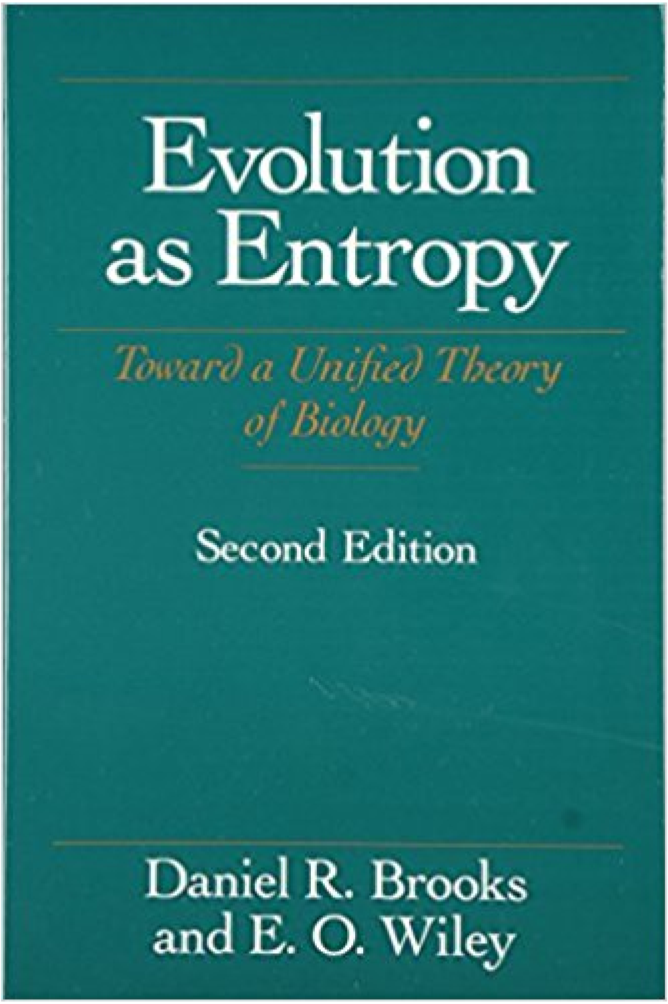
Evolution As Entropy: Toward A Unified Theory Of Biology (Science And Its Conceptual Foundations Series)



Synopsis

"By combining recent advances in the physical sciences with some of the novel ideas, techniques, and data of modern biology, this book attempts to achieve a new and different kind of evolutionary synthesis. I found it to be challenging, fascinating, infuriating, and provocative, but certainly not dull."Ã¢â ¬â •James H, Brown, University of New Mexico"This book is unquestionably mandatory reading not only for every living biologist but for generations of biologists to come."Ã¢â ¬â •Jack P. Hailman, Animal Behaviour, review of the first edition"An important contribution to modern evolutionary thinking. It fortifies the place of Evolutionary Theory among the other well-established natural laws."Ã¢â ¬â •R.Gessink,TAXON

Book Information

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Customer Reviews

This serious and scholarly tome unites the theory of biological evolutioni.e., that biological systems tend to become more ordered and highly structured through evolutionary timewith the seemingly contradictory second law of thermodynamicsi.e., that disorder or entropy increases over time. The authors argue that , in fact, living systems exhibit growing complexity and self-organization as a result of increasing entropy. They support their difficult yet logical arguments with a wide range of examples taken from developmental biology, embryology, morphology, population genetics, systematics, and community ecology. Not easy going for the casual reader, but well worth the effort for others. Recommended for academic collections .P. Robert Paustian, Wilkes Coll. Lib., Wilkes-Barre, Pa.Copyright 1985 Reed Business Information, Inc. --This text refers to an out of print or unavailable edition of this title.

In this extensively rewritten second edition, the authors refine their model for a unified theory of biology, answer their critics, incorporate new ideas, and provide additional illustrations and almost one hundred new references.

