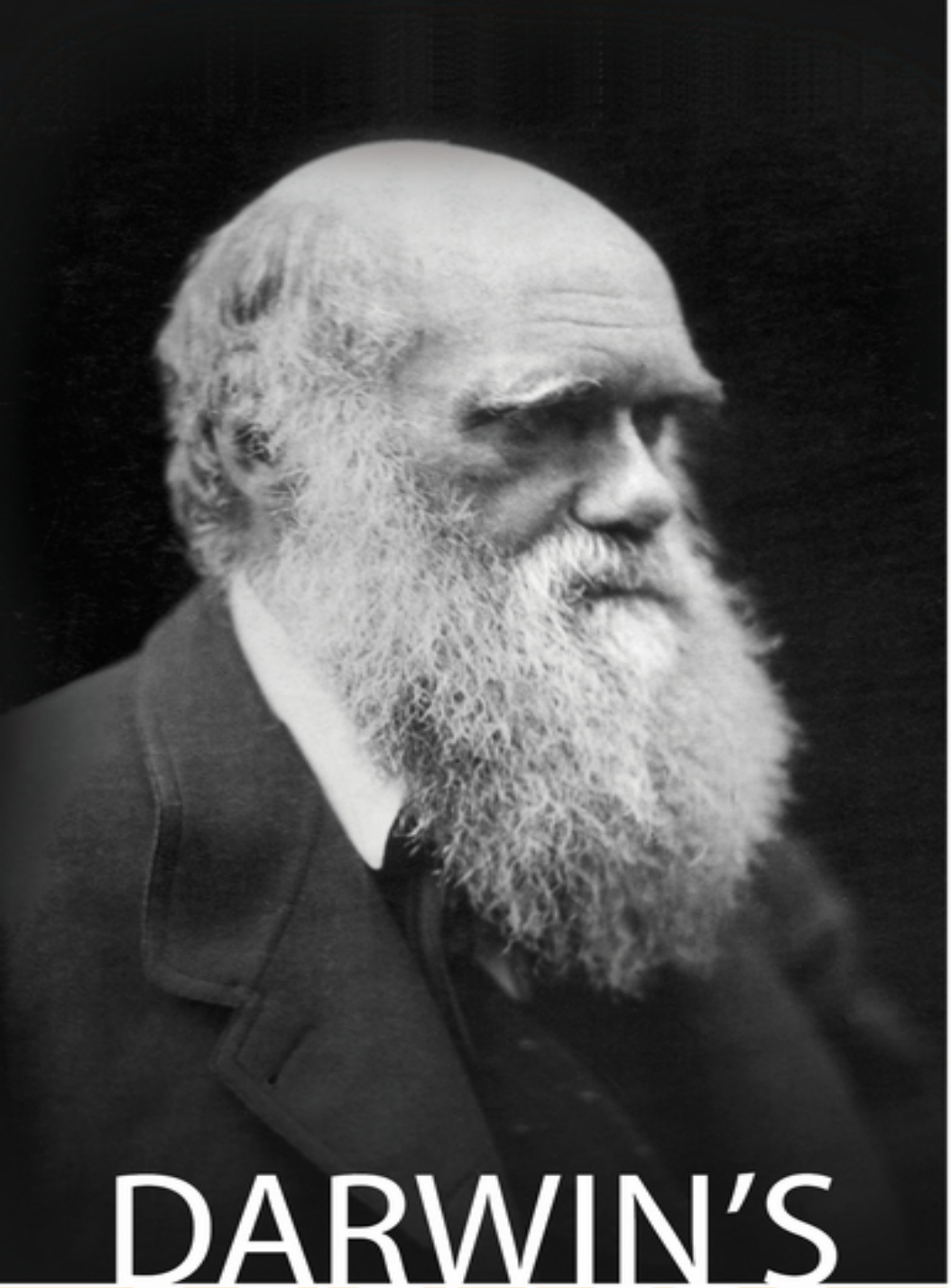

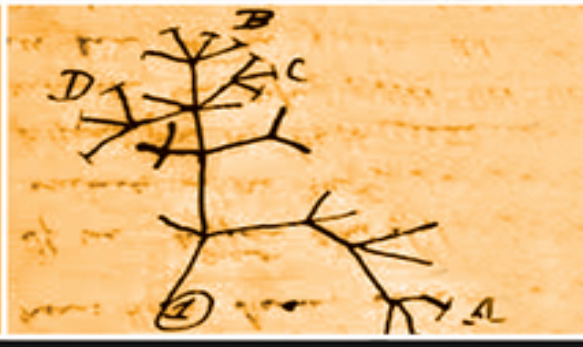

DARWIN'S SCIENCES

Duncan M. Porter and Peter W. Graham

WILEY Blackwell

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Darwin's Sciences

How Charles Darwin voyaged from rocks to worms in his search for facts to explain how the earth, its geological features, and its inhabitants evolved

Duncan M. Porter
and PeterW. Graham

WILEY Blackwell

This edition first published 2016 © 2016 by Duncan M. Porter & Peter W. Graham

Registered office:

John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

Editorial offices:

9600 Garsington Road, Oxford, OX4 2DQ, UK

The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

111 River Street, Hoboken, NJ 07030-5774, USA

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Library of Congress Cataloging-in-Publication Data

Porter, Duncan M., author.

