How Humans Evolved

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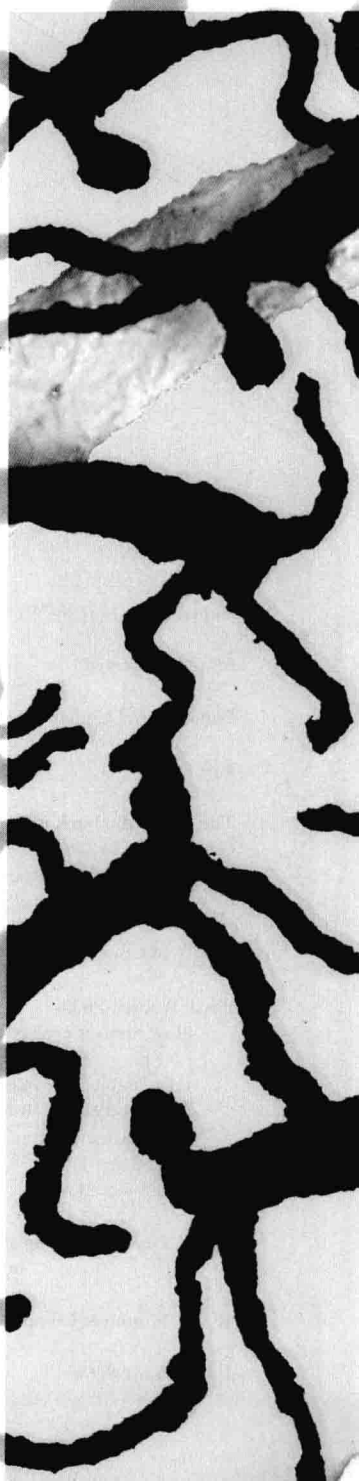

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Preface

This book began as a set of bound lecture notes distributed to students enrolled in the large introductory course on human evolution that we teach at the University of California, Los Angeles (UCLA). We assigned the notes as a substitute for a standard textbook because none of the existing books suited our approach to the course. We think that it is essential for students to understand that studying the processes that shaped human evolution provides us with important insights about ourselves. Other texts deal mainly with the history of the human species as revealed by the fossil record. They concentrate on tracing the human lineage back in time to discover who our ancestors were, when they lived, what they looked like, and how they were related to each other. This knowledge is very valuable, but it is not enough. In order to fully understand the processes that forged our bodies, minds, and behavior, students need to know *how* evolution produces adaptations, creates new species, and shapes behavior. Students also need to understand how this knowledge can be combined with facts gleaned from the fossil record to generate insights about contemporary human behavior. Thus, we were looking for a book that differed from existing textbooks in two fundamental ways. We wanted a book that placed more emphasis on the processes that have shaped human evolution. This 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. We also wanted 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 find a book that confronted these issues openly and clearly.

We distributed the first version of these lecture notes to our students at UCLA in 1986. As we continued to search for a textbook that fit the course, we kept revising our lecture notes. The notes might never have become a "real" book if Alan Rogers and Henry Harpending had not decided to use them in their own courses at the University of Utah and Pennsylvania State University. Their enthusiasm convinced us that it might be useful to publish the lecture notes as a textbook. Had we known how much work stood between the lecture notes and a published textbook, we might never have started. However, ignorance prevailed and we set to work rewriting, expanding, and updating the notes.

In *How Humans Evolved* we retained certain features from the lecture notes that

our students 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. A number of discussion questions appear at the end of each chapter. Some of the questions are meant to help students review factual information presented in the text, and others are intended to help students understand the processes or theoretical principles that are described in the text. Some questions are open-ended and designed to encourage students to think about what the ideas mean. Our students find 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 venues like the *Wall Street Journal*. 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 Joseph Soltis of the University of California, Los Angeles, 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

As we transformed the lecture notes into a textbook, we benefited greatly from the comments and suggestions of many colleagues and friends who encouraged us to write the book, commented upon early drafts, provided access to unpublished material, pointed us to appropriate sources in the literature, and corrected numerous errors. We must first thank Alan and Henry for encouraging us to begin this project. We are also particularly grateful to Kristen Hawkes, Nicholas Blurton Jones, Carol Lauer, Alan Rogers, Vince Sarich, Don Symons, and Russell Tuttle, who read the entire manuscript and provided extensive comments upon the contents.

