HUMAN ADAPTIVE STRATEGIES

AN ECOLOGICAL INTRODUCTION TO ANTHROPOLOGY

DANIEL BATES AND JUDITH TUCKER
WITH LUDOMIR LOZNY

FOURTH EDITION

Human Adaptive Strategies

This book introduces students to cultural anthropology with an emphasis on environmental and evolutionary approaches, focusing on how humans adapt to their environment and how the environment shapes culture. It shows how cultures evolve within the context of people's strategies for surviving and thriving in their environments. This approach is widely used among scholars as a cross-disciplinary tool that rewards students with valuable insights into contemporary developments. Drawing on anthropological case studies, the authors address immediate human concerns such as the costs and consequences of human energy requirements, environmental change and degradation, population pressure, social and economic equity, and planned and unplanned change. Impacts of increasingly rapid climatic change on equitable access to resources and issues of human rights are discussed throughout. Towards the end of the book the student is drawn into a challenging thought experiment addressing the possible impacts of climatic warming on Middle America in the year 2040.

All chapters conclude with "Summary," "Key Terms," and "Suggested Readings."

This book is an ideal text for students of introductory anthropology and archaeology, environmental studies, world history, and human and cultural ecology courses.

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An Ecological Introduction to Anthropology

Fourth Edition

Daniel Bates and Judith Tucker with Ludomir Lozny

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Designed cover image: Daniel G. Bates. Dating from Incan times, these salt pans in Peru are individually owned and exploited, but managed jointly as a form of "commons."

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For Marty Nathan M.D. (1951–2021)

Spouse, parent, social activist, and co-researcher with Elliot Fratkin,
founder of Greensboro Justice Fund and the Markham-Nathan Fund for Social Justice

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Preface

This book has been developed in an era of profound change. Every day brings news of people on the move, driven by unprecedented climate events, both natural and man-made disasters, warfare, and dire economic necessity. Obviously, these words could apply to any social science or literary effort at least since the renowned Greek historian and geographer Herodotus of Halicarnassus (d. ca. 430 B.C.), often described as the "father" of these disciplines, was writing about contemporary events in the Persian Empire and beyond. At that time, Greek-speaking peoples dispersed around the Black Sea and Eastern Mediterranean were just one element in a "multinational" global system dominated by the rulers of a far-flung empire. That not all was peace, mutual respect, and cooperation among the peoples of the Persian Empire is clear from the fact that within 100 years of Herodotus' writing, Alexander the Great (d. 323 B.C.) was able to organize a huge and culturally diverse military force that swept the Empire into the history books.

In what ways does our contemporary environment differ from what has gone on before? Why is it relevant to the writing and use of this book? The short answer is "self-awareness." We might, of course, detail the obvious technical developments in warfare, industry, public health, transportation, and agriculture. Still, this would be true at any arbitrary point selected in time over the last 2,000 years. What seems to us to be unique about our present vantage point is a phenomenon that has developed in an evolutionary nano-second—the extraordinary reach of global computer-driven connectivity. Quite simply, anyone on the globe can now access the means not only to interact with an exponential number of other people; they can draw on incalculable billions of stored "conversations" or data troves going back in time. Artificial Intelligence (AI) and Virtual Reality (VR) taken together are a foundational development when combined with smart phones. As with other foundational breakthroughs, nothing will ever be quite the same. Herodotus described the "wild tribes" of the Caucuses as barely human, but his subjects were never able to read his words nor were they able to access knowledge of Greek language and culture to respond with their own denigrating comparisons. Now, if we write about almost any population, however remote, in the Brazilian Amazon or the highlands of New Guinea, they may well have the means to read it and, if they wish, to reciprocate or possibly repudiate the attention.

We are now experiencing a discernable change in global climate that potentially every adult on earth can see unfolding. People can turn to science to explain and better cope with it, or to religion, or to any number of conspiracy theories, but it has become impossible to scientifically refute it. With VR, individuals can create their own reality, communicate it, and invite others to participate in it. They can, of course, simply deny any reality, as is often the case at the onset of a potential terminal illness or a resounding election loss. The outcomes of the global combination of accelerating climate change with the consequences of these little tested new means of communication are, of course, unknowable. But this makes it all the more imperative that we think globally while maintaining our self-awareness; let's say "enlightened self-awareness." As individuals, we are awash in a tide of facts, ideas, suppositions, and pure bullshit. Awareness invites skepticism, which, as current environmental changes are rapidly becoming irreversible, is a vital tool for personal as well as global survival.

