Preface

Protein synthesis and translational control are central to life as we know it. Proteins are synthesized through the translation of genetic information by an elaborate machinery that is present in nearly all cells in copious amounts. The machinery itself is expensive to produce and to run. It needs to function accurately and it has to respond to regulation over a broad dynamic range and in countless developmental and environmental circumstances. Translation is not the only step in the gene expression pathway that can be regulated, but it is one of the most important. Because of its sensitivity and flexibility as well as the immediacy of its actions on biological events, translational control has widespread influence at the molecular, cellular, and organismal levels. It modulates physiological and pathophysiological processes, and mutations in components of the translation system engender profound consequences leading to a spectrum of genetic diseases. Many antibiotics, including some of the earliest and most often prescribed, target ribosomes and other components of the system, which offer numerous opportunities for clinical intervention. For all these reasons and more, the field is a rich and fertile one for basic and applied investigation.

The book in your hands is the fifth in the series. When the first one, simply entitled *Translational Control*, was published in 1996, we hoped it would be useful and well-read. We knew that the field was fast-moving and, therefore, expected that the book might serve its purpose for a few years before being overtaken by new discoveries. But none of us contemplated the pace and scale of the advances seen over the following 20 years. Many of these were discussed in the next three volumes—*Translational Control of Gene Expression* (2000), *Translational Control in Biology and Medicine* (2007), and *Protein Synthesis and Translational Control* (2012)—and the present volume brings the series up to date. Authorities in the field provide reviews that survey the remarkable developments made in the understanding of protein synthesis and its regulation over the last five years, up to late 2017/early 2018.

Progress has been made in the dimensions of time and space, and mechanistic details continue to unfold in prokaryotes as well as eukaryotes. New insights have been gained as single-cell, single-molecule, and kinetic approaches have been brought to bear. Although most of the components of the translation system have been known for several decades and many of its regulatory processes have been outlined, new factors and regulators continue to be discovered and characterized. Further, the functions of some known but incompletely defined components have become better appreciated. The structures and the modes of action of ribosomes and of protein–protein and ribonucleoprotein complexes are being visualized and examined at ever-finer levels of resolution through the application of techniques such as cryoelectron microscopy and ribosome profiling. At the same time, the field has continued to expand in breadth and complexity. Fresh light is illuminating the relationships between translation and messenger RNA degradation and their partition into subcellular compartments and particles. Answers to long-standing questions, such as the roles of modified bases in RNA, have begun to emerge, yet variations of RNA regulatory elements and structures continue to proliferate and new questions arise that challenge time-honored assumptions. As the details of established mechanisms are revealed at increasingly intricate levels, unorthodox and entirely novel mechanisms of translation initiation have been uncovered and are being analyzed. These advances have increased understanding of processes operating in areas such as cancer, development, neuroscience, and virus infection, and have brought therapeutic interventions within reach. In sum, this is an exciting time in the field; the last few years have yielded much new knowledge but have also shown how much more remains to be learned.