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978-0-521-87079-5 - The Cambridge Companion to The "Origin of Species"

Edited by Michael Ruse and Robert J. Richards

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THE CAMBRIDGE COMPANION TO
THE "ORIGIN OF SPECIES"

The *Origin of Species* by Charles Darwin is universally recognized as one of the most important science books ever written. Published in 1859, it was where Darwin argued for both the fact of evolution and the mechanism of natural selection. The *Origin of Species* is also a work of great cultural and religious significance, in that Darwin maintained that all organisms, including humans, are part of a natural process of growth from simple forms. This Companion commemorates the 150th anniversary of the publication of the *Origin of Species* and examines its main arguments. Drawing on the expertise of leading authorities in the field, it also provides the contexts – religious, social, political, literary, and philosophical – in which the *Origin* was composed. Written in a clear and friendly yet authoritative manner, this volume will be essential reading for both scholars and students. More broadly, it will appeal to general readers who want to learn more about one of the most important and controversial books of modern times.

Michael Ruse is the Lucyle T. Werkmeister Professor of Philosophy and director of the Program in History and Philosophy of Science at Florida State University. The author or editor of more than thirty books, including *Can a Darwinian Be a Christian?* and *Darwinism and Its Discontents*, he is a Fellow of the Royal Society of Canada and the recipient of several honorary degrees.

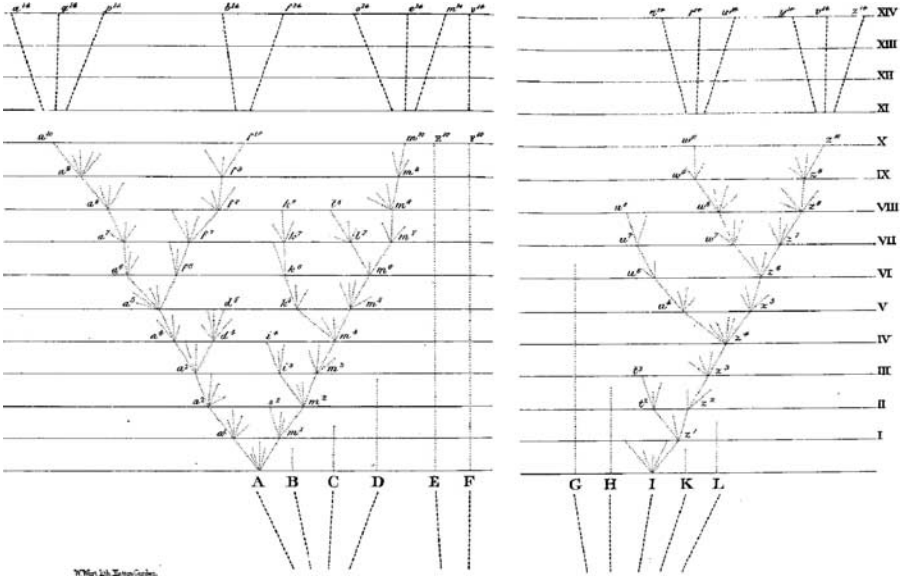
Robert J. Richards is Morris Fishbein Professor of the History of Science and director of the Fishbein Center for the History of Science and Medicine at the University of Chicago. He has held major fellowships for work in the history and philosophy of biology and is the author of many books, including *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* and *The Tragic Sense of Life: Ernst Haeckel and the Struggle over Evolutionary Thought*.

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Darwin's diagram of species (marked A to L) supposedly descending from one genus (not seen). The intervals (marked by roman numerals) represent one thousand or, perhaps, ten thousand generations. Varieties are represented by lowercase letters. At level fourteen, we may suppose the original varieties have become species. "Thus, as I believe, species are multiplied and genera are formed" (*Origin*, 120).

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Edited by

Michael Ruse

Florida State University

Robert J. Richards

University of Chicago



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CONTRIBUTORS

Naomi Back received her Ph.D. from the University of Paris 1 (Panthéon-Sorbonne) in 2005. She is currently employed as Assistant Professor in the Social Sciences Collegiate Division at the University of Chicago.