"Enlightened self-awareness" is in many respects a very good definition of anthropology as a particular focus within the social sciences. It captures the vanity inherent in studying our own species as one among many others, along with skepticism employing objectivity and empiricism. Empiricism is seemingly straight forward as the recognition, assemblage, and measurement of observable facts. Objectivity is more difficult to achieve, but not impossible when we take due precautions to minimize our anthropocentric and ethnocentric biases. These terms describe a perspective on the world centered on humans generally or as specific groups. These biases evidence themselves in the use of the term "human nature" as, for example, an explanation for the occurrence of warfare or in arguing for the superiority of specific "cultural models." Under scrutiny, appeals to "human nature" as an explanation for behavioral preferences are clearly entirely either devoid of substance or self-serving appeals as justification, such as: "It is only natural to for boys (or men) to fight." Ethnocentrism is also unfortunately easily

stretched to absurdity. So-called White nationalists may say they are defending their "Greco-Roman heritage or civilization" without realizing that almost every distinctive element they claim as their own, be it religious or scientific, has an African (Phoenician, Egyptian) or Middle Eastern origin (Babylonian, Assyrian, Sumerian).

Bearing in mind these cautions, the quest for "enlightened self-awareness" can be a very positive motive for engagement with the academic discipline of anthropology, either as preparation for endeavors in other fields or as a career itself. Our presentation focuses somewhat more than is customary on environmental issues, a reflection of the unprecedented anthropogenic climatic transformation the world currently faces. Of course, we should keep in mind humans are not unique in causing climate change. What we call "the climate" has always been the product as well as the driver of organic life and this includes major shifts in temperature and hydrology. And both terrestrial and extra-terrestrial events can impact earth's climate, such as the 1815 eruption of Mount Tambora in Indonesia, said to cause the "year without a summer," and the asteroid that the dinosaurs so unhappily encountered long before people were on the scene. But even so, ecology or the dynamic interconnections that support life in general also support it in particular: our species, our society, our family.

A central theme of this book is that individuals are active decision makers, continually involved in creating and using their cultural and material environments, however misguided their creations may sometimes be. Faced with new problems and new situations, people will often attempt to find solutions that go beyond traditional cultural solutions or customary behaviors and received prescriptions, so that behavioral innovation, diversity, and variation constantly exist within as well as between societies. Those variations that prove to be advantageous are often passed on to new generations; they become part of the culture. Some ways of doing things that are useful in one context may prove otherwise in other situations. Cultural innovation and transmission of ideas and techniques are processes of continual intergenerational experiment, "filtering," affecting all peoples. In every generation, some, perhaps most, ideas, technologies, social usages, and even modes of speech pass through what might be seen as a filter or screen, but not all. Generally, what is transmitted is what seems to work in a specific context. Processes of innovation, the adoption of new ideas and their transmission to others, lie at the heart of cultural variation and are part of broader ecological and evolutionary processes.

The concept of change most accurately captures what is distinctive about humans. Our brief history on earth is one of unparalleled expansion as the early representatives of our species spilled out of Africa to inhabit virtually every region of the globe. This expansion required altering behavior in all domains to meet the demands of very different habitats—in short, the continual interplay between learned behavior and ever-changing environments. Decisions arrived at by individuals, the adaptive strategies of people and societies, and the evolutionary processes of which these form a part are central themes of this book. Our approach, then, is essentially an ecological and evolutionary one. However, one cannot slight what might be called the ideational or symbolic aspects of social life—ways of behaving and believing that validate our behavior, form our social identities, and satisfy our aesthetic needs. Nor can one ignore the extent to which individual and group behavior is played out in environments in which the most striking features are other people and other groups. This is, of course, true across the evolutionary spectrum, but it is particularly notable for humans.