Darwin's sciences : How Charles Darwin voyaged from rocks to worms in his search for facts to explain how the earth, its geological features, and its inhabitants evolved / Duncan M. Porter & Peter W. Graham.

pages cm

Includes bibliographical references and index.

ISBN 978-1-4443-3035-9 (pbk.) – ISBN 978-1-4443-3034-2 (cloth) 1. Darwin, Charles, 1809-1882.

2. Naturalists–Biography. 3. Natural history. 4. Evolution (Biology) I. Graham, Peter W., 1951- author.

II. Title.

QH31.D2P67 2015

508.092–dc23

[B]

2015010081

A catalogue record for this book is available from the British Library.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Cover image: Charles Darwin photograph by Julia Margaret Cameron, taken at Freshwater, Isle of Wight, August 1868 (Courtesy of Google Images 2013).

Marine iguana photograph by Duncan M. Porter, taken on Hood Island (Isla Española), the Galapagos, 1967.

“Tree of Life” – Darwin's first drawing of a genealogical diagram, made in his *Transmutation of Species Notebook B* in July/August 1837, (DAR 121: 36), (Reproduced by kind permission of the Syndics of Cambridge University Library).

Title page image. Charles Darwin at age 22 before he sailed on the Beagle voyage. Sculpture in the new Darwin Garden at Christ's College, Cambridge, where he was a student from 1828 to 1831. Sculpted by Christ's student Anthony Smith, unveiled on Darwin's 200th birthday, 12 February 2009. (Photo by Duncan M. Porter, 2009.)

Preface

Biologists hear the name Charles Darwin from an early age. This was no exception for DMP, who became aware of him in high school biology class, albeit without much understanding of how evolution took place, but an awareness that it did. My biology teacher at Ventura Senior High School, the charismatic Bob Rollins, kindled an interest and opened the doors to the natural world. At Ventura College, botanist/microbiologist Tom O'Neill introduced me to plants, which I fell in love with; zoology was not there pursued because one had to dissect a rat in the beginning course laboratory. Transferring to Stanford University, I came under the spell of some excellent botanists: mycologist Bob Page, plant physiologist Win Briggs (whose first lecture began with a discussion of Charles and Francis Darwin's plant hormone experiments), evolutionist Dick Holm (the best teacher I have ever had), and taxonomist and ecologist Ira Wiggins, who became my MA advisor. A group of biology students there also influenced me greatly, especially undergraduate Curt Givan and graduate students John Thomas and Wally Ernst, all of whom became good friends. My undergraduate advisor Bob Page suggested that I apply to Harvard University to study for a PhD, which I did and, surprisingly to me, was accepted. In the 1960s, Harvard Graduate School was much less stressful for students than now, although perhaps I found it so because of already having spent two graduate years at Stanford. Curt Givan followed me to Harvard, and he and fellow graduate students Beryl Simpson, Jim Walker, Garrison Wilkes, and Steve Young continued to add to my botanical education. As at Stanford, Harvard produced a number of influential professors, especially paleobotanist Elso Barghoorn, ethnobotanist

Dick Schultes, and my PhD advisor, plant systematist Reed Rollins, in whose courses I was a teaching fellow (graduate assistant). It was while I was working on my dissertation that I first encountered Darwin's plant specimens, because one of the species of the genus I was monographing is endemic to the Galapagos Islands. More were studied during a postdoc back at Stanford working on the flora of the Galapagos with Ira Wiggins.

My initial motivation to pursue research on Darwin was supplied by Cambridge University Herbarium assistant curator Peter Sell. After he showed me some Darwin plant specimens from the Galapagos during a visit by me and my wife Sarah in the spring of 1973, I said “But most of these have not been identified.” Peter answered: “No one at Cambridge has ever been much interested in the flora of South America. Why don't you identify them?” On that same trip, we visited the Royal Botanic Gardens, Kew, where botanist Gren Lucas also urged me to identify the Galapagos plants, the second set of which is in the Kew herbarium. On a visit in 1976 to examine the Galapagos collections, I met Darwin experts zoologist Sidney Smith, librarian Peter Gautrey, and botanist David Kohn, at Cambridge University Library, who encouraged my interest in Darwin. At lunch after I presented a talk on Darwin's *Beagle* plant collections at London's Natural History Museum in 1979, Smith, Kohn, and school headmaster and Darwin aficionado David Stanbury urged me to identify the rest of the *Beagle* plants. When I demurred, saying, “I am not prepared to do so,” I was answered: “No one else is prepared to do so. You do it!” A grant from the National Geographic Society led to a Visiting Fellowship at Clare Hall, a graduate college of Cambridge University, where the family and I lived for 10 months in 1980–1981 while I examined Darwin's specimens. I spent 1 week a month with Gren and Shirley Lucas and their family studying the Kew

Darwin specimens. Over the years, all these led not only to the study of Darwin's Galapagos Islands plants and those collected elsewhere on the voyage of HMS *Beagle*, but also to the historical record of his geological, zoological, and botanical collections and interests. Research was pursued almost every summer at Cambridge and Kew. Eventually, I became a senior editor and then for 9 years director of the Darwin Correspondence Project at Cambridge University Library. I was well immersed in what another Harvard influence, evolutionist Ernst Mayr, called the “Darwin Industry.” Along the way, I met my peerless collaborator Peter Graham, and we began teaching an honors colloquium on “Darwin: Myths and Reality”.

