SECOND EDITION

HOW HUMANS EVOLVED

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How Humans Evolved

Second Edition

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Preface

When we wrote the first edition of *How Humans Evolved*, we had two major goals. First, we wanted to create a text that emphasized the processes that have shaped human evolution. It would be a text that integrated recent theoretical and empirical work in evolutionary theory, population genetics, and behavioral ecology with information about the hominid fossil record. Second, it would be a book that seriously considered the role of evolution in shaping contemporary human behavior. Although there is little consensus (and considerable controversy) about evolutionary approaches to human behavior, we wanted to produce a book that confronted these issues openly and clearly. The positive response to the textbook indicates that many of our colleagues shared this vision.

In the second edition of *How Humans Evolved* our objectives remain much the same. However, in the years that have elapsed since the preparation of the first edition, there have been many important new developments in human evolutionary studies. New fossils have been discovered that change our understanding of the history of the human lineage. Emerging evidence about primate cognitive abilities has made us question certain assumptions about the evolution of mind. New theory and data have been applied to understanding the evolution of additional stages in the human life cycle. These developments, and many others, have prompted us to rewrite Chapters 9 and 13 entirely, add new boxes to several chapters, and make substantive changes to a number of chapters in Parts II, III, and IV. New readings from the literature have been selected for nearly half of the chapters, and the list of references for further reading has been updated. The second edition has also given us an opportunity (hopefully) to eliminate all of the errors that escaped our detection and the more competent proofreading by our editor, reviewers, and an exceptional copyeditor.

In the second edition, we have retained features that users of the book have found useful. These include the "key idea" statements, which are set in italics and marked in the margin with a small icon, and the discussion questions at the end of each chapter. The key idea statements are meant to provide a concise statement of the main idea in the material that follows. We recommend that students use the key ideas like yellow highlighters—to help keep track of important concepts and facts and to structure their review of the material. Important and unfamiliar terms are defined in the text when they are first used, and are also defined in the glossary. The discussion questions that appear at the end of each chapter are meant to help students synthesize material presented in the text. Some questions are meant to help students review factual material, and others are intended to help students understand the processes or theoretical principles described in the chapter. Some questions are open-ended and designed to encourage students to think about what the ideas mean. Students have found these questions useful in mastering the material and preparing for exams.

Each chapter of *How Humans Evolved* includes one short reading that is relevant to the material in the chapter. These readings are drawn from a diverse set of sources, ranging from technical articles in scientific journals to more popular literature. These readings are meant to broaden the range of material included in the textbook, allowing us to explore certain topics in more detail, and providing readers with a more direct picture of how research is done. The list of references for further reading at the end of each chapter provides a starting point for students who want to delve more deeply into the material covered in that chapter.

Ancillary Materials

For instructors, there is an Instructor's Manual prepared by Elizabeth Erhart of Southwest Texas State University, which includes a detailed outline of each chapter, answers to all of the discussion questions, and a test bank. The test questions are also available on diskette in MS-DOS and Macintosh formats, and will be provided free of charge upon adoption of this textbook. The publisher has also created full-color transparencies of the figures included in the book for instructor use.

Acknowledgments

The new edition benefited greatly from constructive, critical readings by a number of our colleagues, users of the book, and nonusers. We are especially grateful to Tom Plummer, who again provided valuable help with Part III, and to Patricia Wright for extremely helpful comments on the whole of Part II. Beverly Strassman and Daniel Povinelli reviewed new material based on their work. We thank the following reviewers of the book: Andrew Irvine and Douglas Crews for Chapters 1 through 3; Mark Stoneking and Darrell La Lone for Chapters 2 through 4; James Paterson, Thad Bartlett, Marilyn Norconk, and Patricia Wright for Chapters 5 through 7; Margaret Clarke, Sharon Gursky, and Horst Steklis for Chapters 7 through 9; Mark Griffin, Clark Larsen, and Ann Palkovich for Chapters 13 through 15; Joan Stevenson for Chapters 16 through 18; and Lynette Leidy and Rebecca Storey for Chapters 17 through 19. Although we are certain that we have not satisfied all those who read and commented on parts of the book, we found all of the comments to be very helpful as we revised the text.