In this sense, any understanding of human ecology must consider the politics of group life—factors that determine who gets what, how much, and when. Human populations are often socially far more differentiated than are other social animals. We not only engage in division of labor beyond that associated with age and role in sexual reproduction, but we also create systems of perpetuated inequality, such as caste, class, and other types of difference of economic and political access across age and gender lines. Such inequality has major ramifications for the ways in which we interact with our environments. The fact that there are no physical limits on the accumulation of wealth in a market or capitalist economy, for example, has important consequences for the way that natural resources are exploited. And the fact that the nominal "owners" of resources and the means of exploiting them do not necessarily live and work near them has important consequences for other people who do. Thus, local people may be powerless to prevent their central government from granting rights to a foreign company to cut down the forest they live in. The impact of cultural diversity, exchange, and inequality on humans and on the ways that humans interact with environments has grown with time and with changes in human social organization since the earliest *Homo sapiens* developed tool technology in the Paleolithic period. This is reflected in the growing field of political ecology and is a major theme of this book.

Nor can one ignore the pitfalls inherent in the concept of adaptation, which all too easily can be employed to explain everything and hence nothing. The record of human evolution contains much that is due to chance, misadventure, and error. Further, the ecological and evolutionary perspective includes much more than simply the material aspects of life. Religious and political beliefs and practices, even kinship systems, are as much a part of human adaptation as are subsistence strategies and economic practices. Throughout this text, the many topics

customarily treated as basic to an understanding of human society are integrated rather than treated as separate aspects of culture: politics, economics, and religion are closely intertwined in the adaptive process. We hope that this book conveys some of the excitement and controversy that are part of the contemporary sciences of human ecology and behavior.

The book comprises eight chapters. The five central chapters (Chapters 3–7) focus on ethnographic case studies and discussions relating to distinctive forms of human food procurement, settlement, or subsistence: hunting and gathering, horticulture or low-energy farming, pastoralism, intensive agriculture, and industrial society. This organization reflects a very general evolutionary or historical approach, but it is not offered as a rigid typology or simple sequence of stages of development. It is archaeologically verifiable that foraging was the way of life for all *Homo sapiens* until quite recently. And simple faming or horticulture predates by millennia intensive farming supporting large populations. And, of course, industrial farming came only after advanced metallurgy and mechanized ways to store and use energy. This presentation is entirely comfortable with the fact that any specific population may engage in industrial farming but still derive much from wild harvests or gardens. It is a historical fact that ancient Britons adopted farming on a widespread swathe of their lands, but had mostly abandoned it prior to the erection of Stonehenge (ca. 3,000 years ago). Our advanced technology has not separated us from "nature." About 70% of the world's population is still dependent on unprocessed natural substances: firewood for cooking and heating is an important instance, but also the use of marine resources. To state the obvious, every contemporary population uses a variety of ways of securing their livelihood. Our case studies, as organized here, provide a closer look at the anthropological perspective in action; a number illustrate how anthropologists view long-term cultural change, analyze cultural adaptation, and attempt to understand diverse aspects of social behavior. Most make use of archaeological data to provide richer examples and expanded time frames. Populations whose ways of life and livelihood are as diverse as the San people of southern Africa and the farmers of central California are similarly viewed as people responding to and coping, usually successfully, with the problems facing them. What we do emphasize are the costs and rewards of different ways of providing for necessities of life and the relationship of settlement system, mobility, and economic and political organization to other aspects of adaptation. A distinctive feature of all these chapters is that they describe not only different societies but also a wide range of methods and techniques of studying them. This organization is intended to draw the student into interesting ethnographic material and give an insight into methodological concerns. The bulk of the material comes from cultural anthropological sources but is often used here to focus more immediately on ecological issues. Also, frequent reference is made to current events and topical problems. The first two and the final chapters (Chapters 1, 2, and 8) treat general issues related to human ecology and cultural behavior as well as planned and unplanned change.

