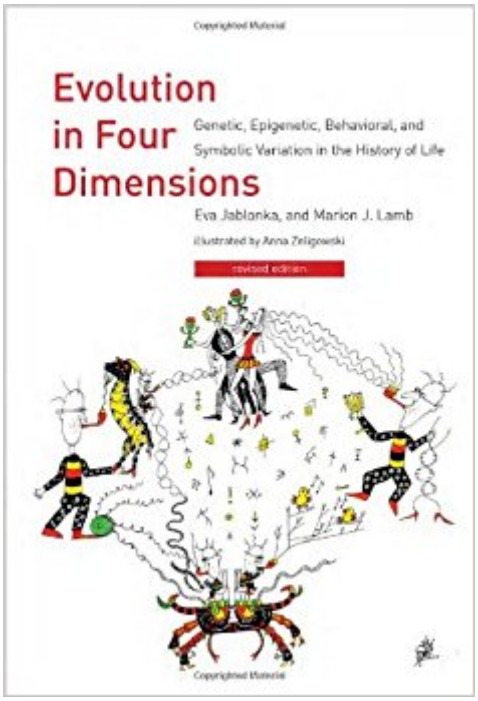
Evolution In Four Dimensions: Genetic, Epigenetic, Behavioral, And Symbolic Variation In The History Of Life (Life And Mind: Philosophical Issues In Biology And Psychology)



Synopsis

This new edition of the widely read Evolution in Four Dimensions has been revised to reflect the spate of new discoveries in biology since the book was first published in 2005, offering corrections, an updated bibliography, and a substantial new chapter. Eva Jablonka and Marion Lamb's pioneering argument proposes that there is more to heredity than genes. They describe four "dimensions" in heredity -- four inheritance systems that play a role in evolution: genetic, epigenetic (or non-DNA cellular transmission of traits), behavioral, and symbolic (transmission through language and other forms of symbolic communication). These systems, they argue, can all provide variations on which natural selection can act. Jablonka and Lamb present a richer, more complex view of evolution than that offered by the gene-based Modern Synthesis, arguing that induced and acquired changes also play a role. Their lucid and accessible text is accompanied by artist-physician Anna Zeligowski's lively drawings, which humorously and effectively illustrate the authors' points. Each chapter ends with a dialogue in which the authors refine their arguments against the vigorous skepticism of the fictional "I.M." (for Ipcha Mistabra -- Aramaic for "the opposite conjecture"). The extensive new chapter, presented engagingly as a dialogue with I.M., updates the information on each of the four dimensions -- with special attention to the epigenetic, where there has been an explosion of new research. Praise for the first edition"With courage and verve, and in a style accessible to general readers, Jablonka and Lamb lay out some of the exciting new pathways of Darwinian evolution that have been uncovered by contemporary research." -- Evelyn Fox Keller, MIT, author of Making Sense of Life: Explaining Biological Development with Models, Metaphors, and Machines"In their beautifully written and impressively argued new book, Jablonka and Lamb show that the evidence from more than fifty years of molecular, behavioral and linguistic studies forces us to reevaluate our inherited understanding of evolution." -- Oren Harman, The New Republic"It is not only an enjoyable read, replete with ideas and facts of interest but it does the most valuable thing a book can do -- it makes you think and reexamine your premises and long-held conclusions." -- Adam Wilkins, BioEssays

Book Information

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Customer Reviews

"Another valuable perspective to the discussion... I found it refreshing to read a science book that is a conscious attempt at good literature." Ã¢â ¬â • Nature"As this important book by Eva Jablonka and Marion J. Lamb shows, the twentieth-century 'neo-Darwins' told the evolutionary story in their own particular way, and some of the richnes of evolution that their forebear had described fell into neglect." Ã¢â ¬â • The New Republic"With courage and verve, and in a style accessible to general readers, Jablonka and Lamb lay out some of the exciting new pathways of Darwinian evolution that have been uncovered by contemporary research." Ã¢â ¬â •Evelyn Fox Keller, MIT, author of Making Sense of Life: Explaining Biological Development with Models, Metaphors and Machines"Eva Jablonka and Marion Lamb have been challenging orthodoxy and promoting heresy in genetics and evolution for twenty years. Their systematic and comprehensive perspective on genetic, epigenetic, behavioral, and symbolic inheritance in evolution is backed up with detailed empirical data, illustrated in a wide survey of phenomena, and presented in clear and forthright prose. Engaging illustrations as well as instructive and entertaining philosophical dialogues help make Evolution in Four Dimensions accessible to students and interested general readers. Those intent on following the path of genetic orthodoxy will now have to work harder than ever to ignore evolution's other three dimensions." Ã¢â ¬â •James Griesemer, Professor of Philosophy, University of California, Davis"An individual's personal experience can influence the characteristics of his or her offspring. Some of the ways in which this happens would have seemed heretical in the past. Eva Jablonka and Marion Lamb's stimulating new book successfully challenges some of the old orthodoxies. I recommend it warmly to anybody with a serious interest in developmental and evolutionary biology." Ã¢â ¬â •Sir Patrick Bateson, Department of Zoology, University of Cambridge, author of Design for a Life: How Behavior and Personality Develop --This text refers to an out of print or unavailable edition of this title.