Gillian Beer is Edward VII Professor Emeritus at the University of Cambridge. She is a Fellow of the British Academy and of the Royal Society of Literature and a Foreign Honorary Member of the American Academy of Arts and Sciences. Among her books are *Darwin's Plots* (second edition 2000), *Open Fields: Science in Cultural Encounter* (1996), and *Virginia Woolf: The Common Ground* (1996). She has recently been writing about rhyming and about the *Alice* books, as well as preparing new work on Darwin and consciousness. She is the president of the British Comparative Literature Association and has twice been a judge for the Booker Prize.

Peter J. Bowler is Professor of the History of Science at Queen's University, Belfast, Northern Ireland. He is a Fellow of the British Academy and a former president of the British Society for the History of Science. He has published widely on the history of evolutionary theory and is now completing a book on popular science in early twentieth-century Britain.

John Hedley Brooke held the Andreas Idreos Professorship of Science and Religion and directorship of the Ian Ramsey Centre at Oxford University from 1999 to 2006. He is an Emeritus Fellow of Harris Manchester College, Oxford, and Honorary Professor of the History of Science at Lancaster University and in 2007 was Distinguished Fellow at the Institute of Advanced Study, University of Durham.

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His books include *Science and Religion: Some Historical Perspectives* (Cambridge University Press, 1991), *Thinking About Matter: Studies in the History of Chemical Philosophy* (1995), and (with Geoffrey Cantor) *Reconstructing Nature: The Engagement of Science and Religion* (Clark, 1998). He is currently president of the UK Forum for Science and Religion. His most recent publications include *Heterodoxy in Early Modern Science and Religion*, coedited with Ian Maclean (2005) and *Religious Values and the Rise of Science in Europe*, coedited with Ekmeleddin Ihsanoglu (2005).

David J. Depew is Professor of Communication Studies and Rhetoric of Inquiry at the University of Iowa. He works in the history, philosophy, and rhetoric of biology, both ancient and modern. He is the coauthor, with Marjorie Grene, of *Philosophy of Biology: An Episodic History* (Cambridge University Press, 2004) and, with Bruce H. Weber, of *Darwinism Evolving: Systems Dynamics and the Genealogy of Natural Selection* (1994). With Weber, he has coedited a number of collections, most recently *Evolution and Learning: The Baldwin Effect Reconsidered* (2003). He has written articles on the bearing of Aristotle's biological treatises on his social and political theory and on how Aristotle and Darwin can most accurately be compared. With John P. Jackson, he is currently working on a book about how Darwinians have intervened in American social and political controversies.

Sandra Herbert is Professor of History at the University of Maryland–Baltimore County and a Fellow of the American Association for the Advancement of Science and in 2006–07 was Distinguished Visiting Scholar at Christ's College, Cambridge. Her book *Charles Darwin: Geologist* (2005) has received awards from the American Historical Association, the Geological Society of America, the History of Science Society, and the North American Conference on British Studies.

Chris Kohler became an antiquarian bookseller in 1961 when he was eighteen, and *Michèle Kohler* joined his firm after their marriage in 1973. They put together collections of books that they sell to university and national libraries throughout the world. They spent twenty years building the most comprehensive collection of books and autograph letters by and about Charles Darwin that has ever

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been assembled, which they sold to the Natural History Museum in London.

David Kohn is General Editor of the Darwin Digital Library of Evolution at the American Museum of Natural History and Robert Fisher Oxnam Professor of the History of Science Emeritus at Drew University. He has edited Charles Darwin's Transmutation Notebooks and is currently writing an intellectual history of Darwin's botany.

Mark A. Largent is an historian of biology. He is Assistant Professor of Science Policy and directs the Science, Technology, Environment and Public Policy Specialization at James Madison College at Michigan State University. He earned his Ph.D. from the University of Minnesota's Program in History of Science and Technology and has taught American history and history of science courses at Oregon State University and the University of Puget Sound. His research and teaching focus on the role of biologists in public affairs and in the history of nineteenth- and early twentieth-century biology. He has published on the history of the evolution/creation debates, evolutionary theory, and the American eugenics movement; his most recent book is *Breeding Contempt: The History of Coerced Sterilization in the United States* (2007).

Tim Lewens works in the Department of History and Philosophy of Science at the University of Cambridge. He is the author of *Darwin* (2007) and *Organisms and Artifacts* (2004).