In Chapter 1, we offer an introduction to general concepts in the study of human social behavior and the concept of culture and an overview of the organization of the book. This edition adds new material to the discussion of culture and gender and expands the discussion of science generally and anthropology specifically. For this reason, we have divided the chapter into two distinct sections to equally emphasize each domain of inquiry. Part One focuses on biological evolution and our evolutionary legacy. Part Two introduces culture and the study of behavior. Taken together, these parts present a concise introduction to general anthropology. Chapter 2 outlines the ecological framework on which subsequent chapters build and provides an extended discussion of evolution, adaptation, politics, decision-making, gender, and behavioral variation. The nature of basic systems of food procurement is introduced, although their developmental histories appear in the subsequent chapters. We explore the developing field of political ecology and stress the central role of gender throughout.

Each of the five case study chapters presents at least two detailed ethnographic cases along with more focused material. Each has boxes presenting relevant detailed or technical material. Students are introduced to basic concepts and methods in the course of learning about particular peoples and places. Together, the text, ethnographic examples, and boxes illustrate topics such as gender, kinship and marriage, economic processes, politics and leadership, social control, religion, and cultural change. The case study material is, we hope, lively, timely, and jargon free; the discussion accompanying it draws attention to important issues, including sources of energy in human society, responding to problems or hazards, aspects of innovation and entrepreneurship, short- and long-term processes of change, and issues of human rights. We hope to showcase anthropological scholarship in action as it addresses important and immediate human concerns, such as the costs and consequences of human energy requirements, environmental degradation, population pressure, social and economic (in)equity in a changing world and planned and unplanned social change.

More specifically, Chapter 3 deals with foraging and has an expanded discussion of reciprocity and social organization in general. Each ethnographic case also deals with efforts of indigenous people to keep or reclaim

their lands. Chapter 4 now looks specifically at horticulture or garden subsistence farming rather than at extensive farming generally. We discuss the early development of farming, using recent material. Along with the Yanamamö, the Pueblo are presented as a largely historical case in which the Eastern and Western groups are compared. There is a detailed discussion of Amazonian groups and their efforts to preserve the integrity of and their access to their lands. Chapter 5, Nomadic Pastoralism, describes a highly specialized land use strategy that in certain respects, namely mobility, resembles hunting and gathering. Pastoralists incorporate movement in their seasonal round of productive activity during which they must exploit great topographic and climate variability. In addition to boxed material describing archaeological research on early pastoralism in Egypt, and the current plight of Bedouin in the Israeli Negev, we present two extensive ethnographic discussions of contemporary pastoralist societies: the Arial of northern Kenya and the Yörük of southeastern Turkey. In Chapter 6, we examine the development of the forms of farming that feed the cities of the world, followed by a more detailed look at peasant household economics, small-scale farmers and change, and increasing inequality. The case of the Tamang of Nepal is updated with recent developments stemming from increasing availability of employment outside the agricultural sector and the country itself. The case of the Mexican village of Cucurpe focusses on land ownership, and the potential impacts of the expansion of mineral mining in the region. The boxed material on the Kofyar of Central Nigeria and changes occurring in rural Egypt provides further context. In Chapter 7, we look at changing demographics and the social and ecological consequences of developments in industrial society and particularly farming. Both the short- and long-term impacts of dams in particular are highlighted. The example of the centralization and subsequent re-privatization of Bulgarian agriculture provides a telling example of individuals' adaptivity to unpredictable government regulations imposed with little consideration of local circumstances. And expanded material on North American agriculture illustrates the rapid changes now underway in response to not only developing technology but also the impacts of increasingly rapid climate changes.

Finally, Chapter 8 deals with planned and unplanned cultural change, development, and the environmental implications of human activities; it concludes with suggestions for risk assessment as we plan for an uncertain future. Starting with a historical overview of the history of the Vikings of Iceland, we proceed to address long-term processes of change. We cover new material on the postindustrial world, "globalism" and the challenges this poses for people struggling to make a living, as well as for those who attempt to assist them in rapidly changing circumstances. A thought experiment dealing with how climate change might affect a middle American city in 2040 invites the reader to consider a wide range of possible scenarios. Readers might be encouraged to apply the effort to the city or place with which they are most familiar. We conclude with a review of the ethical concerns that must accompany and guide development work or applied social science.