Richard Klein provided us with many exceptional new drawings of fossils that appear in Part III, an act of generosity that we deeply appreciate. We also give special thanks to Neville Agnew and the Getty Conservation Institute, which granted us permission to use the image of the Laetoli footprints on the cover of the book and allowed us to publish several photographs of the conservation project.

We remain grateful to our colleagues who provided invaluable help with the first edition of the book by reviewing drafts, providing access to unpublished material, and supplying us with information: Part I—Mark Ridley, Alan Rogers, Scott Carroll; Part II—Dorothy Cheney, Robin Dunbar, Lynn Fairbanks, Sandy Harcourt, Joseph Manson, Susan Perry, Robert Seyfarth, Phyllis Lee, and John Mitani; Part III—Leslie Aiello, Glenn Conroy, Richard Klein, Henry McHenry, Steve Pinker, Tom Plummer, Tab Rasmussen, Alan Walker, and Tim White; and Part IV—Monique Borgerhoff Mulder, Martin Daly, Kristin Hawkes, Nancy Levine, Jeff Long, Jocelyn Peccei, Frank Sulloway, Don Symons, and Margo Wilson. We also appreciate the detailed comments provided by several reviewers who read the first edition at the request of our publishers, particularly Barry Bogin, Richard Klein, Eric Smith, Craig Stanford, and several anonymous reviewers.

Many users of the book commented on the quality of the illustrations. For this we must thank the many friends and colleagues who allowed us to use their photographs: Bob Bailey, Nick Blurton Jones, Sue Boinski, Monique Borgerhoff Mulder, Scott Carroll, Marina Cords, Robert Gibson, Peter Grant, Kim Hill, Kevin Hunt, Lynne Isbell, Charles Janson, Nancy Levine, Carlão Limeira, Joe Manson, Bill McGrew, John Mitani, Claudio Nogueira, Susan Perry, Craig Stanford, Karen Strier, Alan Walker, Katherine West, and John Yellen. The National Museums of Kenya kindly allowed us to reprint a number of photographs. In addition, we thank Richard Byrne who provided a new photograph for the second edition.

We also acknowledge the thousands of students and dozens of teaching assistants at UCLA who have used various versions of this material over the years. Student evaluations of the original lecture notes, the first draft of the text, and the first edition have been helpful as we revised and rewrote various sections. Our teaching assistants have helped us to identify many parts of the text that needed to be clarified, corrected, or reconsidered.

We thank all the people at Norton who helped us produce this book, particularly our excellent editor, John Byram. We thank Paul Fyfe for help in coordinating the new readings and obtaining illustrations; Kathryn Talalay for copyediting expertise; and Elizabeth Erhart for preparing the revised Instructor's Manual.

Finally, we would like to thank our family and friends for their contributions to both the first and second editions of this book. They tolerated our preoccupation with the project from its inception and celebrated the delivery of the first edition. We are grateful for their continued support.

P R O L O G U E

Why Study Human Evolution?

> Origin of man now proved—Metaphysics must flourish—He who understand baboon would do more toward metaphysics than Locke.
>
> —CHARLES DARWIN, *M Notebook,* August 1838

In 1838, Charles Darwin discovered the principle of evolution by natural selection and revolutionized our understanding of the living world. Darwin was 28 years old, and it was just two years since he had returned from a five-year voyage around the world as a naturalist on the HMS *Beagle* (Figure 1). Darwin's observations and experiences during the journey had convinced him that biological species change through time and that new species arise by the transformation of existing ones, and he was avidly searching for an explanation of how these processes worked. In late September of the same year, Darwin read Thomas Malthus's *Essay on Population,* in which Malthus (Figure 2) argued that human populations invariably grow until they are limited by starvation, poverty, and death. Darwin realized that Malthus's logic also applied to the natural world, and this intuition inspired the conception of his theory of evolution by natural selection. In the intervening century and a half, Darwin's theory has been augmented by discoveries in genetics and

