn to speak his own language, so that he also may know to measure and interpret the dimensions of the complicated and mysterious universe that is contained within every living cell.

How does the student learn to speak the language of cell biology? The answer seems clear. He must learn as he would learn to speak the language of a foreign country. First he must learn the simple vocabulary of the cell. Then he must learn to express those words in a meaningful way. Should he desire more than just fluency in his new language, that is, if he seeks to master it, he must develop a new skill—one that is more important; he must learn to ask questions and to approach their solutions. In that regard he must be well aware of the methods of investigation available to him. Thus, it seems appropriate that the first section of *Advanced Cell Biology* be devoted to principles of investigation.

Advances in cell fractionation and the use of the electron microscope have been of greatest importance in cell biology. Electrochemical, optical, and immunologic methods have allowed us to ascertain with great sensitivity and specificity the identities and characteristics of molecules that are fundamental to the maintenance of structure and function of many types of cells and tissues. Information derived from cell culture, X-ray, and resonance methods has added greatly to our understanding of cellular activities.

Once he is equipped with the powerful tool of understanding the application of investigative methods, if the student is to ask the most important questions, it is advantageous, if not essential, for him to understand what is presently known about the cell as a whole; that is, as a collection of many different structures, all of which accomplish specific tasks. He must endeavor to learn and to assimilate what is known about the plasma membrane, mitochondria, Golgi apparatus, cytoplasm, ribosomes, nucleus, nucleolus, and so forth. *Advanced Cell Biology* includes up-to-date discussions of the structural and functional aspects of these cellular components as they contribute to the normal and abnormal functions of living cells.

To the student unfamiliar with the role of the cell membrane, it will become readily apparent that the contribution of that "organelle" is far greater than that of merely serving as a barrier to contain the materials of the intracellular milieu, as scientists once believed. That the cell surface is a rich domain of receptors whose presence or absence and behavior confer critical features to cells is extensively described in Section 3.

The transport, secretion, and storage of molecules of biologic importance are discussed in Section 4. Where appropriate, mention is made of abnormalities in these functions, although abnormal cellular activity is not the main theme of the text.

The recurrent theme of *Advanced Cell Biology* is an emphasis on the structural and metabolic compartmentation that exists within living cells. It is this unique architecture of the cell that allows it to collectively effect its role in the function of the living organism at the systemic level.

Extensive consideration of the specific functions of the various subcellular

components is included in Sections 4 through 11. Familiarity with the ultrastructural organization of the cell is of critical importance because most of the biochemical transformations occur at the molecular level. The student will receive an important message throughout the book: that the structure and function in cells are inseparable. Concise discussions of coenzymes, electron transport and phosphorylation mechanisms in mitochondria, microsomes, and microsomal oxidations are considered in Section 5.

The physiological aspects of the nucleus and of protein synthesis are considered in detail and with great clarity. Discussions of the forms and functions of DNA, its associated enzymes, and mechanisms of replication provide the student with a broad and coherent survey of the field. The nature of these and other events is considered in both prokaryote and eukaryote cells in some chapters, thus providing the student with information that may be used for comparison. Such combined information on both levels of cells is obtainable in few texts presently available.

Section 11, on the cell cycle, provides an extensive consideration of recent observations in this area. It should be of great interest to cell biologists as well as clinical scientists and clinicians who are involved in the application of chemotherapeutic agents used in the treatment of cancer. Finally, Section 12, dealing with the eukaryotic chromosome, provides excellent discussions of the chromosome concept in general, genetic control, somatic cell hybridization, cytologic mapping, and the molecular localization of DNA classes. Each of these areas is clearly defined in terms of its relevance to molecular genetics and is unquestionably important if one is to understand the normal and abnormal activity of the cell nucleus.

Throughout *Advanced Cell Biology* there are chapters that provide consideration of topics of interest in addition to the "core" topics included within the major sections. Some provide consideration of the molecular pathology of cells, whereas others discuss quantitative considerations of certain subjects. In each case, they provide concise and useful additions to the text. Of equal value is the abundance of recent review articles and books listed in the reference sections of some chapters of the book. These publications have been sited for their clarity, accuracy, and completeness; as such they are valuable to students of cell biology at both the intermediate and advanced levels.

Advanced Cell Biology is a collection of discussions prepared by scientists representing many of the related areas of biological science such as biochemistry, microbiology, genetics, physiology, pathology, pharmacology, and anatomy. The combination of these varied backgrounds and approaches to modern problems in cell biology provides the student with a unique mixture of viewpoints that it is hoped will serve as a source of intellectual pleasure and, above all, as an inspiration to further learning.

Acknowledgments

The editors dedicate this work to their beloved wives Paula and Silvia, in recognition of their continuing understanding and support. To all our contributing colleagues, we express our thanks. The efforts made in sharing their knowledge and experience in the respective fields will be appreciated by teachers and students alike. We also express our gratitude to the Research Committees of Veterans Administration Medical Center for their approval of this project.

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