A. J. Lustig is Assistant Professor of History at the University of Texas at Austin. She is the coeditor, with Robert J. Richards and Michael Ruse, of *Darwinian Heresies* (2004) and is currently writing a book on explanations of altruism in biology and society since Darwin.

David Norman is working on describing the early Jurassic dinosaurs *Heterodontosaurus* and *Scelidosaurus*. He is currently directing a major new exhibition entitled Charles Darwin the Geologist at the Sedgwick Museum of Earth Sciences, University of Cambridge. He is also developing exhibitions on Charles Darwin's life as a student at Christ's College, Cambridge, and is a member of the committee organizing the Darwin 2009 Festival at the University of Cambridge. Further, he is coordinating research on Darwin's historical work as

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a geologist and new geological research on material collected from the Galápagos Islands in 2007. He has written several prize-winning books on dinosaurs, their evolution and biology, as well as numerous scientific papers on related topics, including a few on the history of science with respect to fossil reptiles. He was the Asher Tunis Distinguished Research Fellow (Paleobiology) at the Smithsonian Institution, Washington, D.C., for 2000–02 and a Visiting Scholar at St. John’s College, Oxford, in 2006. He is the director of the Sedgwick Museum of Earth Sciences, University of Cambridge; an Odell Fellow in Natural Sciences at Christ’s College, Cambridge; and a University Reader in Vertebrate Palaeobiology at the University of Cambridge.

Lynn K. Nyhart teaches history of science at the University of Wisconsin–Madison. She is the author of *Biology Takes Form: Animal Morphology and the German Universities, 1800–1900* (1995), and of a forthcoming book, *Modern Nature*, on natural history reform movements in nineteenth-century Germany. Her specialty is the history of evolutionary thought in its various guises.

Robert Olby is a retired professor of the history of science at Pittsburgh University. He is the author of many books on the history of genetics, including the classic *The Path to the Double Helix: The Discovery of DNA* (1994).

Richard A. Richards is Assistant Professor of Philosophy at the University of Alabama and Associate Professor of Philosophy at Yeshiva University in New York City. He is the author of articles on Darwin and on taxonomy. For the first decade of his adult life, he was a professional ballet dancer.

Phillip R. Sloan is Professor in the Program of Liberal Studies and in the Graduate Program in History and Philosophy of Science at the University of Notre Dame. His research specializes in the history and philosophy of life science from the early modern period to contemporary molecular biology. His writings include studies of Buffon, Darwin, and Richard Owen and on the history of classification in biology. He is currently working on a book on the conception of life in contemporary biophysics.

Vassiliki Betty Smocovitis is Professor of the History of Science in the Departments of Zoology and History at the University of

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Florida and is affiliate in the Botany department. She is the author of *Unifying Biology: The Evolutionary Synthesis and Evolutionary Biology* (1996). Her research interests include the history of plant evolutionary biology; she is currently completing a biography of G. Ledyard Stebbins.

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Some works are cited often, and for convenience their titles have been abbreviated and used in the text.

Barrett, P. H., P. J. Gautrey, S. Herbert, D. Kohn, and S. Smith, editors. 1987. *Charles Darwin's Notebooks, 1836–1844*. Ithaca, NY: Cornell University Press. (*Notebooks*)

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EDWARD O. WILSON

FOREWORD

One hundred and fifty years past its publication, I believe we can safely say that the *Origin of Species* is the most important book of science ever written. Indeed, given its importance to all of humanity and the rest of life, it is the most important book in any category. No work of science has ever been so fully vindicated by subsequent investigation, or has so profoundly altered humanity's view of itself and how the living world works. The theory of natural selection continues to gain relevance to the things that matter most to humanity – from our own origins and behavior to every detail in the living environment on which our lives depend. Little wonder that the adjective "Darwinian," sometimes lowercased to "darwinian" as a tribute to its fixity, far outranks "Copernican," "Newtonian," and "Mendelian" in the frequency of usage.

