Evolution – both the fact that it occurred and the theory describing the mechanisms by which it occurred – is an intrinsic and central component in modern biology. Theodosius Dobzhansky captures this well in the much-quoted title of his 1973 paper, “Nothing in biology makes sense except in the light of evolution.” The correctness of this assertion is even more obvious today: philosophers of biology and biologists agree that the fact of evolution is undeniable, and that the theory of evolution explains that fact. Such a theory has far-reaching implications. In this volume, twelve distinguished scholars address the conceptual, metaphysical, and epistemological richness of the theory and its ethical and religious impact, exploring topics including DNA barcoding, three grand challenges of human evolution, teleology, historicity, design, evolution and development, and religion and secular humanism. The volume will be of great interest to those studying philosophy of biology and evolutionary biology.

R. Paul Thompson is Professor in the Institute for the History and Philosophy of Science and Technology and the Department of Ecology and Evolutionary Biology at the University of Toronto. His most recent books include The Structure of Biological Theories (1989) and Agro-Technology (Cambridge, 2011), and he is editor of Issues in Evolutionary Ethics (1995).

Denis Walsh holds the Canada Research Chair in the Philosophy of Biology and is a member of the Department of Philosophy, the Institute for the History and Philosophy of Science and Technology, and the Department for Ecology and Evolutionary Biology at the University of Toronto. He is editor of Naturalism, Evolution and Mind (Cambridge, 2001).
EVOLUTIONARY BIOLOGY

Conceptual, Ethical, and Religious Issues

EDITED BY

R. PAUL THOMPSON
University of Toronto

and

DENIS WALSH
University of Toronto
For Michael Edward Ruse

Intellectual pioneer, a founder of modern philosophy of biology,
dedicated student mentor and a warm supportive friend to many
# Contents

<table>
<thead>
<tr>
<th>List of contributors</th>
<th>page ix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgments</td>
<td>xi</td>
</tr>
</tbody>
</table>

Introduction 1

1 Human evolution: whence and whither? Francisco Ayala 13

**PART I EVOLUTION AND THEOLOGY** 29

2 Evolutionary theory, causal completeness, and theism: the case of "guided" mutation Elliot Sober 31

3 Religion, truth, and progress Philip Kitcher 45

**PART II TAXONOMY AND SYSTEMATICS** 63

4 Consilience, historicity, and the species problem Marc Ereshefsky 65

5 DNA barcoding and taxonomic practice David Castle 87

**PART III THE STRUCTURE OF EVOLUTIONARY THEORY** 107

6 Darwin's theory and the value of mathematical formalization R. Paul Thompson 109
Contents

7 Population genetics, economic theory, and eugenics in R. A. Fisher 137
   Jean Gayon

8 Exploring development and evolution on the tangled bank 151
   Jane Maienschein and Manfred Laubichler

PART IV FUNCTION, ADAPTATION, AND DESIGN 173

9 Darwin's cyclopean architect 175
   John Beatty

10 Function and teleology 193
   Denis Walsh

11 How physics fakes design 217
   Alex Rosenberg

Index 239
Contributors

Francisco Ayala is University Professor and Donald Bren Professor in the Department of Ecology and Evolutionary Biology at the University of California, Irvine.

John Beatty is Professor in the Department of Philosophy at the University of British Columbia.

David Castle is Professor at the ESRC Innogen Centre at the University of Edinburgh.

MARC ERESHEFSKY is Professor in the Department of Philosophy at the University of Calgary.

Jean Gayon is Professor at the Institut d'histoire et de philosophie des sciences et des techniques at the Université Paris 1 Panthéon-Sorbonne.

Philip Kitcher is John Dewey Professor of Philosophy at Columbia University.

Manfred Laubichler is Professor at the Center for Biology and Society, and Center for Social Dynamics and Complexity at Arizona State University.

Jane Maienschein is Professor, Regents’ Professor, and President’s Professor at the Center for Biology and Society and School of Life Sciences at Arizona State University.

Alex Rosenberg is Chair and R. Taylor Cole Professor of Philosophy at the Department of Philosophy, Duke University.

Elliott Sober is Professor, Hans Reichenbach Professor, and William F. Vilas Research Professor at the Department of Philosophy at the University of Wisconsin–Madison.
List of contributors

R. PAUL THOMPSON is Professor at the Institute for the History and Philosophy of Science and Technology, the Department of Ecology and Evolutionary Biology, and the Department of Philosophy, at the University of Toronto.

DENIS WALSH is Professor at the Institute for the History and Philosophy of Science and Technology, Department of Philosophy, and the Department of Ecology and Evolutionary Biology, at the University of Toronto.
Acknowledgments

Evolutionary theory has a complex and fascinating history, and it is conceptually and theoretically rich. Hence, it is not surprising that historians, philosophers, and biologists have mined the rich veins of gold it contains. As this volume demonstrates there is considerable gold left to be unearthed.

There is a worthy tradition of thanking those who, directly or indirectly, have had an impact on a volume. Our list is too extensive to make specific mention practicable. Those that have contributed chapters have, obviously, had a crucial impact on its quality and relevance. Those who provided helpful comments on the proposal and the text have improved the final result. We would like to acknowledge the serious health issues that prevented Elisabeth Lloyd and Robert Brandon from submitting chapters. The staff of Cambridge University Press have made important contributions to the accuracy, readability, and style of the volume: Hilary Gaskin (editor), Emma Walker and Anna Lowe, in particular. Also, many thanks to Sylvia Nickerson for the artwork in Chapter 9, Fermin Fulda for compiling the index, and Alison Evans of Out of House Publishing. Those who know our spouses, Jennifer McShane and Deborah Kohn, are familiar with their constant support and encouragement; for others we acknowledge here their support and endurance. Although having no specific hand in this volume, always lurking in the background is the indefatigable Michael Ruse.