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MOLECULAR MACHINES IN BIOLOGY

THE concept of molecular machines in biology has transformed the medical field in a profound way. Many essential processes that occur in the cell, including transcription, translation, protein folding, and protein degradation, are all carried out by molecular machines. This volume focuses on important molecular machines whose architecture is known and whose functional principles have been established by tools of biophysical imaging (X-ray crystallography and cryo-electron microscopy) and fluorescence probing (single-molecule FRET). This edited volume includes contributions from prominent scientists and researchers who understand and have explored the structure and functions of these machines. This book is essential for students and professionals in the biological sciences and the medical field who want to learn more about molecular machines.

Dr. Joachim Frank is a Howard Hughes Medical Institute Investigator, Professor of Biochemistry and Molecular Biophysics, and Professor of Biological Sciences at Columbia University. He is a member of the National Academy of Sciences and a fellow of the American Academy of Arts and Sciences. Dr. Frank has received many awards for his research, including, with David DeRosier, the Elizabeth Robert Cole Award of the Biophysics Society. He has published more than 200 peer-reviewed articles, written numerous book chapters, and authored or edited five books, including *Electron Crystallography of Biological Macromolecules*, co-authored with Robert M. Glaeser, Kenneth Downing, David DeRosier, and Wah Chiu (2007), *Three-Dimensional Electron Microscopy of Macromolecular Assemblies* (2006), and *Electron Tomography*, Second Edition (2006).

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Columbia University

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Preface

The concept of this book goes back to the Center for Molecular Machines, which I started together with similarly minded colleagues – Nilesh Banavali, April Burch, Steve Hanes, Joachim Jaeger, and Janice Pata, among others – at the Wadsworth Center in Albany back in 2005. The most visible manifestation of the Center for Molecular Machines was a monthly seminar series, which we called *Molecular Machine Shop*. The idea was to highlight some of the complicated structures at work in the cell, which were coming increasingly into view mainly through the efforts of X-ray crystallography and cryo-electron microscopy, and to bring out common features and general principles underlying these biological nanomachines. The seminars were meant to encourage interdisciplinary discourse as it was becoming increasingly clear that no single technique alone could unravel the mystery of how such machines work.

In June 2007, we organized a one-day minisymposium in Albany, which brought together experts studying molecular machines with the tools of X-ray crystallography, cryo-EM, single-molecule FRET, and molecular dynamics. In the wake of the event, Allan Ross, then senior editor at Cambridge University Press, approached me to ask if I would be interested in editing a volume on the theme. Some of the speakers of the minisymposium were receptive to the idea, and by asking other scholars working in the field I was lucky in the end to be able to assemble a team of the highest caliber.

I am grateful to all contributors for the dedicated work they have put in, and for their cooperation and patience over a considerable length of time. I would like to thank Joy Mizan, who took over the project after Alan Ross' departure from Cambridge University Press, for her dedicated work to ensure a glitch-free high-quality production, and Melissa Thomas in my lab for creating a beautiful symbolic cell as cover art, starting with a simple idea – M. C. Escher's reflecting glass ball – and with a list of deposition codes of density maps selected from the EM Data Bank.

The cover, I hope, will draw in readers with the promise of an experience that goes beyond conveying scientific facts: on the molecular level, touched by the tools of molecular graphics, life appears as a beautiful dance of colorful structures to scientists and nonscientists alike.

Joachim Frank
New York

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