The *Origin* won the day quickly for such a revolutionary proposal, so much so that Darwin could confidently publish *The Descent of Man* only twelve years later. It succeeded not just for the mass of evidence adduced to support evolution but because of the clarity and authority of its text. The quality of the mind that erected it did not come from the blue. For nearly three decades, extending from the departure of *HMS Beagle* from Plymouth on December 31, 1831, to the day in 1859 the *Origin* was sent to press, Darwin remained almost continuously absorbed in scientific natural history. He inhabited this subject, and he lived it. And fortunately, the middle of the nineteenth century was a time that so little was known about nature in the rest of the world, so few unifying concepts existed to guide the collection of data, that every fact, every specimen was valued. Darwin's mind was an open vessel. By absorbing with little

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discrimination those domains of natural history most relevant to geology and evolutionary biology, he became enormously learned.

In preparing my recent anthology entitled *From So Simple a Beginning* (2006), I read for the first time in chronological order all four of Darwin's greatest books, *Voyage of the Beagle* (1845), the *Origin of Species* (1859), *The Descent of Man* (1871), and *The Expression of the Emotions in Man and Animals* (1872). These are, I can assure you, the four to read, and straight through if you can. It is impossible to imagine a higher quality of original intellectual exposition. Taken in sequence, the four books reveal the development of a mind priming itself to address the greatest of subjects during the most opportune of times to do so. Darwin must have been continuously exhilarated by what he had come upon. Galileo had his telescope. Leeuwenhoek had his microscope. Darwin had his idea.

Charles Darwin is the most written-about scientist in history. The reader may well ask, in picking up the present Companion, whether we need more: do we need more, even as part of a centennial celebration? The answer is yes! Light continues to be thrown by evolutionary thought on more and more subjects. The human self-image continues to grow in depth and clarity as a result. All this is worth an ever-evolving commentary. The history, provenance, and impact of the *Origin* and Darwin's other great books deserve repeated rounds of assessment.

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INTRODUCTION

In 1859, the English naturalist Charles Robert Darwin published his major work, the *Origin of Species*. In this work, he argued that all organisms living and dead are the end result of a long, slow, natural process of development from forms far simpler and that indeed all life, by reason of its descent from but a few ancestors, is related. He also proposed a mechanism, natural selection, meaning that only a few survive and reproduce and that success in this process is on average a function of the distinctive features of organisms – over time, this leads to change, change that is in the direction of adaptation. Eyes, ears, noses, leaves, trunks, flowers, flippers, fins – these are the things that are produced by evolution, and these are the things crucial for survival and reproduction.

At once, it was recognized that the *Origin* was a major work of science. Indeed, it was seen as a major event in the history of Western civilization. As Copernicus had expanded space, so Darwin expanded time. Moreover, this was something that impinges on human beings. The *Origin* is not directly about humans. The only explicit reference is an almost throwaway passage at the end of the book. "Light will be thrown on the origin of man and his history." But no one was fooled. Humans may be important, but our importance must be tempered by our shared links with the rest of life. What perhaps could not have been seen back in 1859 was the extent to which Darwin and his book would be subjects of intense interest and controversy at the beginning of the new millennium, here in the first decade of the twenty-first century. Thinking of other major events in the years of the *Origin*, clearly the Crimean War and the Indian Mutiny had far-reaching effects – the former if only for medical care in battle and the latter eventually for the independence of

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the subcontinent. But today these are matters of historical interest and not of contemporary controversy. Not so the *Origin*. In part because of the controversy about creationism, in part because the mechanism of natural selection is debated vigorously in the science community, in part because Darwin's thinking does strike so fundamentally at the visions that we all have of ourselves, the *Origin* itself is still reprinted, reread, discussed and debated.

This Cambridge Companion has been written, edited, and published precisely because the *Origin* is still today a work of vital significance and interest. It is not a substitute for reading the *Origin* itself. We suggest that you have a copy of the *Origin* beside you as you open this volume – for reasons that will be made clear, we suggest that you use the first edition of the *Origin*, and it will be easiest to use the readily available facsimile, for it is to this that the contributors in this volume refer. The order of the contributions to this volume is straightforward. After an initial introduction, the topics of the *Origin* are introduced and discussed in order. Then there are several essays on issues that come out of the *Origin*. We stress that this is a work on the *Origin* and not on Darwin or evolution generally. As always with Cambridge Companions, the intent is to introduce pertinent ideas to readers new to the issues, but at the same time to try to offer thoughts that the more experienced and professional will find relevant and challenging.