PWG, for his part, also first encountered Darwin in a high-school Advanced Biology course, heard more of him at Davidson College, but first studied Darwin's writing (*On the Origin of Species*, as edited by Morse Peckham) in Clyde de L. Ryals's magisterial Victorian course in the English graduate program at Duke University. Later, as a Lilly Post-Doctoral Fellow studying the then-new field of Medical Humanities in the University of Florida's Humanities Perspectives on the Professions program, I met David Locke, a science writer turned English professor who was offering an innovative course applying the methods of literary analysis to iconic texts of science: Harvey's *De motu cordis*, Newton's *Optics*, Freud's *Interpretation of Dreams*, Einstein's *Relativity*—and, most pertinent to me in the long term, Darwin's *Origin*. The chance to teach *Origin* to David Locke's undergraduates kindled my keen interest in Darwin as a person and a writer, an interest that resurfaced a few years later when Duncan and I, both fairly new faculty members at Virginia Tech in Blacksburg, serendipitously met at the local Episcopal Church. Our team-taught University Honors Colloquium on “Darwin: Myths and Reality” rose out of several long and engrossing

conversations on Darwin the man and his works. This course worked well from the get-go, given that its two teachers, a scientist and a humanist, came at Darwin from different disciplinary perspectives but shared a belief that it was crucial to understand Darwin as much more than just the author of *Origin*, itself a text more invoked than actually read. Thanks in great measure to another serendipitous event, an introduction offered by Bert Moyer, a distinguished historian of science and chair of the History Department at Virginia Tech, collaboratively teaching Darwin led us to being enlisted by Viking Penguin as editors of *The Portable Darwin*. This challenging task led us both to read far more comprehensively—and then with great regret to excise, first selectively, then radically—in order to settle on some 600 pages to represent Darwin's intellectual achievement in our anthology.

My scholarly interests have varied widely over time. They have ranged over topics in literature and medicine and in British Romanticism (especially the works of Lord Byron and Jane Austen)—and they have also included Charles Darwin. Attempting to account for this eclecticism to a more single-minded colleague, I hit on a tentative explanation: “Byron and Austen appeal to me because they're the two English Romantics with a sense of humor, and Darwin's in the mix because he is, like them, one of the great British empiricists of the 19th century.” That improvised formulation eventually resulted in a comparative book, *Jane Austen* & *Charles Darwin*: *Naturalists and Novelists*. This intertextual conversation juxtaposes two thinkers and writers, superficially quite different but in some respects surprisingly similar, who share an inclination to look with a clear eye at the concrete particulars of the world before them, to form opinions on the basis of attentive observation rather than of transmitted opinion and to say what they have seen in

accessible, often elegant prose. During the years when I was writing the four long essays that would become *Jane Austen* & *Charles Darwin*, Duncan and I were sporadically engaged in designing a Darwin biography to supplement *The Portable Darwin* and fit the needs of our undergraduate students, who sometimes drowned in the details of whatever biography (we assigned a number of the finest) we taught in our colloquium. Determined that our students would come to know Darwin as a man with a long, complex arc of scientific accomplishment, not just a one-book star, we envisioned a slim volume organized according to Darwin's different categories of scientific research: geology, zoology, botany, and the social sciences. Over the years, this slim volume substantially expanded—to that extent, we found ourselves following in Darwin's footsteps—as it appeared ever more important to represent Darwin's intellectual accomplishments in their totality, to examine all his books, many of his scientific papers, and his remarkable, revealing correspondence, more of which was becoming accessible each year, thanks to the ongoing efforts of the Darwin Correspondence Project. Over the years of reading, researching, and writing, we have learned a great deal from other Darwinists and from one another—but the debt's not symmetrical, and I am the more deeply indebted party. It has been a great blessing, delightful and edifying in equal measures, to collaborate with a scientist and scholar who has walked in Darwin's footprints and who offers the distilled essence of a life-long scholarly devotion in what he has contributed to our manuscript.

Duncan M. Porter
Peter W. Graham
Blacksburg, Virginia
July 2014

Acknowledgments

Unfortunately, most of those mentioned in our Preface as mentoring us throughout our careers are now deceased. Fortunately, however, most of those mentioned in the following paragraphs are still living, active, and in contact with us.

We are particularly grateful to William Huxley Darwin for permission to quote from the Darwin letters and manuscripts. We also thank the Syndics of the Cambridge University Library for permission to quote from Darwin manuscripts and reproduce several drawings in their possession (Figures 3.1 and 3.4), facilitated by Adam Perkins.

