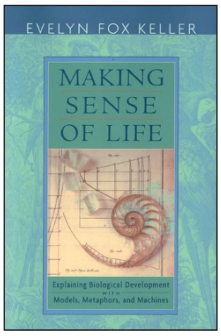
A rich biodiversity of explanations



Making Sense of Life: Explaining Biological Development with Models, Metaphors, and Machines

by Evelyn Fox Keller

Harvard University Press, 2002
388 pp. paperback 2003, $17.95
ISBN 0-674-01250-X

Reviewed by Lynne M Harris

In *Making Sense of Life*, Evelyn Fox Keller enquires into what constitutes knowledge and explanatory theory in the biological sciences. In attempting to answer this vast question, Keller limits herself to the discipline of developmental biology and the processes by which a fertilized egg grows and becomes patterned as one of the multitude of biological forms which we see around us today. Keller does not make any presumptions about what a suitable explanation is. Instead, she looks at a range of explanations of how an organism comes to be and then discusses whether these explanations are, or ever were, valid, and if so, why.

Making Sense of Life is chronologically divided into three sections. In the first, Keller evaluates various mathematical and physical models that were used to explain development in the first half of the twentieth century. She examines Stephane Leduc's attempt to explain the development of an organism by the synthesis of artificial organisms out of inorganic chemicals. She then evaluates D`Arcy Thompson's *On Growth and Form*, which again aims to explain biological development by using only physical and chemical principles. Finally, Keller focuses on the history of mathematical biology using Alan Turing's model of embryogenesis as an example. Keller is disappointed that mathematical biology has never caught on with biologists and questions why this is the case.

In the second section, Keller looks at the role that experimental genetics has had in addressing biological development. Here the author argues that the process of constructing explanations of development from genetic data is primarily a 'linguistic' activity, in that it relies on the evolution of 'novel metaphors'. Taking such terms as 'gene action', 'genetic program', 'feedback' and 'positional information', Keller claims that these 'novel metaphors' name phenomena about which very little is known and, thereby, inspire, help and focus researchers in a given field.

Lynne M. Harris is at Balliol College, Oxford OX1 3BJ, UK.
e-mail: lynne.harris@balliol.ox.ac.uk

In the final segment of her book, Keller evaluates the function of machines, particularly computers, recombinant DNA and molecular imaging, in the recent history of developmental biology. Using such examples as Eric Davidson's model for the regulation of gene activity and Christopher Langton's program of artificial life, Keller discusses what these new additions to the biologist's tool kit have meant for contemporary developmental biology.

A primary theme of this book is that profound epistemological differences distinguish the theoretical and the experimental biologist. To the experimental biologist of the eighteenth and nineteenth centuries, seeing was believing. This view contrasts with that of the mathematical biologist, for whom pure reasoning is what matters most. Now, with molecular imaging, belief in that direct observation has re-emerged.

Keller's thesis is that an explanation has value if it meets the needs of the people to whom it is explaining the given phenomenon. These needs will vary, depending on the attitudes, understanding and culture present in that community at that time. My only criticism is that by limiting her enquiry to the field of development, with its particular set of processes and mechanisms, she may not be taking into account very different epistemological goals or scientific methods that occur in other areas of biology. By extending her enquiry to molecular or evolutionary biology, she might be able to make this conclusion more secure.

The author concludes that the natural world is so complex and diverse that biologists need a multiplicity of explanatory styles to even attempt to understand nature. This far, I agree. But Keller finds it difficult to envision that natural selection could engineer a mental apparatus that could understand the natural world. But surely an organism possessing a mental apparatus that could fully comprehend itself and everything around it would have a huge selective advantage.

I admire Keller for the task that she undertakes with this book. The scientific explanations are set out clearly, their historical and cultural contexts explained in detail and their philosophical value discussed at length. Being a student of biology and not a fan of philosophy, however, I found some of the discussions in this book far too exhaustive. If an explanation accurately and thoroughly explains a given process, that is good enough for me. The lengthy analysis of explanations of processes that have since been proven false, found in the first section of this book, were rather tiresome. The descriptions of the current explanations were of interest to me, and my understanding of these and of their predictive implications in developmental biology is certainly now wider.

This book is packed with developmental biology, and newcomers to this field might find it hard going. I feel that this focus limits the accessibility and breadth of appeal of the book, and ultimately it was not for me. But for those with a keen interest in the philosophy and history of science and some understanding of developmental biology, this book will be a rewarding read. ■