The volume opens with a piece by one of the editors, Michael Ruse, that gives some background to the *Origin*, why it was written and when. There is an ongoing debate about the long interval of time between the moments at which Darwin thought up his ideas and the date of eventual publication. Why was there this gap, and indeed is it even right to speak in terms of a "gap"? At the same time, the piece gives an overview of the work, suggesting that – as Darwin himself said – it is "one long argument" and not simply a bunch of ideas thrown together. It is suggested that the work is skillfully constructed in the light of the dictates of the leading methodologists of science active when Darwin was a young man, but also that in judging the style one should take note of the sponsors of the naturalist, and why he would be trying to meet their approval and gain their sympathy. Also discussed are a number of issues arising from the *Origin*, for instance, the extent to which one can truly say that

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Darwin was working in a British tradition as opposed to the style and methods of various continental thinkers.

The *Origin* opens with an extended discussion of the work of animal and plant breeders and the uses that they make of artificial selection. This is the topic of Mark A. Largent's paper. After a careful discussion of the information offered by Darwin, including a recognition of the ways in which Darwin separated out the differing intentions of and effects produced by the breeders – including a discussion of something Darwin called "unconscious selection" that he thought very important – Largent takes up a topic about artificial selection that is much discussed, namely, its role in the *Origin*. Is it just a heuristic device to get the reader ready for natural selection, or does it have a deeper role, that of making natural selection and the evolution consequent upon its action more evidentially plausible? Largent argues we can answer questions like these only by considering the extended work that Darwin himself did on breeding such organisms as pigeons.

Robert Olby tackles the important question of variation. In order for natural selection to work, there must be a renewable supply of variation. If there is not, then selection will soon have used up everything and ongoing change will grind to a halt. Darwin had no theory of heredity – what we call "genetics" – and although he did later come up with (what we now consider) a misguided theory, it was never introduced into the *Origin*. Olby looks at the data that Darwin did introduce into the *Origin*, and at the kinds of speculations that he made about it. Olby also looks at the changes that Darwin made through various editions of the *Origin*, in the light of his own work and the criticisms of others. Finally, Olby tackles the much-debated question of whether Darwin could and would have put his theory on a much firmer basis had he read the work of the Moravian monk Gregor Mendel, the man who is today regarded as the father of modern genetics. Olby suggests that an adequate answer to this question is far from obvious.

We have next a discussion of the linchpin of Darwin's thinking, natural selection. Robert J. Richards (the other editor of this volume) tackles this topic, taking us through the discovery of natural selection as a force for change, together with a secondary mechanism that Darwin called "sexual selection," and on to the eventual

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discussion of selection in the *Origin*. Richards's discussion uncovers a major difference between two camps of contemporary Darwin scholars (a difference that separates the two editors of this Companion!) – between those, like Ruse, who think that Darwin was the quintessential English thinker and that natural selection was a mechanism very much in the mold of the industrialists of the eighteenth century, and those, like Richards, who see Darwin much more in the continental Romantic tradition and who therefore see selection as something contributing to this tradition, being focused essentially on humans and their interests, their moral concerns, and their unique, high place in the world, which they owe to the worldwide progressive force of nature.

One still sometimes hears people say that although Darwin's book was titled the *Origin of Species*, in fact the topic of species is virtually absent from the book. This is simply not true, for there is much said in the *Origin* both on the nature of species in a world of evolution and on the reasons for their coming into being – the next chapter shows the latter in some detail. It is true, however, that one gets no explicit formal discussion of the topic of species, and it is Phillip R. Sloan's task to pull together what Darwin has to say about species in the *Origin* and to put the discussion in a historical context. This Sloan does by going back and looking at earlier (especially eighteenth-century) discussions of classification (systematics) and then at how Darwin tackled the topic in various writings up to and including the *Origin*. An important part of Sloan's discussion focuses on the debate after publication of the *Origin* and how Darwin's critics and friends tried to incorporate his thinking into their discussions and scientific forays.