Quotations from *The Correspondence of Charles Darwin* (© Cambridge University Press 1985–2013) and Richard Darwin Keynes's editions of *Charles Darwin's Beagle Diary* (© Cambridge University Press 1988) and *Charles Darwin's Zoology Notes & Specimen Lists from H.M.S. Beagle* (© Cambridge University Press 2000) are reprinted with the permission of Cambridge University Press. Erasmus Barlow kindly granted us permission to quote from the publications of his mother, Lady Nora Barlow, aided by her granddaughter Claire Barlow. Peter C. Lack (The Estate of David Lack) granted us permission to reproduce Figure 3.3 from his father's *Darwin's Finches* (Copyright © David Lack 1947), with the aid of Sophie Wilcox of The Alexander Library of Ornithology, University of Oxford.

At Cambridge University Herbarium, the late Peter Sell, David Briggs, Gina Murrell, John Parker, and Christine Bartram supplied encouragement and information about Darwin's plant specimens, and Christine kindly provided us

with a photo of Darwin's first known plant collection, reproduced as Figure 4.2. At Clare Hall, the late Jim Council, Bob Ackerman, Dame Gillian Beer, Richard Eden, Michael Loewe, Martin Rudwick, David Sacks, and Ekhard Salje all provided keen interest and verbal engagement in our project; David Gosling provided that as well as information on Darwin's influence in India. The late Richard Darwin Keynes, a superb student of his great-grandfather, also showed great interest in our planned book.

At Virginia Tech's Department of Biological Sciences, successive Department Heads Bob Jones and Brenda Winkel provided encouragement and an office. T. F. Wieboldt expertly photographed illustrations from various books for us, and Valerie Sutherland kindly digitized slides. Richard Bambach, formerly in the Virginia Tech Department of Geosciences, shared his knowledge of Darwin as a geologist and evolutionist. Dick Burian and the late Marjorie Grene, of the Department of Philosophy, asked and answered many questions about Darwin and evolution. Newman Library's Interlibrary Loan department was very helpful in obtaining copies of books and papers needed for our research.

At John Wiley & Sons, Alan Crowden and Ward Cooper encouraged us from the beginning, when they were employed by Cambridge University Press. Our Project Editor, Kelvin Matthews, has been not only encouraging, but also very patient with us. Assistant Editor Laura Bell designed our beautiful cover and Prasanthi Mahalingam provided helpful copy-editing.

Our text was read and commented on by Anna Altizer, Michael Ghiselin, Sandra Herbert, Heather Pierce, Tony Pierce, Sarah Porter, and David West (by most more than once!). Sandra (author of *Charles Darwin, Geologist*),

Michael (author of *The Triumph of the Darwinian Method* and editor of *Darwin and the Galapagos*), and David (author of *Fritz Müller: A Naturalist in Brazil*) all provided insightful commentary from their wide backgrounds in history and the natural sciences; this book's integrity has been increased by their input. Anna, Heather, Tony, and Sarah are nonscientists, who were asked to test the readability and understandability of the book; we hope that their contributions have helped make it more accessible to those who know little or nothing about the historic Darwin. We are greatly indebted to them all, as we are to our students in University Honors 3004, Charles Darwin: Myths and Reality, over the many years we have taught it. These honors students, the collective human inspiration for our project, were encouraged to enroll in the colloquium by Jack Dudley and Terry Papillon, successive directors of the Virginia Tech Honors Program. Frank Sulloway, of the University of California, Berkeley, has long been a helpful source of Darwinian information, particularly on the Galapagos Islands

We are especially indebted to Gren and Shirley Lucas, who helped start all this by providing DMP with a home away from home sporadically for many years, while he was pursuing research in England on Darwin, and treated him as a member of their family. Permission to use Figure 6.1 was granted by them and their children, to whom this book is dedicated.

Chapter 1
Introduction

Reflecting back on his childhood while in his sixties, Charles Darwin wrote in his autobiography that by the age of eight “my taste for natural history, and more especially for collecting, was well developed.” He recalled that he “collected all sorts of things, shells, seals, franks, coins, and minerals. The passion for collecting, which leads a man to be a systematic naturalist, a virtuoso or a miser, was very strong in me, and was clearly innate, as none of my sisters or brother ever had this taste” (*Autobiography*: 22–3). It is clear that this innate trait led him to accumulate during his lifetime not only natural history specimens, but also voluminous notes on them and on relevant subjects, numerous publications, and a vast correspondence with naturalists and others around the world. These documents have left subsequent generations a vast treasure trove of information about Darwin, his interests, and his family that we have mined in producing this book.

Today, many people picture Charles Darwin as a solemn, black-cloaked, gray-bearded Victorian patriarch staring at them with rheumy eyes, as seen in the well-known photographs Julia Margaret Cameron had taken in 1868 (Figure 1.1). However, he was only 22 when he embarked on the life-altering voyage of HMS *Beagle* in December 1831 and 28 when he began his notebooks on transmutation of species (evolution) in March 1837 (Figure 1.2).