These are exciting times for science. One recent development involves a unification between physics and biology - in particular between the maximum entropy principle of thermodynamics and a generalized version of Darwinian evolution. This unites fundamental principles in the realm of science that covers living systems with different principles in the science that covers inorganic dissipative structures.Attempts to integrate Darwinian evolution with thermodynamics have been going on for a while. One notable attempt can be found in the book "Evolution as Entropy" by Brooks and Wiley. I reviewed this book to see whether it had any of these ideas in place back in 1986.In summary, it did not. Though the book discusses the relationship between evolution and entropy, it is completely missing the idea of entropy maximization. Indeed, instead of considering overall entropy production by orgaisms and ecosystems, the book focuses on the informational entropy of the genome. Maybe there’s something interesting to be found there - but this book has nothing to do with the modern ideas of entropy maximization that shows such promise in uniting physics and biology.The book does mention entropy mimimization in half a dozen places. There are a couple of senses of entropy mimimization - or entropy production mimimization that make sense. One is that organisms act like fridges - in that they pump entropy out of their interiors into the environment, to maintain an ordered internal state. Another is that,in closed environments, entropy production tends to decline over time, as resources are dissipated. These notions are fairly commonplace and uncontroversial. However, it isn’t clear that Brooks and Wiley are referring to either of them. They seem to think that organisms mimimize entropy production rates, which is mistaken.Perhaps I should discuss the merits of what they do propose. However, their proposals do not look very interesting. The entropy of the genome is subject to the whims of natural selection. Nor does the genome form a closed system - which complicates attempts to apply thermodynamic laws to it. In short, while the concept of informational entropy can be applied to the genome, doing this is nowhere near as interesting as the more modern approaches based on maximizing overall entropy production.I should also add that I didn’t like the book very much. Not only does it completely miss what turned out to be the main point, but also it is not very readable or coherent. As an attempt to replace modern evolutionary theory, it seems to have been a failure - and it looks as though it failed for a good reason: the authors don't have much of a coherent or useful theory.

This is a very technical book, but it was well worth the effort for me. I first read it 8 years ago, and I still re-read it about once a year to ponder the implications. It is a refreshing, challenging, and potentially revolutionary view of evolution. While it may not prove to be the final understanding of this topic, it is a solid attempt to provide a thermodynamic underpinning for the law of Evolution.It contains 2 profound and provocative hypotheses:1) Information stored in living creatures' DNA can be modeled as a hierarchy of information stored at the different structural scales of the genome. This is based on the work of Prigogine to unify classic energetic entropy with informational entropy. (they call this Hierarchical Information Theory)2) assuming that 1 is true, if you calculate the entropy stored in the hierarchy across a given population of a specie, the entropy will rise at the rate predicted by standard formulations of the 2nd law of thermodynamics rate as the population reproduces and evolves.I found the critique in the 1-star review to be far off the mark. Apart from the ad hominem critique of the authors as non-biologists, the 2nd law of thermodynamics does not include a 'quality of energy' or 'quality of information' measure, as (apparently) asserted in the cited critique. While many people (and scientists) incorrectly view the law as implying that the quality of energy diminishes over time, a more correct view states that energy (or information) will become less _available_ over time, with fewer and fewer states accessible. This is precisely the point of the theory propounded in this book - to describe evolution without recourse to non-physical quantities such as information 'quality'.

of mathematical equations from information theory with little or no physical substance. One of the authors (Brooks) appears to be a misplaced mathematician who formally became a zoologist. It should be remembered that General Relativity was first submitted for publication by a mathematician (Hilbert) ahead of a physicist (Einstein) by a matter of weeks (but essentially by theft from Einstein, being a former mentor of Einstein)and dismissed in favour of the physicist as lacking any physical insights.The late Volkenstein succintly criticized the book in his outstanding book "Physical Approaches to Biological Evolution"as follows:"As useless as the book cited above is the book 'Evolution as Entropy'by Brooks and Wiley. The basic proposition in this work is that speciation is controlled by the stochastic premises of the second law of thermodynamics. One may only regret that in the 43 years since the publication of Schrodinger's work [the book 'What is Life?'] a book has appeared whose authors do not understand the role of the second law of thermodynamics in living nature...the authors are concerned only with the amount of information and, hence, with entropy.

But, by confining oneself to these concepts alone, one can hardly say anything about evolution...in the world of living things the quality or value of information is often of decisive importance...No appropriate methods have yet been worked out for estimation of the quality of information...The problem of the origin of valuable information is very important to biology. It can be expressed by the formula:V = log(P/P0)where P and P0 are respectively the probabilites of achieving a ’purpose’ before and after the information is received.As we have seen, interesting results can be obtained with the aid of the tentative definition of information value as the indispensability, non-redundancy of information. However, the transition from static information theory, in which time does not figure, to dynamic information theory, which includes reception and memorizing and, hence, time and semantics has not yet been realized in physics.The molecular theory of orgasmic evolution has not yet been united with the synergistic approaches and its development is beset with formidable difficulties... The key problem of evolutionary theory is the relationship between genotype and phenotype studied at different levels...As we have seen, this problem is missing in systems that are studied in the Eigen theory."

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