Following on Sloan's discussion, David Kohn tackles a very important topic in the *Origin* (the word "keystone" in the title to the chapter is a word that Darwin himself used about the topic). How is it that organisms diverge in kind, and more importantly, why do they do so? Why are not all organisms identical? If you look at Darwin's notebooks, you can see that from the beginning he is wrestling with this problem, but it was not until the 1850s that he got on top of it, seeing that it is through divergence and diversification that many more organisms can exist and be supported than otherwise. Kohn points to the very great significance of metaphor for Darwin – in this case, the industrialist's metaphor of the division of labor. The

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creation of organisms that are different and adapted for different ends means that more life can flourish than would happen otherwise. As Kohn points out, this is the basis for another of Darwin's celebrated metaphors, the tree of life.

A. J. Lustig takes on two linking chapters in the *Origin*, first that dealing with organs of great perfection and second that dealing with instinct. The former basically completes the case for evolution through selection. Lustig shows how Darwin cleverly turns the argument on its head, or at least on its side, arguing that although we cannot see the evolution of perfection through time, we can in space, by setting up a series of existent organisms from the simplest to the most complex. Lustig also notes how here (as elsewhere) there are theological concerns lying beneath the most secular of discussions. The latter chapter, on instinct, starts to take us to the second part of the *Origin*, where Darwin applies his theory across a wide range of topics and problems. The discussion is important both for the extent to which it shows that behavior is as much a subject for selection and evolution as are physical features, and also for the ways in which Darwin had to wrestle with what today is known as the units-of-selection problem. In social organisms, like the ants and bees, was selection working on the individual insect or on the hive as a whole, and why does this matter?

When the layperson thinks of evolution, at once the fossil record comes to mind. Indeed, how often has one heard someone say that they believe in evolution because of the fossils – or, alternatively, that they do not believe in evolution because of the fossils! As it happens, however, although the fossil record is clearly crucial for the belief in evolution, when it comes to mechanisms there is often debate – who, after all, could see selection working on the trilobites or the dinosaurs? Darwin realized this to the full, and his extensive discussion in the *Origin* of paleontology is concerned in major part with answering problems and objections. However, as Sandra Herbert and David Norman show in their contribution, there is more to the story than this, and in the *Origin* Darwin is also concerned to make the positive case for evolution and selection as based on the fossil record. Note how some of the things that Darwin has to say about the record – for instance, about the status of higher organisms, especially humans – clearly bear on topics mentioned earlier. (Although Darwin makes explicit mention of humans only at the

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end of the *Origin*, throughout the work there are hints about and references to our species.)

Next, Peter Bowler takes up Darwin's discussion of geographical distribution. It is well known that this was an important topic for Darwin, because as a young man, when he was the ship's naturalist on HMS *Beagle*, he had been tremendously impressed by the distributions of the birds and reptiles on the Galápagos Archipelago. Why do you have different finches and mockingbirds and tortoises on islands within sight of each other, when on the mainland there is far less biodiversity? And why are the animals of the Galápagos like the animals of the South American continent and not like those of Africa, whereas the animals of the Canary Islands are like those of Africa and not like those of South America? These are facts that Darwin uses to bolster his case for evolution against the religious who want everything to be the function of creative miracle. Bowler shows how Darwin fits his discussion into a pattern that mirrors that of the earlier discussion of paleontology – one dealing with space and the other with time.

The penultimate chapter of the *Origin* (the final is recapitulatory) is something of a grab-bag discussion, as Darwin starts to clean up the topics he has so far left undiscussed. The first is that of classification or systematics, and Richard A. Richards's discussion of this subject is a nice complement to the earlier discussion of species by Phillip Sloan. Richards also puts things in historical context, talking both of the system of the Swedish taxonomist Linnaeus in the eighteenth century and of classificatory suggestions of the early nineteenth century, including the rather odd quinary system of William MacLeay. Richards also shows how very crucial was the thinking about homology and analogy by the anatomist Richard Owen, a man who was to become much hated by the Darwinian party. This is all a springboard for a discussion of classification in the *Origin*, where Darwin shows that his theory explains the possibility and nature of organic classification and how in turn this possibility and nature (in a kind of feedback way) make plausible Darwin's theory. Richards also goes on to show how Darwin's thinking was to impinge on the thinking of classifiers after the *Origin*.