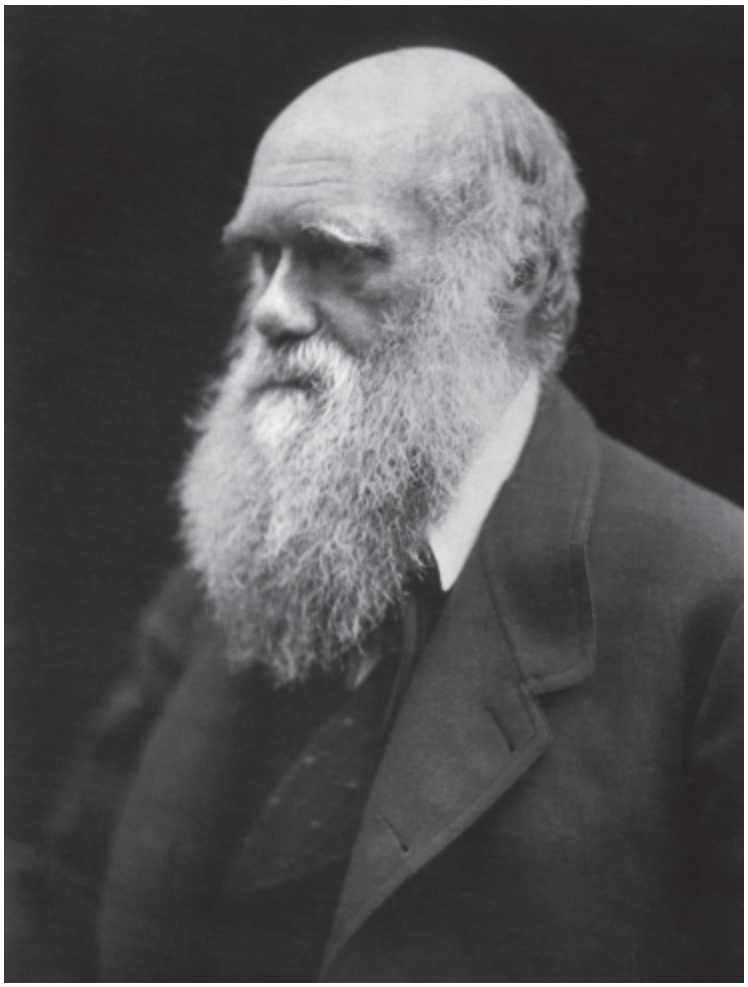


Figure 1.1 Photograph of Charles Darwin at the age of 59, by renowned photographer Julia Margaret Cameron at Freshwater, Isle of Wight, August 1868.

(Courtesy of Google Images, 2013.)

Figure 1.2 Charles Darwin at the age of 22 before he sailed on the *Beagle* voyage. Sculpture in the new Darwin Garden at Christ's College, Cambridge, where he was a student from 1828 to 1831. Sculpted by Christ's student Anthony Smith, unveiled on Darwin's 200th birthday, 12 February 2009.

(Photo by Duncan M. Porter, 2009.)

The narrative that follows will not be the usual chronologically organized biography about Darwin's life. For comprehensive biographical details, the reader should seek out the recent books by Adrian Desmond and James Moore (*Darwin. The Life of a Tormented Evolutionist* 1991) or Janet Browne (*Charles Darwin. Voyaging* 1995; *Charles Darwin. The Power of Place* 2002). Or, for recent studies of certain aspects of Darwin's life, see Keith Thomson (*The Young Charles Darwin* 2009), which leads up to his theory of evolution by natural selection; Randal Keynes (*Annie's Box* 2001) on Darwin's loss of his favorite daughter; or Edna Healey (*Emma Darwin* 2001) and James and Kent Loy

(*Emma Darwin. A Victorian Life* 2010) on his domestic life; Andrew Pattison (*The Darwins of Shrewsbury* 2009) and Tim Berra (*Darwin and His Children* 2013) on the family; Richard Keynes (*Fossils, Fishes, and Fuegians* 2002) on the *Beagle* voyage; Thalia Grant and Greg Estes (*Darwin in Galápagos* 2009) on where he went and what he saw in these islands; Rebecca Stott (*Darwin and the Barnacle* 2003) on his research with barnacles; Daniel Pauley (*Darwin's Fishes* 2004) on his research with fishes; and Sandra Herbert (*Charles Darwin, Geologist* 2005) on his career in geology. All these readable books rely heavily on the definitive, multivolume *Correspondence of Charles Darwin* (*Correspondence* 1985–2013), as henceforth must all research on Darwin's life and work. So does our study—which is the first biographical treatment to emphasize his lifelong research in various fields of endeavor, what he did, why he did it, and what its implications were and are for his time and ours. This account, ordered by topic rather than chronology, logically follows our earlier book (*The Portable Darwin* 1993), which reprinted and discussed a number of his research papers and excerpts from his books. Above all, we aim to help our readers understand that Darwin's career did not build toward—and then subside from—one grand idea (natural selection or evolution) but instead involved many longstanding projects, some distinct and some interrelated, which together served to generate, support, and enrich his understanding of change as the great constant of the natural world.

First, we must set the stage with some family background. Much of the information in the following three paragraphs is from the new, first unabridged, edition of *The Life of Erasmus Darwin*, written by Charles Darwin in 1879 and edited by King-Hele (2003). The first known Darwin ancestor of Charles Darwin lived in the early sixteenth century, near the River Trent in Lincolnshire, in east-

central England. Here, in the village of Marton, just south of Gainsborough near the border with Nottinghamshire, dwelt several generations of Darwins. Through marriage, in the late seventeenth century, the family seat became Elston Hall, Newark, Nottinghamshire. It was here that Robert Darwin, Charles' great-grandfather, was born in 1682.

