

## Microcosm: *E. coli* and the new science of life

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### Book Review

Escherichia coli is omnipresent in the mammalian gastrointestinal tract, but its life in broad daylight is also a fascinating story. In his new book, *Microcosm: E. coli and the new science of life*, science writer Carl Zimmer reminds us that *E. coli* has been the substratum for an astonishing number of scientific breakthroughs. The tools of molecular biology were forged on *E. coli*'s anvil, and application of these tools to the study of the bacterium itself has illuminated genetic regulation and exchange, virulence, nanomachines, bacterial social behavior, and evolution. Carl Zimmer is an American science writer at the zenith of his profession. He contributes to highly visible publications, including the *New York Times*, *National Geographic*, and *Scientific American*, and he is a winner of the 2007 National Academies Communication Award, the highest honor for science writing. He has authored numerous books on topics of biology and medicine, though Zimmer is, impressively, not a professional scientist. Zimmer opens the book with a historical introduction, beginning with the identification of *E. coli* by the great pediatrician and microbiologist Theodor Escherich, spanning the isolation of the *E. coli* strain K12 by Edward Tatum, and climaxing with the panorama of Nobel laureates who exploited K12 and its progeny. Zimmer indicates the improbable paradox of *E. coli*'s existence: "There's a powerful drive throughout the universe, [...]"

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## Microcosm

*E. coli and the new science of life*

Carl Zimmer

Pantheon Books. New York, New York, USA. 2008.

256 pp. \$25.95. ISBN: 978-0-375-42430-4 (hardcover).

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*Escherichia coli* is omnipresent in the mammalian gastrointestinal tract, but its life in broad daylight is also a fascinating story. In his new book, *Microcosm: E. coli and the new science of life*, science writer Carl Zimmer reminds us that *E. coli* has been the substratum for an astonishing number of scientific breakthroughs. The tools of molecular biology were forged on *E. coli*'s anvil, and application of these tools to the study of the bacterium itself has illuminated genetic regulation and exchange, virulence, nanomachines, bacterial social behavior, and evolution.

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machines can initially achieve their astonishing complexity in the face of entropy's mandate. These discussions are enlightening for the biology watcher.

Zimmer also guides the reader through the highlights of modern *E. coli* research, lucidly reviewing complex and still-emerging stories. His summary of the complicated regulatory scheme controlling *E. coli* flagellar function is accurate, as is his discussion of alternative sigma factors. His appreciation of microbial biofilms is similarly clear and current, though the relationship between biofilm formation and intestinal colonization is as murky for Zimmer as it is for the professional microbiologist.

Zimmer devotes considerable attention to genome plasticity and natural selection in *E. coli* genesis, indicating how far we've come since Darwin. Zimmer declares that selection can be powered by humans individually (e.g., by antibiotic administration), collectively (e.g., by large-scale industrial food production), or inadvertently (e.g., by acting as host to a microbial pathogen). In an era when the theory of natural selection is under siege politically, exploration of its nuances is welcome.

The book has the feel of a personal encounter with great scientists. Yes, Zimmer complements his reading of the primary scientific literature with other written sources but apparently a relatively small number of personal interviews with the giants whose stories he relishes (judging from his notes). The acknowledgment section, in contrast, suggests that Zimmer's theses have been vetted by a brigade of today's *E. coli* community. Regardless of the source, Zimmer's synthesis provides the texture of humanity for biological research.

Though a pleasant read, Zimmer's work leaves us without the bird's eye insights characteristic of the best science writers, such as Lewis Thomas, Jared Diamond, and the incomparable Hans Zinsser. Despite, and perhaps because of, the daily immersion of scientists in their experiments, we often lose the grand vision of life's universal principles. Recognition of these by the gifted science writer invigorates science and enriches the lay public. The value of Zimmer's contribution will be greatest to the lay science enthusiast who realizes that no matter how sophisticated our scientific tools, biological systems generate an inexhaustible source of wonder.

The *E. coli* biologist may be distracted by several errors and omissions in the book. For example, each chapter is decorated with a figure of a bacterium bearing polar flagella (*E. coli* is, of course, peritrichous), and antibacterial peptides are positively, not negatively, charged, as Zimmer claims. Prominently superficial is a discussion of *E. coli*'s true nature: commensal inhabitant of the mammalian gastrointestinal tract. Zimmer admits that *E. coli* K12 is an aberration, perverted by acts intentional and accidental. But commensal *E. coli* is the paragon that nature intended, though it is relatively neglected by Zimmer. Perhaps this opportunity provides the fodder for a sequel.

*Microcosm* reminds us that scientific discovery makes compelling reading in the hands of a master storyteller. Mr. Zimmer has woven a fascinating tapestry, intercalating the energy of world-changing scientific discovery with the fascinating complexity of a well-understood living organism. His work will be welcomed by the scientist and the science enthusiast.