In addition to a list of key terms, suggested readings, and illustrations for each chapter, this book contains several features we hope may prove pedagogically useful, including:

- Each case study is presented in a contemporary setting, showing people coping with issues and problems to which the reader can easily relate.
- Each case is tied to larger issues of cultural transformation and change.
- Cases exemplify a variety of research methods and theoretical approaches.
- Each chapter addresses energy requirements, environmental hazards, and special problems faced by the populations under discussion, the development and significance of their adaptive strategy in human history, and the social organizational concomitants.
- Each chapter has boxed inserts that present either recent technical reports in summary form or address specialized topics in greater depth than possible in the text.

Acknowledgments

We undertook this edition of a well-established book using material largely derived from *Human Adaptive Strategies*, third edition, published by Pearson 2004. Since the previous work, much has changed in the intellectual environment not to mention in our physical environment. The three present collaborators are long-time associates editing *Human Ecology: An Interdisciplinary Journal*. The responsibility for the present content rests with Daniel Bates as lead author, and Judith Tucker, who has worked on the earlier editions and on this project from the earliest stages to completion. Ludomir Lozny, an archaeologist who has worked with us at *Human Ecology* for over 20 years, enthusiastically embraced this project as many of the new studies used here come from Human Ecology sources as well as from areas in his own specialization, Old World archaeology.

Foremost, of course, we owe a great debt of gratitude to the scholars who carried out the often difficult and time-consuming research on which this book reports and those who generously agreed to our use of their images (many of which were *Human Ecology* covers), including Claudio Aporta, Shankar Aswani, Michael Barton, Vincent Battesti, Peter Bogucki, Andrzej Boguszewski, Leif Brottem, Jean Clottes, Richard Daly, Tom Dillehay, James Eder, Gary Feinman, Elliot Fratkin, Michael Gurven, William Irons, Michael Little, Lech Lozny, John Metz, Amal Rassam, Philip Reno, Neil Roberts, Brigitta Hauser-Schauldin, Romuald Schild, Marina Temudo, Martina Tyrrell, Bram Tucker, Sandagsuren Undarga, Joe Lamia Vod, and James R. Welch. Special thanks to Stacie A. Shellner for timely logistical assistance. In addition, we thank Jonathan Mazower and Fiona Watson of Survival International and Sander Manse at the Kéré Foundation for their enthusiasm and generosity.

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Finally, we dedicate this book to Marty Nathan, wife of our long-time friend and colleague Elliot Fratkin, whose compassion, skills, and generosity touched so many.

Daniel G. Bates
Judith Tucker
Ludomir Lozny

1 Evolution and the Study of Human Origins and Behavior

This chapter deals with two domains of knowledge that we can safely say are topics basic to any discussion of human "long history," namely, our biological origins and the coevolution of culture. The tools and evidence needed to discuss these require their own, somewhat distinct treatment. To facilitate this presentation, we divide this chapter into two parts, beginning with the Study of Human Origins. Part two is focused on the Science of Cultural Anthropology.

PART ONE: THE STUDY OF HUMAN ORIGINS

It is safe to say that among all forms of life on Earth, humans are unique in only one incontrovertible respect: their capacity for self-reflection and curiosity as to their own origins. Modern humans emerged out of Africa in what might be described as a biological nanosecond. So recently, in fact, that our species has occupied only 1/3,500,000,000,000th of the period of 3.75 billion or so years that there has been life on Earth. The features that we so proudly trumpet as uniquely ours, such as our cognitive and communicative skills, toolmaking dexterity, care and compassion toward others, all on close examination turn out to be to some degree shared with other animals. But one fact that remains distinctively part of our heritage is that no other large animal has evolved so rapidly and spread in such great abundance throughout most of the Earth's land masses.

All the life sciences are concerned with what makes species persist and thrive or as most have done, become extinct, but some, and anthropology in particular, focus more directly on what is responsible for the success of our species, and what we might surmise about our future. The latter issue is an especially difficult question for humans in large part because our past, with respect to our present condition, is too brief to be a reliable guide. The global population is predicted to reach 8 billion in 2024, greater than the number of all who have lived before. As financial disclosures always note, "past performance is no guide to future performance." We might be little more than the equivalent of a blossom of bacteria in a laboratory's petri dish. Certainly, the latest series of global coronavirus pandemics gives pause for thought as does impending climate change.