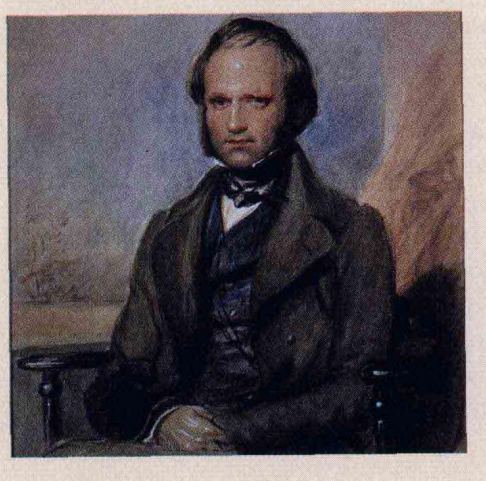

Figure 1

When this portrait of Charles Darwin was painted, he was about 30 years old. He had just returned from his voyage on the HMS *Beagle* and was still busy organizing his notes, drawings, and vast collections of plants and animals.

Figure 2
Thomas Malthus was the author of *Essay on Population,* a book Charles Darwin read in 1838 and that profoundly influenced the development of his theory of evolution by natural selection.

amplified by studies of the evolution of many types of organisms. It is now the foundation of our understanding of life on earth.

This book is about human evolution, and we will spend a lot of time explaining how natural selection and other evolutionary processes have shaped the human species. Before we begin, it is important to consider why you should care about this topic. Many of you will be working through this book as a requirement for an undergraduate class in biological anthropology, and will read the book in order to earn a good grade. As instructors of a class like this ourselves, we approve of this motive. However, there is a much better reason to care about the processes that have shaped human evolution: understanding how humans evolved is the key to understanding why people look and behave the way they do.

The profound implications of evolution for our understanding of humankind were apparent to Darwin from the beginning. We know this today because he kept notebooks in which he recorded his private thoughts about various topics. The quotation that begins this prologue is from the *M Notebook,* begun in July 1838, in which he jotted down his ideas about humans, psychology, and the philosophy of science. In the 19th century, metaphysics involved the study of the human mind. Thus Darwin was saying that, since he believed humans evolved from a creature something like a baboon, it followed that an understanding of the mind of a baboon would contribute more to an understanding of the human mind than would all of the works of the great English philosopher, John Locke.

Darwin's reasoning was simple. Every species on this planet has arisen through the same evolutionary processes. These processes determine why organisms are the way they are by shaping their morphology, physiology, and behavior. The traits that characterize the human species are the result of the same evolutionary processes that created all other species. If we understand these processes, and the conditions under which the human species evolved, then we will have the basis for a scientific understanding of human nature. Trying to comprehend the human mind without an understanding of human evolution is, as Darwin wrote in another notebook that October, "like puzzling at astronomy without mechanics." By this, Darwin meant that his theory of evolution could play the same role in biology and psychology that Isaac Newton's laws of motion had played in astronomy. For thousands of years, stargazers, priests, philosophers, and mathematicians had struggled to understand the motions of the planets without success. Then, in the late 1600s, Newton discovered the laws of mechanics, and showed how all of the

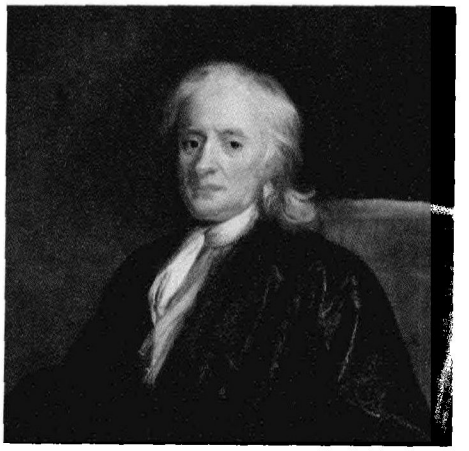

Figure 3
Sir Isaac Newton discovered the laws of celestial mechanics, a body of theory that resolved age-old mysteries about the movements of the planets.

intricacies in the dance of the planets could be explained by the action of a few simple processes (Figure 3).