Part I was improved by the helpful comments of Mark Ridley and Alan Rogers. In addition, Scott Carroll reviewed our description of the behavior of soapberry

bugs in Chapter 3. Part II benefited from the comments of Dorothy Cheney, Robin Dunbar, Lynn Fairbanks, Sandy Harcourt, Joseph Manson, Susan Perry, and Robert Seyfarth. Phyllis Lee and John Mitani generously provided material for Chapter 7. For Part III, we received extremely helpful comments from Henry McHenry, Tom Plummer, and Tab Rasmussen. Tim White commented on Chapters 11 to 13, Alan Walker on Chapters 11 and 13, and Steve Pinker on Chapter 15. Leslie Aiello provided us with several unpublished manuscripts that were helpful in writing Chapters 11 to 14, and Glenn Conroy allowed us to see the unpublished manuscript of his new book. Part IV benefited particularly from the detailed comments of Don Symons and Kristen Hawkes. Jeff Long read and commented on Chapter 16, Jocelyn Peccei directed us through the literature on human menopause for Chapter 17, and Frank Sulloway kindly provided a date for the death of Emma Wedgwood Darwin, a fact omitted from most biographies of her husband; Margo Wilson and Martin Daly read Chapters 18 and 19; Monique Borgerhoff Mulder provided comments on Chapter 19; and Nancy Levine kindly permitted us to cite unpublished data on polyandry in Chapter 19.

We would like to thank the following people for providing us with photographs: Bob Bailey, Nick Blurton Jones, Sue Boinski, Monique Borgerhoff Mulder, Scott Carroll, Marina Cords, Robert Gibson, Peter Grant, Kim Hill, Keven 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.

A number of reviewers also read the book at the request of our publishers, and their responses were very valuable as we revised and rewrote various parts of the book. Among these reviewers were Barry Bogin, Richard Klein, Eric Smith, and Craig Stanford. In addition, there were numerous anonymous reviewers whom we are unable to thank individually. Both those who liked and those who disliked the book made a significant mark on the present version.

We also acknowledge the thousands of students and dozens of teaching assistants at the University of California, Los Angeles, who were exposed to various versions of this material between 1986 and 1996. Student evaluations of the first draft of the book were particularly helpful as we revised and rewrote various sections. Our teaching assistants helped us to identify parts of the text that needed to be clarified, corrected, or reconsidered.

We are also grateful to a number of our colleagues who encouraged us to undertake this endeavor, commiserated with us over its seemingly interminable gestation, and expressed general enthusiasm about the project. Thus, in addition to all those we have mentioned already, we would like to thank the members of our department at UCLA, Robert Aunger, Bob Bailey, Leslie Boggs, Kim Caro, Leda Cosmides, Lorraine Daston, Rob Foley, Sarah Blaffer Hrdy, Lynn Isbell, Tico McNutt, Nadine Peacock, Peter Rodman, Pete Richerson and John Tooby.

William Curtis of Wiley Liss initially encouraged us to write this book. Jim Jordan offered us a contract with W. W. Norton that we couldn't refuse, and was enthusiastic about the project from the outset. His successor at Norton, John Byram, saw the project through the long and laborious process of publication. Rachel Warren and Jessica Elliot have been helpful in many different ways, and Susan

Middleton did a superb job as copyeditor. Monica Olson helped track down references and spot errors and Catherine Ruello located many of the photographs in the text. We thank them all for their hard work on the book's behalf.

Finally, we would like to thank our family and friends whose contributions were as important as the contributions of our colleagues. Bryony and Tim Longden provided hospitality and friendship in Maun, Botswana, as we worked on the final stages of the book. Our family tolerated our preoccupation with the project, and did what they could to help us complete it.

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 the 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*

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.

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 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 appreciate this rationale. 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. This is apparent 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

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.

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 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 have insatiable appetites for 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.

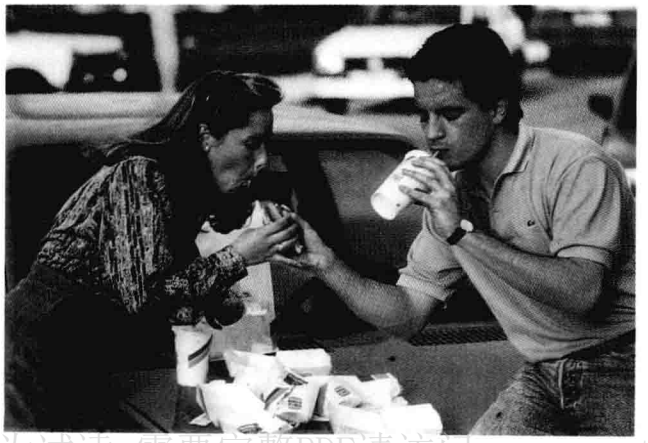


Figure 4
A nearly insatiable appetite for sugar, fat, and salt may have been adaptive for our ancestors who had little access to sweet, fatty, and salty foods. We have inherited these appetites and have easy access to these foods. As a consequence, many of us suffer from obesity, high blood pressure,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

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 multicultural 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

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?