Still, there is a lot we can learn from past and present human populations. Despite the enormous variety of local problems and hazards that humans must deal with to survive, all the world's peoples are very similar in biological makeup and physique. For the last 30,000 years, since the Neanderthals, a very closely related species—cousins in fact, were absorbed into other coexisting Eurasian populations, anatomically modern humans remain the only human species. Within our species, there are only localized populations with essentially quite minor physical or phenotypical variations. The terms to keep in mind are phenotype, which refers to the physical expression of genetic codes, or genotype. We are all very much alike genetically and behaviorally. Common physical congruities are obvious, but there are also striking behavioral congruities: for instance, the near universality of religious beliefs, moral strictures, and the importance of family and kinship. Fathers in every society take an interest in their offspring quite unlike most males in our living nonhuman primate cousins. What does vary greatly around the world lies in the specifics of human social life, life sustaining procurement strategies and myriad rituals, traditions, and customs. This overall unity combined with localized variability contains clues to both our rapid growth in numbers and global dispersal and may well contain hints as to what will constrain our future. Contemporary anthropology, among the social sciences, takes a global perspective but is not alone in this endeavor: psychology, sociology, human biology and ecology, and cultural geography are closely interrelated disciplines.

These fields, to varying degrees, emphasize the connections between human society and the larger web of life. Only by appreciating the fact that we are subject to the same forces that affect all other living organisms can we come to understand those many aspects of human behavior that distinguish us from other species. And if we more fully appreciate the extraordinary unity and diversity evident in the ways of life of the world's peoples, we may come to a better understanding of our own multicultural society and even ourselves as individuals.

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A perspective on humankind encompassing nonhuman life forms is relatively recent in scientific thought. For millennia, scholars were accustomed to thinking of the world's living things as eternally fixed and unchanging. Although similarities among species were widely noted, these similarities were not thought to represent the outcome of a shared and ongoing process of change—the process we call evolution. Rather, each species was seen as a unique entity with unique and fixed characteristics.

However, by the mid-nineteenth century, the idea of evolutionary change had become respectable in European scholarly circles and soon became familiar to the public, in large part as a result of the tremendous impact of Charles Darwin's *On the Origin of Species by Means of Natural Selection,* published in 1859. Darwin's thesis is that species are related to one another by descent, with modifications, from common ancestors. He postulated that such modifications occur primarily through differential reproduction, or the ability of some members of a species to produce more surviving offspring than others. These favored individuals pass on their traits to the next generation, whereas the less favored do not do so to the same degree. Darwin called this process natural selection and demonstrated that it can change the characteristics of an entire species over time or even give rise to new species.

While Charles Darwin understood that all species of plants and animals tend to produce more offspring than the environment can support, which results in intense competition for living space, resources, and mates, and only a favored few survive long enough to reproduce. He also noted that individual members of a species differ from one another physically, but he had only vague idea of how this could play out in distinct traits. A major weakness of Darwin's theory as originally formulated was that it could not explain how favored characteristics were inherited—and such a systematic explanation was needed. The prevailing belief was that every individual inherited a blend of its parents' characteristics. If true, this implied that advantageous variations would be lost by dilution with less advantageous traits long before natural selection could act on them. It was an obscure Austrian monk named Gregor Mendel (1822–1884), who discovered the hereditary basis of natural selection.

In the garden of his monastery in what is now the Czech Republic, Mendel spent years crossbreeding strains of peas and other plants attempting to find out how traits are transmitted from one generation to the next. He discovered that biological inheritance was not an irreversible blending of parental traits. Rather, individual units of hereditary information, later called genes, were passed from parent to offspring as discrete particles according to certain regular patterns (recessive and dominant traits). In one individual, a gene's effect might be blended with the effects of other genes or even suppressed altogether. But the gene itself remains unchanged, ready to be passed on to the next generation where it might express itself and thus be available for natural selection.