In the same way, understanding the processes of evolution enables us to account for the stunning sophistication of organic design and the diversity of life, and to understand why people are the way they are. As a consequence, understanding how natural selection and other evolutionary processes shaped the human species is relevant to all of the academic disciplines that are concerned with human beings. This is a vast intellectual domain that includes medicine, psychology, the social sciences, and even the humanities. Beyond academia, understanding our own evolutionary history can help us answer many questions that confront us in everyday life. Some of these questions are relatively trivial. Why do we sweat when hot or nervous? Why do we crave salt, sugar, and fat, even though large amounts of these substances cause disease (Figure 4)? Why are we better marathon runners than mountain climbers? Other questions are more profound. Why do only women nurse their babies? Why do we grow old and eventually die? Why do people look so different around the world? As you shall see, evolutionary theory provides answers or insights about all of these questions. Aging, which eventually leads to death, is an evolved characteristic of humans and most other creatures. Understanding how natural selection shapes the life histories of organisms tells us why we are mortal, why our life span is about 70 years, and why other species live shorter lives. In an age of horrific ethnic conflicts and growing respect for multi-

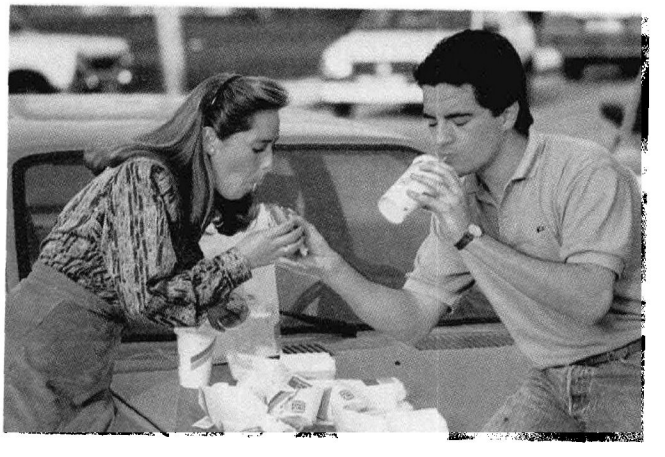

Figure 4
A strong appetite for sugar, fat, and salt may have been adaptive for our ancestors who had little access to sweet, fatty, and salty foods. We have inherited these appetites and have easy access to these foods. As a consequence, many of us suffer from obesity, high blood pressure, diabetes, and heart disease.

cultural diversity, we are constantly reminded of the variation within the human species. Evolutionary analyses tell us that genetic differences between human groups are relatively minor, and that our notions of race and ethnicity are culturally constructed categories, not biological realities.

All of these questions deal with the evolution of the human body. However, understanding evolution is also an important part of our understanding of human behavior and the human mind. The claim that understanding evolution will help us to understand contemporary human behavior is much more controversial than the claim that it will help us to understand how human bodies work. But it should not be. The human brain is an evolved organ of great complexity, just like the endocrine system, the nervous system, and all of the other components of the human body that regulate our behavior. Understanding evolution helps us to understand our minds and behavior because evolutionary processes forged the brain that controls human behavior, just as they forged the brain of the chimpanzee and the salamander.

One of the great debates in Western thought centers on the essence of human nature. One view is that people are basically honest, generous, and cooperative creatures who are corrupted by an immoral economic and social order. The opposing view is that we are fundamentally amoral, egocentric beings whose antisocial impulses are held in check by social pressures. This question turns up everywhere. Some people believe that children are little barbarians who are civilized only through sustained parental effort, while others think that children are gentle beings that are socialized into competitiveness and violence by exposure to negative influences like toy guns and violent TV programs (Figure 5). The same dichotomy underpins much political and economic thought. Economists believe that people are rational and selfish, while other social scientists, particularly anthropologists and sociologists, question and sometimes reject this assumption. We can raise an endless list of interesting questions about human nature. Does the fact that in most societies women rear children and men make war mean that men and women differ in their innate predispositions? Why do men typically find younger women attractive? Why do some people neglect and abuse their children, while others adopt and lovingly raise children who are not their own?