Eva Jablonka is Professor at the Cohn Institute for the History and Philosophy of Science and Ideas at Tel Aviv University. Marion J. Lamb was Senior Lecturer at Birkbeck College, University of London, before her retirement. Jablonka and Lamb are also the authors of Epigenetic Inheritance and Evolution.

The stages of biological evolution described in this useful overview seem to mirror developmental stages in many other fields of study, from quantum physics to concept development in children. I found their discussion of Dawkins's 'meme' especially enlightening, although their emphasis on biology led them to ignore Jean Piaget's classic studies of developmental stages in children's thinking. And of course modern developments in computer simulation and the internet can also be assimilated into their stages of evolution. But this is a seminal work that foreshadows a 'quantum leap' in our thinking about evolution.

Jablonka and Lamb use a difficult to read style throughout their book. The information within is interesting and sound but it is a chore to get through. It was required reading in my anthropology class, a cliff notes edition would have been preferred.

Excellent book. Takes up a very complex subject and deals with it methodically, in as plain a language as can be applied to it. Very relevant for people who are interested in understanding the current state of genetics.

A recent biotechnology trade publication wrote that "epigenetic research surges on many fronts", and a study of textbooks in molecular biology that have been published in the last few years reveals that epigenetic mechanisms are relevant in biological systems. This book could be considered a definitive summary of what is known about epigenetic mechanisms in evolution, but also goes beyond it by arguing behavioral and "symbolic" variation also plays a significant role. Readers will get in-depth discussion of these terms and also get exposed to some speculation from the authors on how all four mechanisms, genetic, epigenetic, behavioral, and symbolic drive the evolutionary process. However the authors are careful to note the difference between speculation and facts, and this intellectual honesty is refreshing and motivates the reader to consult some of the many references given in the book. At various places in the book, readers are expected to have a solid background in molecular biology in order to follow the discussion, but non-experts in this field, such as this reviewer, can with some concentrated effort appreciate what the authors are talking

about.Some of the highlights in the book include:1. The reminder that genes are not "simple causal agents" with traits being the result of interactions among a collection of genes. Along these lines, gene regulatory networks have become a significant area of research in the last few years.2. The point made that the Darwin theory of natural selection is a general theory of evolution, and does not make specific assumptions on the mechanisms behind heredity or variability. This assertion motivates the reader to search for different representations of Darwinian theory, this book being one of them, and further, ask the question as to how many such representations are possible, given the constraints of observation and experimentation. Are there for example, any "higher dimensional" versions of Darwinian theory (greater than 4)?3. The discussion on information theory and its use in genetics.4. The discussion on the ability of genomes to compensate for the lack of activity of a particular gene. This is very relevant to current methods in genetic engineering, which sometimes have their goal the "knockout" of certain genes.5. The reminder that there is much that is unknown in molecular biology. One example given is the nature of the regulation of splicing.6. The discussion on the advantages of sexual reproduction versus mere cloning.7. The discussion on self-sustaining feedback loops in gene activity. This has connections with the field of mathematics called nonlinear dynamics, and a large amount of research in this field is devoted to understanding these feedback loops.8. The view of the authors that RNA interference is a cellular immune system. This is an interesting idea, and motivates the reader to do further reading on whether it is an idea that is viable in immunology and molecular biology.9. The discussion on "real-time" genome modification in the Sciara fly, wherein chromosomes are eliminated in both somatic and germ-line cells. The astute reader will naturally wonder how many other biological organisms are able to do this.10. The role of methylation in transgenic strategies. This discussion is very important to those readers who want to understand the risks involved in genetic engineering. Transgene flow is considered to be a risk by some, but methylation apparently would assist in alleviating this risk.Some of the disappointments in the book include:1. The use of thought experiments to argue some of the main points. This is not a major detraction, but this use can degenerate into philosophical speculation if one is not careful, and it seems the authors are aware of this.2. The authors should have included more discussion on why they think the "four categories" of epigenetic inheritance are not independent.3. The assertion made without elaboration that when humans imitate they always intend to do so. Along these lines the authors need to elaborate in more detail what they mean by a "modular system of imitative learning." Their thinking on this would be very interesting to those readers involved in the field of artificial intelligence. Indeed, the authors' assertion that "imitation is a context- and content-sensitive process, not mere copying" is very important to those who are attempting to implement cognitive

