



## Life's Ratchet: How Molecular Machines Extract Order from Chaos

By Peter M. Hoffmann

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**Life's Ratchet: How Molecular Machines Extract Order from Chaos** By Peter M. Hoffmann

Life is an enduring mystery. Yet, science tells us that living beings are merely sophisticated structures of lifeless molecules. If this view is correct, where do the seemingly purposeful motions of cells and organisms originate? In *Life's Ratchet*, physicist Peter M. Hoffmann locates the answer to this age-old question at the nanoscale.

Below the calm, ordered exterior of a living organism lies microscopic chaos, or what Hoffmann calls the molecular storm—specialized molecules immersed in a whirlwind of colliding water molecules. Our cells are filled with molecular machines, which, like tiny ratchets, transform random motion into ordered activity, and create the “purpose” that is the hallmark of life. Tiny electrical motors turn electrical voltage into motion, nanoscale factories custom-build other molecular machines, and mechanical machines twist, untwist, separate and package strands of DNA. The cell is like a city—an unfathomable, complex collection of molecular workers working together to create something greater than themselves.

Life, Hoffman argues, emerges from the random motions of atoms filtered through these sophisticated structures of our evolved machinery. We are agglomerations of interacting nanoscale machines more amazing than anything in science fiction. Rather than relying on some mysterious “life force” to drive them—as people believed for centuries—life's ratchets harness instead the second law of thermodynamics and the disorder of the molecular storm.

Grounded in Hoffmann's own cutting-edge research, *Life's Ratchet* reveals the incredible findings of modern nanotechnology to tell the story of how the noisy world of atoms gives rise to life itself.

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### Editorial Review

Review

#### *Physics Today*

“[A] fascinating glimpse into recent research on molecular machines, research that lies at the intersection of biology, chemistry, and physics.... *Life's Ratchet* does an excellent job of conveying the tension between mechanical descriptions of molecular machines...and the chemical perspective.... I highly recommend this book to scientists in the fields of biophysics and nanoscience as a readable introduction to a broad variety of topics in those areas.”

#### *The Scientist*

“What distinguishes life from its nonliving ingredients? How could life arise from the lifeless? These questions have vexed philosophers and scientists for more than 2,500 years. Bio-besotted physicist Peter Hoffmann wrote *Life's Ratchet* to get to the beating heart of the matter. After a lively, lucid grand tour of the controversy's history...Hoffmann arrives at modern molecular biology and the technological breakthroughs, such as atomic force microscopy, that enable us to see the very atoms of a cell.... A masterwork of making the complex comprehensible, this book would make a smashing freshman biology textbook—and that's a compliment.”

#### *New Scientist*

“In *Life's Ratchet*, biophysicist Peter Hoffmann reveals that the secret to life isn't some mysterious force. Rather, it is chaos itself. Hoffmann provides a ringside perspective on life at its most fundamental level, gained through his work on imaging and manipulating molecules.”

#### *Kirkus Reviews*, starred review

“A fascinating mix of cutting-edge science with philosophy and theology.”

#### Werner R. Loewenstein, author of *The Touchstone of Life and Physics in Mind*

“Peter Hoffmann brings the universe of the very small to life. *Life's Ratchet* is an exciting guide to the wondrous strange nanoworld of molecules driving the machinery of life. Engaging, provocative, and profound.”

#### *City Book Review*

“*Life's Ratchet* is nothing short of brilliant. With wit and literary prowess, author Peter M. Hoffmann delivers a profound message about the nature of the life within our lives. He writes with a grace and careful thoughtfulness—the Shakespeare of scientific literacy.”

#### *Physics World*, Best Books of 2012

“[A] clearly written book about molecular motors and other nanoscale structures.... It does a very good job of capturing the excitement driving current research on this increasingly important topic.”

#### *Nature*

“*Life's Ratchet* engagingly tells the story of how science has begun to realize the potential for matter to spontaneously construct complex processes, such as those inherent to living systems. The book is a good mix

of history and the latest concepts, straightforwardly explained.... The book's important message is that there is a revolution brewing. This revolution will not tell us what matter is made of. Instead, as described in *Life's Ratchet*, it will tell us how matter and energy combine to make me and you.”

About the Author

**Peter M. Hoffmann** is a professor of physics and materials science at Wayne State University in Michigan and the founder and director of the university's Biomedical Physics program. He lives in Saint Clair Shores, Michigan.

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Do you have favorite book? In case you have, what is your favorite's book? Reserve is very important thing for us to learn everything in the world. Each guide has different aim or even goal; it means that book has different type. Some people sense enjoy to spend their time to read a book. They are reading whatever they have because their hobby is usually reading a book. Why not the person who don't like studying a book? Sometime, man or woman feel need book once they found difficult problem or perhaps exercise. Well, probably you will need this *Life's Ratchet: How Molecular Machines Extract Order from Chaos*.

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