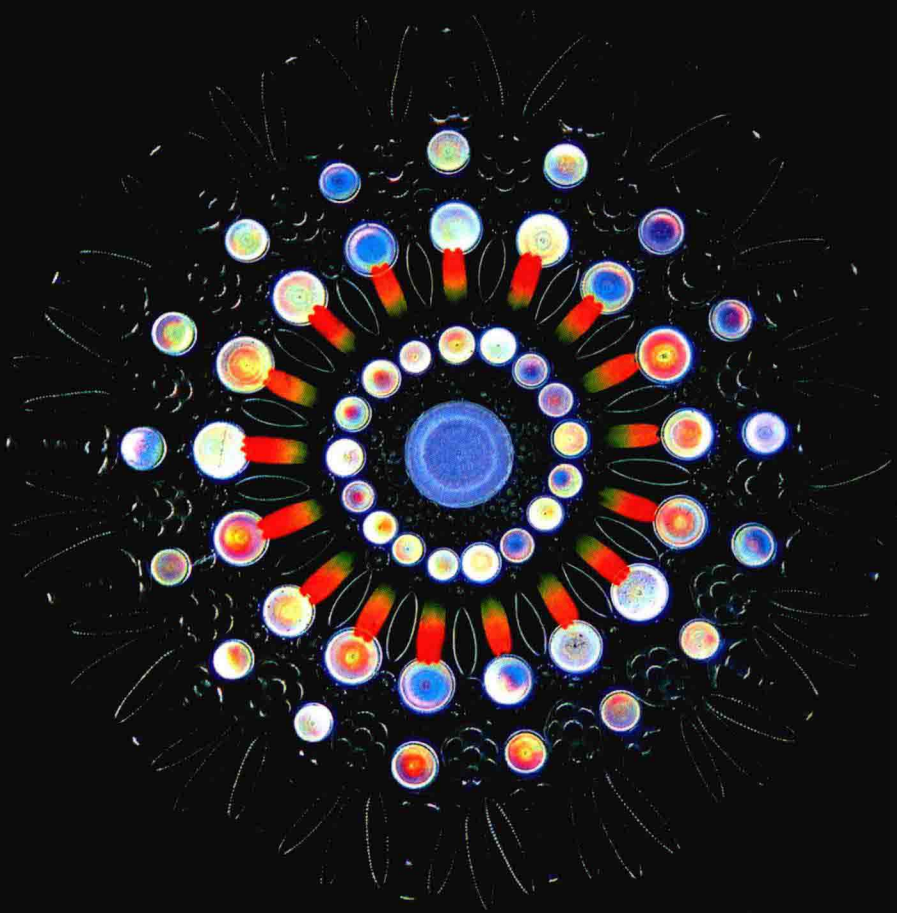


# EVOLUTIONARY BIOLOGY

Conceptual, Ethical, and Religious Issues



EDITED BY  
R. PAUL THOMPSON AND DENIS M. WALSH

CAMBRIDGE

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*Conceptual, Ethical, and Religious Issues*

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and

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## EVOLUTIONARY BIOLOGY

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.

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*For Michael Edward Ruse*

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

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## *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.



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## Introduction

Contemporary analytic philosophy of biology was forged in the 1960s. It began a little more than 50 years ago with Morton Beckner's *The Biological Way of Thought* (1959). Building on this seminal contribution, in articles and books, Thomas Goudge (*The Ascent of Life*, 1961), Marjorie Green (*Approaches to a Philosophical Biology*, 1968), David Hull (*Philosophy of Biological Science*, 1974), and Michael Ruse (*The Philosophy of Biology*, 1973) laid the foundation for modern philosophy of biology.<sup>1</sup> These founders of the field articulated and staked out positions on nearly all the important logical and conceptual underpinnings of evolutionary biology, as well as the social implications of its theories and empirical discoveries.

Michael Ruse's 1973 *Philosophy of Biology* consolidated the field by providing a rigorous analysis and comprehensive treatment of nearly all the critical conceptual issues, including those that have remained contentious; it still stands as a *tour de force*. In 1979, *The Darwinian Revolution: Science Red in Tooth and Claw* was published. It remains an exemplar of the integration of philosophy of science and history of science. Since that time, he has:

- founded, in 1986, the leading journal in philosophy of biology, *Biology and Philosophy* (and nurtured it into being one of the top four journals in philosophy of science);
- founded, in 1995, and edited, from 1995 to 2011, the *Cambridge Studies in Philosophy and Biology* series, which during that period published 80 of the most important books in the field;

<sup>1</sup> A few biologists – J. H. Woodger, C. H. Waddington, and Bernhard Rentch, for example – and physicists – Erwin Schrödinger, for instance – had tackled philosophical aspects of biology but philosophical interest in biology by philosophers of science dates from the work of this group. Earlier philosophical work such as Henri Bergson's *Creative Evolution* and the use by philosophers of Darwinian fitness and Lamarckian inheritance, such as by Herbert Spencer, are very different from contemporary analytic philosophy of biology.