processes in non-human machines. This is further exemplified in the authors' discussion on "radical" evolutionary psychology and its view that the brain is a collection of modules, each having a particular cognitive task. The authors are clearly skeptical about the existence of these modules, and it would be interesting to know whether they would find the concept of "entangled" modules, i.e. those where task sharing is the defining characteristic, useful for their conception of symbolic inheritance systems.4. Since plants do not exhibit complex or intentional behaviors, the authors need to show why behavioral inheritance systems are not relevant, or weakly so, in the evolutionary biology of plants. This point is naturally made at the place in the book where the authors discuss the difficulties of showing the relevance of behavioral inheritance systems in animals, i.e. showing the existence of animal traditions and so on. This question can also be asked in their discussion on symbolic inheritance systems: plants do not interpret symbols or have symbolic grammars. Here again, the authors point to the absence (or purported absence) of symbolic systems in animals. Humans therefore seem to have a multi-dimensional inheritance system, and are therefore unique in this regard.5. In their discussion of symbolic inheritance systems, the authors place too much emphasis on generative theories of grammar, and do not take into account other theories, such as cognitive grammar. How would these other theories be integrated into their thinking on the role of symbolic inheritance systems?

Jablonka and Lamb pull together many ideas about evolution to suggest that the Modern Synthesis prevalent since the 1930s is due for a reconceptualization. They argue that evolution involves not one but four kinds of inheritance systems: genetic, epigenetic, behavioral, and (in humans) symbolic. Epigenetic systems involve cellular variations appearing in the course of development, so that cells with the same DNA can develop in quite different directions. Since this information is preserved when cells divide, it can also be inherited in the reproduction of unicellular or asexually reproducing multicellular organisms. (Inheritance by sexually reproducing organisms is tricker but also possible.) Behavioral inheritance among organisms occurs through the transfer of behavior-influencing substances and through imitative and non-imitative learning. Human symbolic communication is an especially rich inheritance system, with features such as the capacity to share imagined behaviors never before tried. The genetic and non-genetic inheritance systems work together in evolution, with non-genetic changes often becoming genetically assimilated. For example, if a human population domesticates cows and starts relying on dairy products, genetic variations in the ability to digest lactose become relevant to natural selection, and so gene frequencies can change as a result of the change in customs. Jablonka and Lamb suggest that

non-genetic changes often lead the way in animal evolution, with genetic changes playing catch-up.Not only is this book a far cry from the simplistic genetic determinism that characterizes many popular discussions of evolution, but it is also a departure from 20th-century Darwinian orthodoxy. While genetic changes are usually blind to outcomes, the variations that are transmitted epigenetically, behaviorally or symbolically are often more targeted, arising in responses to signals from the environment. The environment plays the dual role of inducing as well as selecting variations, and the variations are more like educated guesses about what will work than random shots in the dark. The fact that these acquired innovations can be inherited (one way or another, though not by direct modifications of genes) means that evolution is partly Lamarckian after all, at least in a broad sense of the term.Orthodox Darwinism has always been a philosophically puzzling doctrine. For a theory of change, it has placed a surprising amount of emphasis on the continuity of being, with change appearing as an accident that only occasionally happens to contribute to that continuity. For a theory of information, it has been surprisingly preoccupied with blind, completely uninformed variation. Jablonka and Lamb's understanding of evolution is both more dynamic and informationally richer. Inherited information is no longer confined to the genome, but can include information acquired and used in the course of development. Organisms participate in evolution not just as vehicles for the transmission of fixed information units (genes or their imagined cultural counterparts, memes, a notion J & L critique vigorously), but as active acquirers and interpreters of information. This is consistent with Stuart Kauffman's contention that life is even more complex and creative than biologists have realized.The book is extremely well written and documented, so that the arguments are easy to follow by readers with a limited background in biology. Highly recommended for biologists and non-biologists alike.

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