Mendel's work attracted little attention in the scientific community until after both he and Darwin were dead. It was rediscovered in the early 1900s, but its relevance to evolution was not fully appreciated until the next generation. By that time, other apparent discrepancies in Darwin's theory had been resolved, and it was finally accepted that the human species, along with every other species, is a product of evolution. Today, evolutionary theory is at the very heart of all research in the biological and natural sciences. With the recent breakthroughs in modern genetics, population biology, and biochemistry, the utility of the "evolutionary synthesis," as it is now called, is established beyond doubt.

The idea that humans may also be a product of a long sequence of ongoing change received support of a rather startling variety: the discovery of humanlike fossils in association with stone tools. Fossils are the naturally mineralized remains of organic matter—earlier forms of plant and animal life turned to stone and thus preserved—very often lying underground for thousands of years until chance discovery brings them to light. While such finds have been recorded and speculated upon from the eighteenth century onward, it is only relatively recently that they can be accurately dated and related to specific early ancestors. For example, in 2015, Sonia Harmand and colleagues reported on a set of stone tools found in association with clearly hominin fossils at a site in West Turkana, Kenya, which they dated to 3.3 million years ago (Harmand et al. 2015). Many more such tools have been found in southwestern Kenya near Lake Victoria, which further suggests that there the craftsmen were making a wide variety of sharp-edged tools from rock sourced at some distance. These discoveries suggest that early *Homo sapiens* were not the first toolmakers but that toolmaking behavior has an extremely long hominin evolutionary history.

Such discoveries confirm the idea that not only human beings themselves but also societies are the products of evolution—that is, they developed from earlier forms. Over millions of years, the human body and human societies have emerged from earlier human and prehuman forms, through a combination of physical evolution (cumulative changes in biological makeup) and cultural evolution (cumulative changes in thought and behavior). The study of contemporary peoples and their social behavior offered here is closely tied to this view of the world: the evolutionary view. One way to envision the process is to draw on a metaphor suggested by British biologist Richard Dawkins (1995), who likens the development of life on Earth, from its origins as very simple organisms

capable of reproduction to the dazzling complexity of the world today, to an ever-growing and branching river—a "river out of Eden." In this scenario, all past and present living things are "vehicles of information," carriers of DNA, or genes and have the potential, sometimes realized and sometimes not, to replicate themselves, so that the "river out of Eden" is a swirling flow in which genes meet, unite, sometimes compete, and, when separated by branching, give rise to new species.

Central to this view of life is the special property that genes have to use material at hand with which to replicate themselves, including such flaws in copying that might arise. This model with its singular but elegant economy of assumption goes a long way to explain diversity or "ways of making a living" among millions of species. Although each species, not to mention each working organ of each individual seem so evidently "designed" to work or "make a living," all are products of cumulative change. Each variation builds on past developments while using genetic information at hand—a blind process stretching back through geological time. While this blind process inevitably leads to change, it also not infrequently leads to increasing complexity, as changes in one species reverberate through the "ways of making a living" of others on whom they prey or for whom they themselves are prey.

The Human Evolutionary Legacy

Evolution, at its most basic, occurs whenever there is a genetic change in a population, and the evolutionary process is thus a constant as individuals are added through birth or removed through death or migration. While natural selection is one major force acting on the genetic composition of populations, any force that causes the genetic composition of a population to change is evolutionary. For example, spontaneous change or *mutation* adds new genetic material, *genetic drift* alters the composition of a daughter population randomly, such as group migration and colonization of an island by individuals carrying distinctive traits—take the somewhat notorious case of Pitcairn Island settled by British mutineers and their Polynesian consorts. Interbreeding, or gene flow that transfers genetic information among populations, is also a major source of both change and unity in human populations.