- written more than 20 books (almost all of which have been translated into other languages);
- edited more than a dozen books;
- contributed more than 100 journal articles;
- been a leader in championing evolution in the broader society and in promoting science education.

Moreover, his impact on philosophy of biology includes mentoring several generations of researchers and scholars who have achieved international reputations in their own right. He has received numerous prestigious research awards, including the John Simon Guggenheim Fellowship and Isaak Walton Killam Fellowship. He was elected Fellow of the Royal Society of Canada and Fellow of the American Association for the Advancement of Science, and has received honorary degrees from the University of Bergen, McMaster University, and the University of New Brunswick.

Given his formative role in the development of philosophy of biology, his contributions to research and scholarship, his broader social contributions, his mentoring of generations of scholars and researchers, and his impressive publication record and influence, it is fitting that this volume of original articles by internationally renowned philosophers of biology should be dedicated to him. Although some of the contributors to this volume disagree with some of his positions and arguments, all recognize his importance and the profound impact he has had on the field; many make direct reference to his work. As Michael has told so many of us over the last 50-plus years, “criticize me; just don’t ignore me.” He has certainly not been ignored and there is no shortage of criticism.

This volume continues the exploration of evolutionary biology that he initiated. Today evolution – both the fact that it occurred and the theory, descended from Darwin, describing the mechanisms by which it occurred – is an intrinsic and central component in modern biology. Theodosius Dobzhansky captures this well in the oft-quoted title of one of his 1973 papers,<sup>2</sup> “Nothing in biology makes sense except in the light of evolution.” The correctness of this assertion is even more obvious today than in 1973. Philosophers of biology, historians of biology, and biologists agree that the fact of evolution is undeniable, and that the theory of evolution provides unity to evolutionary biology as a whole, is conceptually rich, and has far-reaching social implications. Like all scientific theories,

<sup>2</sup> Dobzhansky 1973.

however, there are some conceptual and epistemological underpinnings on which there is no settled opinion. Also, like all sciences, there are implications of evolutionary biology that engender intense public controversy.

Notwithstanding the central place of evolutionary theory in biology, there are a number of conceptual and epistemological underpinnings on which there is no settled opinion. These include: the relationship of organisms and their molecular components, the nature of species, the nature of adaptation, the formal (logical/mathematical) structure of evolutionary theory, and the nature and role of development. Each of these poses deep philosophical challenges. The chapters in this volume continue and advance the discussion of them.

The contributors to this volume are philosophers and biologists who have been at the forefront of seeking resolutions to these pivotal conceptual and societal issues. With the exception of the tension between evolution and certain religious sects, there has been considerable convergence, over the last 50 years, with respect to all these issues. Sometimes the convergence has moved debate closer to resolution; sometimes it has led to an identification of remaining impediments. In the case of the tension between evolution and literalist fundamentalist Christianity and Islam, the nature of the tensions and the critical importance of resolving them have been brought into sharper focus. The goal of the volume is to provide readers with a window on the current thinking of those who have shaped the discourse on these contentious issues over several decades.

The collection begins with a contribution from the eminent evolutionary biologist Francisco Ayala. Professor Ayala has a longstanding history of collaboration with Michael Ruse, and his chapter demonstrates the rich potential to be found in the cross-pollination between philosophy and evolutionary biology that Ruse has done so much to foster. Ayala takes up themes broached in Ruse's most recent book, *The Philosophy of Human Evolution* (2012). Specifically, Ayala addresses the evolution of ethical behavior in the transition from ape to human. Ethical behavior has clearly evolved, but quite how it might have done so has been a challenge to evolutionists. There are two principal problems for any evolutionary ethics. The first is that the standard strategy deployed in explaining the evolution of some structure or ability appears to break down in the case of the human capacity for moral judgment and action. Typically, to explain the conditions under which some feature has evolved, one simply articulates the fitness benefit that feature confers on its bearers. The vexed problem for evolutionary ethics is that moral imperatives and fitness imperatives don't obviously coincide. The second problem is what Ayala calls the

“naturalistic fallacy.” Those who seek to ground ethical behavior in evolution run the risk of negating it. If ethical behavior consists in acting ultimately on fitness imperatives, then we have merely been duped by our genes into thinking we are acting under the guise of the moral good.