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 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

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.

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.

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).

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.

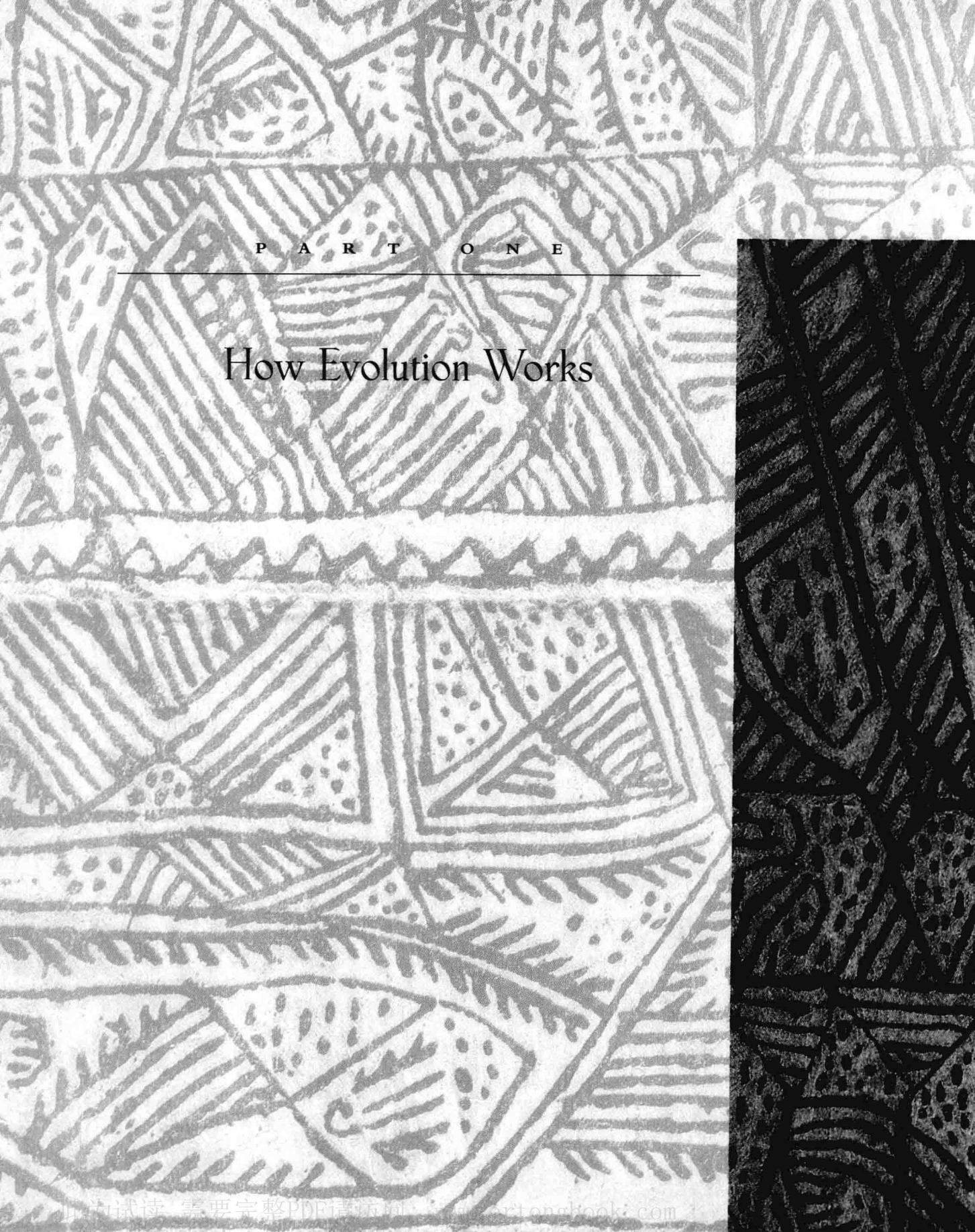
Part Four: Evolution and Modern Humans

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).

Figure 8

A Bushman pauses to gather berries.

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.



PART ONE

How Evolution Works