Robert Darwin and his wife Elizabeth Hill had seven children in seven years. The youngest of these was the famous physician, poet, and philosopher Erasmus Darwin, born at Elston Hall in 1731. In 1750, Erasmus entered Cambridge University, as did his older brother John, but left without receiving his Bachelor of Arts degree. He entered Edinburgh Medical School in autumn 1753 and returned to Cambridge in 1755 to take a Bachelor of Medicine degree. Although Erasmus apparently never completed his M.D. (King-Hele 1999), until the fame of his grandson outstripped his own a century later, when one spoke of “Dr. Darwin”, one referred to Erasmus, not Charles.

Erasmus Darwin first attempted to practice medicine in Nottingham, where as a fledgling physician, he attracted no patients. Several months later, he moved to Lichfield in Staffordshire, where he was more successful, and in 1781, to the city of Derby in Derbyshire. He eventually became so successful that King George III is reported to have asked, “Why does not Dr. Darwin come to London? He shall be my physician if he comes” (King-Hele 2003: 69).

Erasmus was married twice and fathered 14 children, five by his first wife Mary Howard, two after she died by his son's nursemaid Mary Parker, and seven by his second wife Elizabeth Pole. The fourth child of his first marriage was Robert Waring Darwin, Charles' father, born in Lichfield in 1766. Like his father, Robert became a physician, studying medicine at Edinburgh Medical School, probably beginning

in 1782 (King-Hele 1999), and receiving his M.D. from the University of Leiden in 1785. He returned to Edinburgh for another year, and in 1786, Erasmus settled him in the market town of Shrewsbury, county seat of Shropshire, in northwestern England, where he soon became even more financially successful than his father. In 1796, Robert married Susannah Wedgwood, the eldest child of the renowned potter Josiah Wedgwood, founder of the famed ceramics firm of Josiah Wedgwood & Sons Ltd. and a good friend of Erasmus Darwin.

Six children resulted from this first Darwin–Wedgwood union: Marianne (1798–1858), Caroline Sarah (1800–1888), Susan Elizabeth (1803–1866), Erasmus Alvey (1804–1881), Charles Robert (1809–1882), and Emily Catherine (1810–1866). Marianne married Dr. Henry Parker in 1824, Caroline her first cousin Josiah Wedgwood III in 1837, and Catherine the Rev. Charles Langton in 1863; Susan never married. Erasmus, who also never married, trained as a physician at Edinburgh University like his father and grandfather, but never practiced. Charles, of course, is the main subject of our story.

Charles, to whom we will subsequently refer as CD, following the Darwin Correspondence Project's usage, was born at the Mount, Robert and Susannah's substantial house on the edge of Shrewsbury on the 12th of February 1809. This auspicious day was also the birth date of Abraham Lincoln, born on a farm near Hodgenville, Hardin County, Kentucky, under rather different circumstances. Lincoln's parents were illiterate farmers, whereas CD was from the start of life securely situated in the rich and privileged British upper middle class. Both grandfathers were members of the free-thinking Lunar Society of Birmingham, and Dr. Erasmus Darwin articulated—in such works as *The Loves of the Plants*, *Zoonomia*, and *The Temple of Nature* (E. Darwin 1789, 1794–1796, 1803)—the

most prominent eighteenth-century English case for evolutionary development. For a fascinating look at the Lunar Society see Uglow (2002), and for more on CD's grandfathers see Wedgwood and Wedgwood (1980), and King-Hele (1999).

In his *Autobiography* and elsewhere, CD disavowed the influence of his grandfather Erasmus's transformationist speculations on his own. However, CD's first Transmutation Notebook (*Notebooks*), “commenced about July 1837” (170), began with the title “*Zoonomia*” and with a discussion of asexual and sexual generation and references to that earlier book. Despite his apparent reluctance to acknowledge Erasmus's influence on him, CD recapitulated a family pattern in his choice of problems and projects, if not in his particular conclusions, just as his marriage in 1839 to his first cousin Emma Wedgwood conformed to the precedent of his father's and his older sister Caroline's marriages to Wedgwoods.

The young CD's early life followed a well-worn path in other ways. Like his older brother Erasmus, CD was sent to Shrewsbury School, where a classical curriculum centered on Greek and Latin offered little to interest a boy whose passions were such rural pastimes as hunting, shooting, and collecting rocks and insects. Hoping that his second son could be molded into a professional man of his own sort, Dr. Robert Darwin in 1825 sent CD to join Erasmus, who was already pursuing a medical degree, in studying medicine at Edinburgh University. Edinburgh's medical faculty and curriculum were as distinguished as any in Europe, but CD's interests lay elsewhere: in the gathering, dissecting, and stuffing of new specimens for his collections, and in the papers presented at meetings of the Plinian Society, a student club that focused on topics in natural history. A crucial relationship in CD's Edinburgh days, as we shall see, was with the Lamarckian zoologist

Dr. Robert Grant, who introduced him to the study of marine invertebrates. In his second year at Edinburgh, CD decided against medicine as a career. The brutality of nineteenth century operations revolted him. CD recalled having “attended on two occasions the operating theatre in the hospital at Edinburgh, and saw two very bad operations, one on a child, but I rushed away before they were completed. Nor did I ever attend again, for hardly any inducement would have been strong enough to make me do so; this being long before the blessed days of chloroform. The two cases fairly haunted me for many a long year” (*Autobiography*: 48).