Ayala’s chapter seeks to finesse these two problems simultaneously. He distinguishes between two questions that are often conflated: (1) whether our capacity for moral deliberation and behavior is an evolutionary endowment, and (2) whether the specific moral norms that guide our actions are an evolutionary endowment. Ayala delivers a positive verdict on the first question: “Humans evaluate their behavior as either right or wrong, moral or immoral, as a consequence of their eminent intellectual capacities, which include self-awareness and abstract thinking. These intellectual capacities are products of the evolutionary process, but they are distinctively human” (p. 18). But, in opposition to much of sociobiology and mainstream evolutionary ethics, he insists upon a negative answer to the second: “moral norms according to which we evaluate particular actions as morally either good or bad ... are products of cultural evolution, not of biological evolution. The norms of morality belong, in this respect, to the same category of phenomena as the languages spoken by different peoples, their political and religious institutions, and the arts, sciences, and technology” (p. 18).

The capacity for ethical behavior, Ayala argues, is conferred on us by three distinctively human cognitive abilities: the ability to anticipate consequences, the ability to make value judgments, and the ability to choose between available courses of action. While these abilities are jointly constitutive of the capacity for ethical behavior, they are not exclusively moral faculties. They grow out of the facility that our hominin ancestors developed for the use and production of tools, means–end reasoning, the planning and assessment of other forms of action. Ayala sees “no evidence that ethical behavior developed because it was adaptive in itself ... It seems rather that the likely target of natural selection was the development of advanced intellectual capacities” (p. 22).

After Francisco Ayala’s tour through the challenges facing the study of human evolution, Part I of this collection turns to an area of dispute in which Michael Ruse has become particularly prominent in recent years: the compatibility of evolutionary biology with religious thought. Ruse has been perhaps the pre-eminent exponent of conciliation between the power of evolutionary biology to reveal the mysteries of life, and the draw many feel toward devotional religious belief. Ruse has consistently valued irenics over histrionics on these matters; his has been the voice of

moderation heard over the stentorian tones emanating from both secular and religious extremes. His *Evolution and Religion: A Dialogue* (2008) captures all these tones with a keen composer's ear. This section features two eminent philosophers of science, Elliott Sober and Philip Kitcher. Each in his way comes out strongly in support of both Ruse's placatory tone, and his compatibilist message.

Elliott Sober argues that evolutionary theory is logically consistent with the conception of a god familiar to Abrahamic religions, who intervenes in the processes of the world. Sober explains that evolutionary theory is fundamentally probabilistic. The theory yields probabilities of certain outcomes – for instance the increase of one trait type over another – given certain conditions. As Sober points out, probabilistic theories can be true, inductively generalizable, testable, and informative, even if they are not causally complete. There is room then, for “hidden variables,” causes of evolutionary phenomena that are not articulated by the theory. It is *logically* consistent, then, with evolutionary theory that these unarticulated causes may be supernatural in origin. Nothing in evolutionary theory proscribes this. It is commonly thought that if there is divine involvement in the processes of evolution, it should be manifested in the pattern of evolutionary novelties. A providential god should or would bring about novelties that are beneficial to those organisms in which they arise. Biologists know, however, that evolutionary novelties arise through mutations, and that mutations are random – in the sense of unguided. But the unguidedness of mutations is in no way incompatible with the thesis that they are divinely caused: “[W]hat biologists mean, or ought to mean, when they say that mutations are unguided says nothing about whether God ever causes a mutation to occur” (p. 32). Invoking Pierre Duhem, Sober reminds us that the application of a scientific theory to the world requires auxiliary assumptions. Evolutionary theory could only have implications about the existence of a deity if it were supplemented by certain auxiliary assumptions. But these auxiliary assumptions are all philosophical, and not biological, in nature. They are not licensed by evolutionary theory alone. Striking a note strongly concordant with Ruse's own message, Sober concludes: “Atheists who think that evolutionary theory provides the beginning of an argument for disbelieving in God should make clear that their arguments depend on additional premises that are not vouchsafed by scientific theory or data” (p. 43).