Understanding human evolution does not reveal the answers to all of these questions, or even provide a complete answer to any one of them. However, as

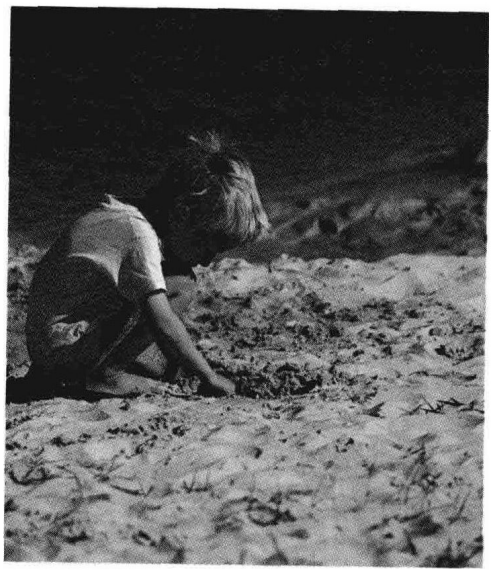

Figure 5

One of the great debates in Western thought focuses on the essential elements of human nature. Are people basically moral beings, corrupted by society? Or fundamentally amoral creatures socialized by cultural conventions, social strictures, and religious beliefs?

we shall see, it can provide useful insights about all of them. An evolutionary approach does not imply that behavior is "genetically determined," or that learning and culture are unimportant. In fact, we will argue that learning and culture play crucial roles in human behavior. Behavioral differences among peoples living in different times and places mainly result from flexible adjustments to different social and environmental conditions. Understanding evolution is useful precisely because it helps us to understand why humans respond in different ways to different conditions.

Overview of the Book

Humans are the product of organic evolution. By this we mean that there is an unbroken chain of descent that connects every living human being to a bipedal, apelike creature that walked through tall grasses of the African savanna 3 million years ago (mya), to a monkeylike animal that clambered through the canopy of great tropical forests covering much of the world 35 mya, and finally to a small, egg-laying, insect-eating mammal that scurried about at night during the age of the dinosaurs, 100 mya. To understand what we are now, you have to understand how this transformation took place. We tell this story in four parts.

Part One: How Evolution Works

More than a century of hard work has given us a good understanding of how evolution works. The transformation of apes into humans involved the assembly of many new, complex adaptations. For example, in order for early humans to walk upright on two legs, there had to be coordinated changes in many parts of their bodies, including their feet, legs, pelvis, backbone, and inner ear. Understanding how natural selection gives rise to such complex structures, and why the genetic system plays a crucial role in this process, are essential for understanding how new species arise. An understanding of these processes also allows us to reconstruct the history of life from the characteristics of contemporary organisms.

Part Two: Primate Behavior and Ecology

In the second part of the book, we consider how evolution has shaped the behavior of nonhuman primates. This helps us to understand human evolution in two ways. First, humans are members of the primate order, and we are more similar to other primates, particularly the great apes, than we are to wolves, raccoons, or other mammals. Studying how primate morphology and behavior are affected by ecological conditions helps us to determine what our ancestors might have been like and how they may have been transformed by natural selection. Second, we study primates because they are an extremely diverse order and are particularly variable in their social behavior. Some are solitary, others live in monogamous pairs, and some live in large groups that contain many adult females and males. Data derived from studies of these species help us to understand how social behavior is molded by natural selection. We can then use these insights to interpret the hominid fossil record and the behavior of contemporary people (Figure 6).