Darwin was very proud of his discussion of embryology in the *Origin*. The big puzzling question was why exactly it is that, although the adults of different species may be very different, their embryos

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are often nigh identical – the naked eye cannot distinguish a human embryo from that of a dog. Darwin saw that this all followed from the different selective pressures on organisms at different times of their lives. Embryos are basically under the same conditions, whereas adults are not, and hence they get driven apart. But there was more to embryology than this, and Lynn K. Nyhart's contribution also focuses on these extra facts and problems, particularly the extent to which Darwin shared the views of the continental embryologists who thought that there were parallels between the development of the individual organism and the history (whether evolutionary or not) of the group or race. Obviously these issues take us right to the heart of the debate about the extent(s) to which Darwin can be considered a naturalist in the English tradition or a more Romantic thinker in the continental line.

We now start on a slightly different track. The main arguments of the *Origin* have been covered. The contributions from now on deal with particular issues arising from the *Origin*, issues that merit discussion in their own right. (For this reason, there is no longer any binding reason behind the ordering of the contributions, and the reader should feel free to read them in any order.) Vassiliki Betty Smocovitis writes about Darwin's botany in the *Origin*. Although we tend to think of Darwin as an animal man – finches, pigeons, tortoises, bees, and so forth – the study of plants was always something of prime importance for him, and indeed after the *Origin* most of his own empirical research was on plants, starting with a sprightly little book on orchids. Smocovitis shows how plants do in fact play a large role in the *Origin*, especially in the early chapters. There is discussion of them in the world of breeders, as a source for variation and for the argument that varieties can turn into species, for refining the meaning of the struggle for existence, as well as for examples of fantastic adaptive abilities. Smocovitis argues that in many respects Darwin was way ahead of his time and that his evolutionary speculations about plants were fully appreciated only in the middle of the last century, almost a century after the *Origin* first appeared.

David J. Depew raises topics that have been gaining increasing scrutiny from scholars recently, topics that more traditional scientific and philosophical approaches tend to miss. He is concerned with Darwin's style and his argumentative strategy. One very interesting point that Depew makes speaks to an issue that has often puzzled

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readers of the *Origin*, namely, who exactly does Darwin take to be his opponents? He often speaks of religiously based opposing ideas, but it is not easy to see exactly who the people holding such ideas might be. Depew suggests that this fuzziness might have been deliberate. Darwin did not want to make too strong and clear a case for the opposition because readers might be swung to this opposition! Depew also raises a topic that has been discussed since Aristotle, namely, the role of metaphor in thought and especially in scientific thought. There is much use of metaphor in the *Origin*, and Depew's question is about its use and dispensability. Could one have Darwin's theory without all of the flowery language?

What about religion and the *Origin*? Fortunately, as John Hedley Brooke shows in his contribution, we know a lot about Darwin's religious beliefs, starting with a fairly literal Anglicanism when at college, which on the *Beagle* voyage turned into a kind of deism – God as unmoved mover, Who works through unbroken law – and finally towards the end of his life turns again into a form of agnosticism, so favored by many leading Victorian intellectuals. We know also that it was never really science that changed Darwin's thinking about religion, but other generally more theological issues like hellfire and damnation. Brooke focuses much of his discussion on the religion of the *Origin*, arguing that Darwin at that time was no atheist or even agnostic, but trying to work out a form of deism, which frees God from the details but puts Him behind the overall working and excellence of the living world. Brooke also shows that the religious response to the *Origin* was by no means uniform, and that reactions varied from enthusiastic acceptance to outright hostility. Matters were also complicated by the fact that the Anglican Church in Britain had other more pressing issues to deal with, especially the trends in continental theology ("higher criticism"), which was throwing much uncomfortable light on the literal claims of Holy Scripture. Whatever else, Brooke shows that the relationship between the *Origin* and religion was complex and multifaceted.