Philip Kitcher in his chapter addresses the delicate issue of reconciling the role of religion with the atheist's conviction that religious beliefs are false. Kitcher aligns himself with Ruse here, against a phalanx of

outspoken contemporary atheists, particularly the self-anointed “four Horsemen.” “Although we agree with the Horsemen that there is a sense in which all religious doctrines are false, we don’t take this to be the end of the proper discussion of religion” (p. 46). Kitcher draws upon the pragmatist insight that the world we inhabit is to a significant degree one of our own making, structured by “our psychological faculties and our purposes” (p. 48). As scientists we pursue the process of comprehending, predicting, and intervening on the world. And we have generated ways of thinking appropriate to those purposes. “But these are not our only purposes,” Kitcher reminds us (p. 49). “We devise ways of thinking and forms of language directed toward different ends – in play, in literature and arts, in ethics, and in religion” (p. 49). Kitcher introduces us to the idea that truth in general applies to sentences that are employed in the pursuit of a human project. As such there exist a range of species of truth. Kitcher outlines his conception of religious truth. *S* is weakly religiously true (roughly) just when there is an established religious practice that affirms *S*. *S* is strongly religiously true (again, roughly) just when any progressive modification of said practice would continue to affirm *S*. There are weakly religious truths. Kitcher speculates that there may be no strongly religious truths (except, perhaps, for strong ethical truths). He doubts “whether any particular fiction, even the myths of the axial age, is so deep and fundamental that it delivers strong religious truths” (p. 60). That said, religious practice will rightly continue to form a part of the human project of responding to the challenges of “forging identities” and “achieving communities”. These projects are in no way incompatible with the scientific project of comprehending, predicting and intervening on the world.

Part II focuses on taxonomy and systematics, another topic on which Ruse has made many important contributions. The concept “species” is central to taxonomy and has been a thorny concept since before the publication of the *Origin*. Darwin spends much of the first three chapters of the *Origin* arguing for, essentially, a nominalist conception; that is, species are not real, they are a human artifact that is useful – perhaps essential – to biology but not part of the nature of things. Contemporary evolutionary biologists recognize a number of different – and not necessarily compatible – definitions of “species.” The most commonly known is the biological species concept; members of the same species can interbreed without sterility. This has proved a useful definition in a number of contexts but does not apply to non-sexually reproducing organisms, and they comprise most of the living world. Moreover, it doesn’t even apply in many cases of



sexually reproducing organisms. The classic exception is ring species and there are numerous instances of ring species.

Marc Ereshefsky responds directly to Michael Ruse's work on the species concept. He identifies two philosophical issues that Ruse has addressed. One is the ontological status of species: are species natural kinds akin to elements on the periodic table or are species individuals akin to particular organisms? The other concerns whether "species" refers to a real category in nature or whether the species category is merely an artifact of our theorizing. On both issues, he contends that Ruse made major and important contributions. Nonetheless, although Ruse's arguments concerning species are cogent and innovative, Ereshefsky contends that they are flawed. He mounts a case for considering species as historical entities, something to which, he contends, Ruse pays too little attention. On the question whether "species" refers to a real category in nature, he offers a pragmatic form of species anti-realism.

David Castle explores the nature and role of DNA barcoding in taxonomic practice. Barcoding is relatively new in taxonomy. As the term suggests, DNA barcoding is similar to merchandise barcoding except the "bars" are short segments of DNA rather than lines of different lengths, thicknesses, and spacing. Hence, barcoding provides a method by which groups of organisms can be differentiated by comparing short, standardized regions of DNA. Castle examines the how the taxonomic community has responded to DNA barcoding; to state that this technique is still controversial is to understate the polarization it has created. A pluralist perspective seems appropriate – that is, traditional taxonomic practice and barcoding informing each other – but that has yet to be achieved. Castle opens his chapter with a very useful introduction to barcoding, its aims and methods. He then examines three main objections to barcoding. His position centers on barcoding as an evolving method and he sees the objections to it as, in significant part, being motivated by protection of past practices; barcoding, "exemplifies to traditional taxonomists many perceived threats they most fear." The outcome of his analysis should lay the groundwork for a pluralistic approach and allay the fear of traditional taxonomists.

Part III focuses on the structure of evolutionary theory. Two views on the structure of evolutionary theory dominated philosophical discussion in the 1960s. One, strongly influenced by logical empiricism, maintained that the logical structure of theories in biology was the same as physics; both sought axiomatic-deductive systems of laws, which explained and predicted phenomena by deducing them using the laws of the theory and