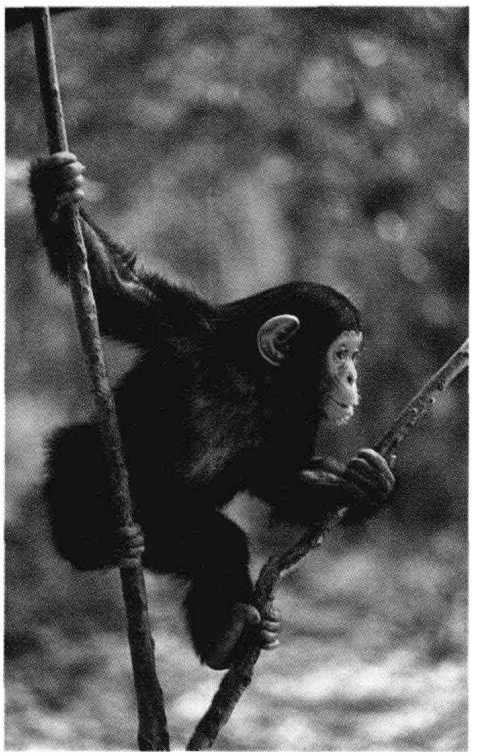

Figure 6
We will draw on information about the behavior of living primates, like this chimpanzee, to understand how behavior is molded by evolutionary processes, to interpret the hominid fossil record, and to draw insights about the behavior of contemporary humans.

Part Three: The History of the Human Lineage

General theoretical principles are not sufficient to understand the history of any lineage, including our own. The transformation of a shrewlike creature into the human species involved many small steps, and each step was affected by specific environmental and biological circumstances. To understand human evolution, we have to reconstruct the actual history of the human lineage and the environmental context in which these events occurred. Much of this history is chronicled in the fossil record. These bits of mineralized bone, painstakingly collected and reassembled by paleontologists, document the sequence of organisms that link early mammals to modern humans. Complementary work by geologists, biologists, and archaeologists allows us to reconstruct the environments in which the human lineage evolved (Figure 7).

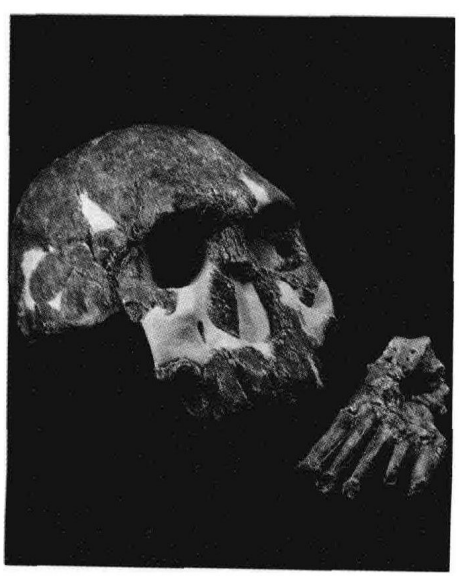

Figure 7
Fossils painstakingly excavated from many sites in Africa, Europe, and Asia provide us with a record of our history as a species. This creature, *Homo habilis*, lived in East Africa about 2 million years ago, walked upright on two legs, made and used stone tools, and had a brain substantially bigger than the brains of contemporary apes. This is the oldest known member of our own genus.

Figure 8
A Bushman pauses to gather berries.

Part Four: Evolution and Modern Humans

Finally, we turn our attention to modern humans and ask why we are the way we are. Why is the human species so variable? How do we acquire our behavior? Why do women undergo menopause? How has evolution shaped human psychology and behavior? How do we choose our mates? Why do we care for some children and neglect others? We will explain how an understanding of evolutionary theory and a knowledge of human evolutionary history provide a basis for addressing questions like these (Figure 8).

The history of the human lineage is a great story, but it is not a simple one. The relevant knowledge is drawn from many disciplines in the natural sciences, such as physics, chemistry, biology, and geology, and from the social sciences, mainly anthropology, psychology, and economics. Learning this material is an ambitious task, but it offers a very satisfying reward. The better you understand the processes that have shaped human evolution and the historical events that took place in the human lineage, the better you will understand how we came to be and why we are the way we are.

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