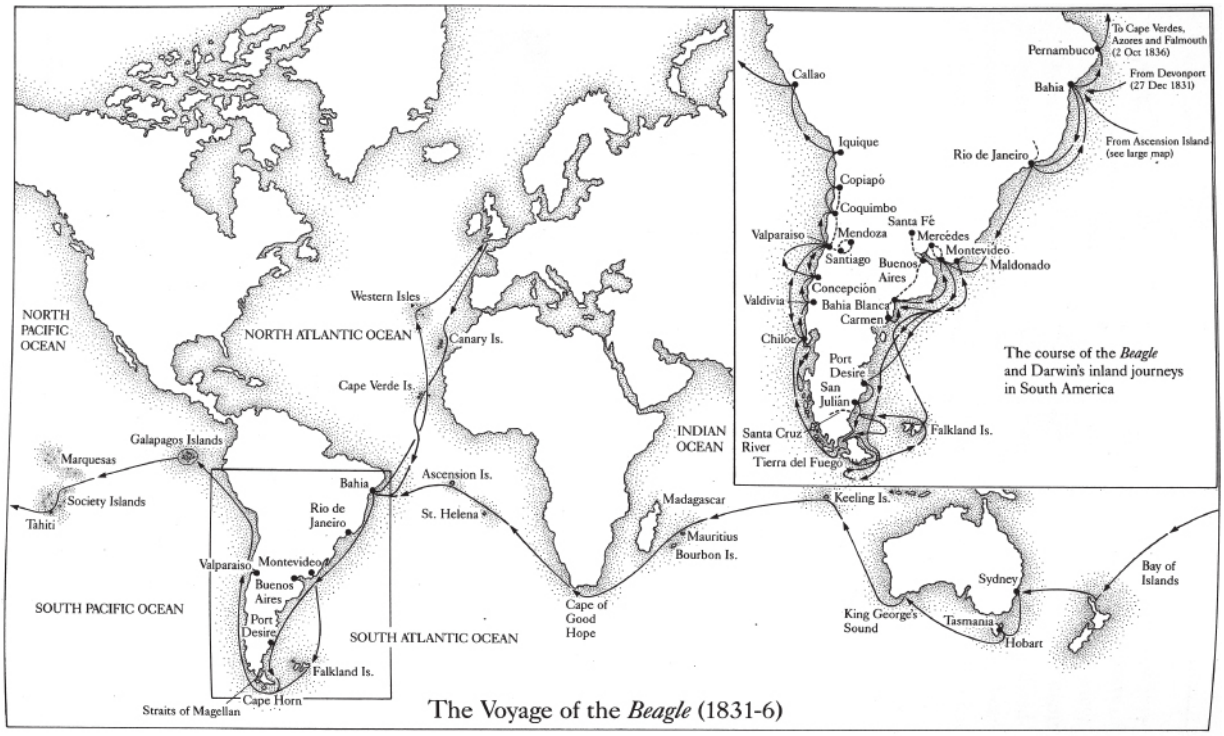
Recognizing that CD did not have the makings of a medical man, his father settled on the gentlemanly alternative of holy orders and the comfortable, undemanding life of a country clergyman as offering a congenial future for his less-than-promising second son. And so, Christ's College, Cambridge became the next academic institution to accept the young CD, who did what was necessary to pass his examinations but saved his energy for more favored pastimes: the sporting pursuits of undergraduate gentry and his old love for natural history. The latter now took the form of competitive beetle-hunting in the company of such fellow enthusiasts as his second cousin William Darwin Fox. Other new and important friendships established at Cambridge were with two clergymen who also had scientific interests. The Woodwardian Professor of Geology, Reverend Adam Sedgwick, who at the time was engaged in research that resulted in his Cambrian time scale (see Secord 1986), took CD on an excursion through North Wales. He stimulated the younger man's interest in sedimentary stratification, possibly laid the foundation for his conversion to geological gradualism, that large changes are accumulations of smaller changes over time, and certainly convinced him, as no mere book had yet done,

“that science consists in grouping facts so that general laws or conclusions may be drawn from them” (*Autobiography*: 70). The Professor of Botany Reverend John Stevens Henslow's influence on CD's development was even more crucial. sHis son Francis Darwin later wrote (F. Darwin 1917: 86): “Cambridge was a turning point in his scientific life, chiefly through Professor Henslow's discovery that the youth whom his father Dr. R. W. Darwin thought likely to be a mere sporting man and a disgrace to his family, was really a remarkable person, possessed by a burning zeal for science.” CD became known at Cambridge as “the man who walks with Henslow” (*Autobiography*: 64); thanks to Henslow's intervention, CD was considered for the post of companion to the captain and unpaid naturalist on HMS *Beagle*, a naval vessel about to return to southern South America to complete coastal surveys begun in 1826. For more on Henslow and CD, see the latest Henslow biography, by Walters and Stow (2001).