As a young man, Darwin loved music and literature and the arts generally. As an old man, he regretted that, under the pressure of a life of science, his feeling for the aesthetic side of human existence had withered and gone. At most, he wanted a novel with a good story, a happy ending, and preferably a pretty heroine. In fact, he sold himself

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short, for it is clear that as a writer he always showed the influence of great works of creative art, novels and poetry, as well as related volumes of travel and the like. The *Origin* certainly exhibits this. In her contribution, Gillian Beer shows that the relationship between evolution, especially Darwin's evolution, and literature – novels and poetry – has always been much closer than many realize and that Darwin's thinking has been a rich source of inspiration for authors, from the creators of the very greatest works of fiction, notably George Eliot's *Middlemarch*, down to novelists and poets writing today. Beer shows also how this influence has extended from the most sober and widely admired works to what can only be described as light fiction of the frothiest kind. *Tarzan of the Apes* is influenced by the *Origin* just as much as Thomas Hardy's *Jude the Obscure*. Through Beer's essay, we start to grasp how the *Origin* has been as much a cultural influence as a simple and pure work of science.

Naomi Beck takes up the question of the influence of the *Origin of Species* on political thinking. This is a vast subject, and she distills the discussion down to three important responses to the *Origin*. First, Beck looks at the reactions of the man who in that day was even more closely identified with evolution than Darwin, namely, Herbert Spencer. She shows that although Spencer welcomed the *Origin* with enthusiasm, in fact what he did (perhaps typically) was to read Darwin through his own progress-tinted spectacles, and that the Darwin who found his way into Spencer's writings owed little to the efforts of the author of the *Origin*. Clémence Royer, the first translator of the *Origin* into French, was an ardent progressionist and advocate of forward-looking movements, from republicanism to feminism. The way she introduced the *Origin* may have given her and her admirers great satisfaction, but it made the rather staid author of the book itself very uncomfortable. Finally, there are the fathers of Marxism, Karl Marx himself and his great supporter and collaborator Friedrich Engels. They too praised Darwin – Marx particularly was much in the camp of those who saw Darwin as a very English thinker – but eventually their own thoughts and conclusions were little related to the ideas of the *Origin*. Finishing Beck's piece, one might conclude that the *Origin* is a little bit like tofu – it can take on flavorings of many kinds, according to the wishes of the chef.

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Darwin was not a philosopher, and the *Origin* is not a work of philosophy. Nevertheless, Darwin was an educated Englishman; he had read philosophy as part of this education – Plato, the British empiricists, some continental thinkers (his later work *The Descent of Man* shows a keen appreciation of Kant), and most particularly the methodologists of science of his day. Tim Lewens teases out these themes, particularly the influence of the methodologists. Lewens has much to say about what today is regarded as a particularly important kind of scientific strategy, namely, the use of "inferences to the best explanation," where one gathers up the information and tries then to infer the best overall explanation of what is empirically at stake. Lewens argues that this is an important part of the argumentation of Darwin and that the chief influence here was the astronomer and philosopher of science John Herschel. Seeing how today we are still embroiled in disputes about Darwin and his *Origin*, the reader might compare Lewens's account of Darwin's methodology to the rather different one given in the introductory essay of Ruse.

Finally, Michèle and Chris Kohler talk about the *Origin* as a physical object – what sort of book it was, how it was published and distributed, what it cost, and all of those sorts of matters. They also trace the publishing history of the *Origin*, first in English and then in translation. Particularly interesting are their comparisons of the *Origin's* fate to that of other well-known works on evolution, notably Robert Chambers's anonymously published *Vestiges of the Natural History of Creation*. The *Origin* holds its own, but not much more than that. However, do note the interesting point that the Kohlers make about the purchase of the *Origin* by lending libraries. The actual readership of the *Origin*, in whole or in part, may have been large. Among other interesting facts that the Kohlers have unearthed is the way in which the first edition of the *Origin* has shot up in value in recent years. The book may never sell in its lifetime what a book on wizards sells in its first twenty-four hours, but the original now costs what no scholar could ever afford. Let us hope that the tax laws incline rich collectors to give to research libraries, so that all can continue to enjoy the great work by a great scientist.

It remains now only for us as editors to thank Cambridge University Press for letting us produce *The Cambridge Companion to the "Origin of Species,"* to thank our contributors for writing such

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splendid pieces, to thank the world's most distinguished living evolutionary biologist, Edward O. Wilson of Harvard University, for writing a Foreword, and to thank the William and Lucyle T. Werkmeister Fund of Florida State University for supporting a conference where early versions of these contributions could be presented and discussed by all.