Feature Book Review

RNA Royale

Review of: *RNA: Life's Indispensable Molecule*, by James Darnell; 2011; 416 pp.; Cold Spring Harbor Laboratory Press (Cold Spring Harbor, NY); ISBN-13: 978-1-936113-19-4

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INTRODUCTION

Throughout the modern history of biology, DNA has been given a front-row seat. Many biology textbooks and courses present the RNA molecule as an accessory to the DNA molecule. Although we take the roles of RNA for granted, its history is not as well known as that of DNA. Perhaps it was long overdue for a stellar RNA researcher such as James Darnell to undertake such a challenge. The book he has written is as remarkable as his career. No one seems more capable of describing the journey into RNA discovery than Darnell, a scientist, educator, and author. The highly detailed account, along with a flawless sense of history, takes the reader through a fascinating journey of several decades of discoveries and exciting findings in molecular biology. Darnell's very personal style makes this book enjoyable, despite the highly technical experimental details in some of the chapters.

PREHISTORY AND HISTORY OF RNA

Darnell writes that we "can legitimately argue whether a 2011 student 'needs' to know any pre-1990 history" (p. 2). Readers may agree or disagree with this statement. Many important findings on RNA have emerged since the 1960s. Chapter 1, "The Dawn of Molecular Biology: History of Macromolecules before RNA," goes into the history of our knowledge of DNA and culminates with the discovery of the structure of DNA. This chapter, which is a great crash course in the history of early molecular biology, sets the stage for the detailed

chapters on RNA that follow and hints at scientists' suspicions about the importance of RNA before 1950 (p. 9). Chapter 2, "RNA Connects Genes and Proteins: Ribosomes, tRNA, and Messenger RNA," deals with the discovery of mRNA in bacteria. It is a great chapter in terms of introducing the key players in the field, along with some of the classical

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techniques with which many undergraduates may not be familiar. The discussions on the Jacob–Monod operon and some of the experiments on bacteriophages demonstrates Darnell’s talent in communicating difficult experiments (pp. 76–86). Chapter 3, “After mRNA: The Genetic Code, Translation, and the Biochemistry of Controlled RNA Synthesis in Bacteria,” discusses the genetic code in detail and segues to the regulation of gene expression in prokaryotes by focusing on the work of Nirenberg (pp. 104–109) and several well-known molecular biologists, such as Ochoa, Khorana, and Brenner.

The fourth chapter, “Gene Expression in Mammalian Cells: Discovery of RNA Processing, Genes in Pieces, and New RNA Chemistry,” focuses on gene expression. It is very detailed, and my personal least favorite, since it goes into many highly technical details that may not appeal to certain audiences. This chapter showcases the diverse roles of RNA molecules as both informational and functional players (p. 137). It also highlights the importance of cell culture techniques for studying mammalian molecular genetics (pp. 143–155). The last section of the chapter is devoted to RNA splicing. Chapter 5, “Controlling mRNA: The Cell’s Most Complicated Task,” deals specifically with mRNA regulation in eukaryotes. It is extremely long and packed with plenty of information. Luckily for the reader, the author summarizes in Table 5-1 (p. 234) the many ways in which gene expression is regulated in eukaryotes. This format should greatly simplify and illuminate the organization of underlying principles for the nonscientist reader. One of my favorites sections of this chapter is the discussion on chromatin modification (pp. 263–274), which is extremely clear and concise. The chapter includes much information, page after page, both exciting and provocative in terms of how fertile the field is for future advances. For instance, the processing of certain proteins involved in cell specification in the brain seems very promising for understanding some neurological diseases (pp. 304–306). The last section of this long chapter addresses small RNAs and shifts the focus onto some recent work. This chapter is a testament

to the importance of advances in our understanding of RNA in completing our comprehension of gene expression.

RNA AND EVOLUTION

In Chapter 6, “RNA and the Beginning of Life,” Darnell covers RNA evolution and RNA chemistry as crucial pieces in the understanding of RNA as a key player in the origin of life. The sections on prebiotic chemistry and RNA self-replication, although a bit short, illustrate those main concepts, which are critical to our understanding of these topics. I would have liked a much longer chapter, given the engaging style of the author. The chapter concludes with the work of Carl Woese on three kingdoms of life, and the primacy of RNA. This chapter could trigger some exciting discussions about evolutionary consideration from a molecular perspective.

CONCLUDING REMARKS

After reading more than 400 pages of text, I was not exhausted. I wanted to read more about where the study of RNA is heading. This book should be mandatory reading for advanced undergraduates and graduate students in biology and biochemistry. Even newly minted doctoral recipients could benefit from reviewing some key experiments, as well as some of the outstanding scientists who revolutionized molecular biology. No other scientist and author could have been more well-suited than Darnell, who treats us to such elegant writing while delivering such indispensable information about RNA. Despite some highly technical sections in his book, the author has done a great service by bringing to our attention RNA’s place at the forefront of molecular genetics and its intimate connection with DNA and proteins. Teachers at the precollege and college levels could benefit from this book not only by reviewing some classical work in the field but also by being reminded that the story of RNA is far from over.