There were obstacles to CD's embarking. The most substantial was his father, whose strong (but malleable) opinion that the adventure would spoil CD's chances of settling down to a clerical life was overcome by uncle Josiah Wedgwood II, who argued for natural history being suitable for a clergyman. Once family support was secured, there was doubt as to whether Commander Robert FitzRoy, the aristocratic and staunchly Tory captain of the *Beagle*, would make the offer. But in December 1831, CD did set out on the *Beagle*, a small, rebuilt barque whose surveying expedition, planned to last 2 years, actually took almost 5 years. Despite formidable obstacles—tedium, isolation, perennial seasickness and crowding on shipboard, clashes of temperament with the volatile and politically and religiously conservative FitzRoy—CD found the voyage transformative. “The voyage of the *Beagle* has been by far

the most important event in my life and has determined my whole career" (*Autobiography*: 76).

The *Beagle*'s voyage took her through the Canary and Cape Verde Islands to the east coast of South America (Figure 1.3). While the coastal surveys proceeded, CD disembarked at such places as Bahia, Rio de Janeiro, and Montevideo for long expeditions into the countryside, where, as on the ocean (when it was calm), he was tireless in gathering geological, zoological, and botanical specimens. The luxuriance of exotic life-forms in the rain forest of Brazil particularly overwhelmed him and made his mind "a chaos of delight" (*Beagle Diary*: 42). The ship surveyed the coast of Patagonia, the Falkland Islands, and the windy, desolate headlands of Tierra del Fuego, where it left an English missionary and three Fuegians, who had been indoctrinated in British culture and Christian values. CD's first contact with native Fuegians in their "untamed" (*Correspondence* 1: 302) state filled him with feelings as strong as, but antithetical to, those aroused by the tropical rain forest's flora and fauna. He returns to the contrast repeatedly: a characteristic instance appears in a 30 March 1833 letter from the Falkland Islands, where CD wrote to his sister Caroline "an untamed savage is I really think one of the most extraordinary spectacles in the world. – the difference between a domesticated & wild animal is far more strikingly marked in man" (1: 302–3). We will return to the Fuegians and CD's powerful reaction to their circumstances in a later chapter.



The route of the voyage of the *Beagle*, 1831–1836

Figure 1.3 Map of the *Beagle*'*s* circumnavigation of the world, December 1831–October 1836, drawn by Laszlo Meszoly.

(Reprinted by permission of the publisher from *One Long Argument*: *Charles Darwin and the Genesis of Modern Evolutionary Thought* by Ernst Mayr, Cambridge, Massachusetts: Harvard University Press, Copyright © 1991 by Ernst Mayr. Photo by T. F. Wieboldt, 2014.)

Battered and buffeted by strong winds, the *Beagle* succeeded with some difficulty in rounding Cape Horn, and while the Pacific shore was being charted, CD left the ship to explore Chiloé Island, the Chilean coast, and the Andes. In the volcanic Galápagos archipelago off the South American coast, he encountered populations of tortoises, lizards, mockingbirds, and finches that differed slightly but distinctly from island to island. Although he did not realize it at the time, these varying populations offered compelling evidence of evolutionary divergence. The voyage continued across the Pacific to Tahiti and New Zealand, then on to several landfalls on the southern edge of Australia and

Tasmania, the Cocos (Keeling) Islands, across the Indian Ocean to Mauritius, and from the Cape of Good Hope to St. Helena and Ascension Island. From there, the *Beagle* did not proceed north to England, but back across the Atlantic to Brazil, to recheck longitude measurements. Heading home after this detour, CD and his shipmates returned to England in October 1836, almost 5 years after leaving her shores. CD would not leave Britain again—but like many a British connoisseur back from the Grand Tour or imperial adventurer returned from a tour of duty in the colonies, he carried home exotic collections and recollections that would enrich, and entirely alter, the rest of his life.

Back in England, CD found that his expedition had made him, if not famous, at least a rising star among the naturalists. The many crates of specimens (some brought back on the *Beagle*, others shipped home at Dr. Darwin's expense) now needed to be unpacked, arranged, and studied. Over the next few months, he found specialists eager to help with this vast project: John Gould of the British Museum took on the birds, Thomas Bell of King's College, London, studied the reptiles and amphibians, Richard Owen of the College of Surgeons, later to be a hostile critic of CD's evolutionary views, examined the fossil mammals from South America, George R. Waterhouse, curator at the Zoological Society, described the living mammals, and naturalist Reverend Leonard Jenyns the fishes. Their monographs were published in *The Zoology of H.M.S. Beagle*, edited by CD. Others wrote a number of shorter papers on the basis of his collections.

Established in London and increasingly involved with the Geological and Zoological societies, CD began to make intellectual order of 5 years' worth of impressions and observations. At the same time, he solidified social and collegial alliances of the sort that would serve his needs. CD took up again with his Cambridge mentor Henslow,