There is almost complete scientific agreement that taxonomically speaking (that is, for purposes of classification) our contemporary species, *Homo sapiens sapiens*, is a relatively recent product of evolutionary processes, certainly not much more than 315,000 years old and more likely closer to 100,000 (DeSilva 2021). The most recent find from Morocco (Hublin et al. 2017) suggests that our species may have evolved around 300,000 years ago in different regions of Africa. Even though most fossil remains of our earliest human-like, or hominin, forebears were found in widely scattered locations in Eurasia (none in the Americas), it soon became clear that the first hominins evolved in Africa. While the so-called "Out of Africa" scenario remains valid, very recent DNA and fossil evidence reveals that this development was very complex, involving many different branches of hominins rather than a neat unilinear evolution of one species. Just in Africa, we see a bewildering array of early hominins, collectively termed *australopithecines.* As Chris Stringer of the Natural History Museum in London describes it, we are a "composite" species with no specific center of origin in Africa (New Scientist 2020: 39). African multiregionalism is a major shift in thinking in that our ancestral lineage is not a simple "tree" but rather involves a multitude of closely related "bushes." Genetic studies as well as the fossil record reflect a transition among diverse branches of hominins. It is also clear that modern humans, and presumably ancestral populations, are highly mobile and continually interbreed with neighboring populations.[1] Major changes can occur in what geologists consider rather short periods although by human measures based on life experience almost too slowly to notice. Philip Reno (2017), an anthropologist specializing in biomedical science, notes that when we visit a zoo and peer at our closest living relatives—bonobos, chimpanzees, orangutans, and gorillas—two things captivate us. They look very much like people with their grasping hands and expressive faces. But they clearly are not human: we walk upright, have far larger brains, enjoy a global distribution, and live in uniquely human social groupings—to mention just a few distinguishing traits. While it is often assumed that evolution proceeds with improvements on existing traits and capacities through adding or modifying genes, Reno along with a growing number of other scientists are discovering that major changes can derive from genetic losses: the disappearance of key stretches of DNA (ibid.: 44).

Together with David Kingsley, and other colleagues, Reno compared the DNA of modern humans with that of other mammals and with archaic humans, the Neanderthals and the Denisovans, known from fossils recently discovered in Siberia. Their findings have revealed that while all mammals share a large percentage of genes overall (humans and chimps share 99% of the genome responsible for making protein) there are significant differences in the "switches" that activate proteins to make a brain or bone or hair.

It is not hard to recognize the significance of changes in brain or skeletal development. But Reno became interested in one human feature not much commented upon: the penis. Unlike humans, many mammalian males, including nonhuman primates, rodents, cats, and bats have penis spines of keratin (like fingernails). These may range from simple microscopic cones to large barbs or spikes (ibid.: 47). He notes that the copulation time of spine-sporting primates is very brief: with chimps at less than ten seconds. This change had huge implications for the course of human development: unlike the great apes, human males take a strong interest in their offspring and generally have strong pair bonding, and this increases the overall reproductive rate. Furthermore, strong familial bonding facilitates cultural learning, which is of pivotal significance for the distribution of modern human populations (Figure 1.1).

As we stressed earlier, we are relatively homogeneous in terms of genetic material often termed our genome despite internal variation within every population. In fact, most anthropologists feel it is inappropriate, or at best problematic, to speak of significantly different biological races, as individual differences within large populations are as great as or greater than differences among geographically defined populations.

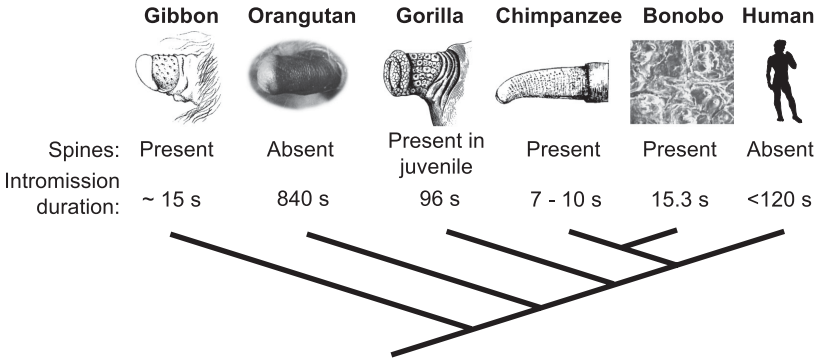

Figure 1.1 The different penis spine patterns in our ape relatives and the associated copulation times. Pleasurable sexual interactions may facilitate long-term bonding. The anatomical loss of another long-established primate trait in the larynx may have facilitated the evolution of human language.

Source: P. Reno.

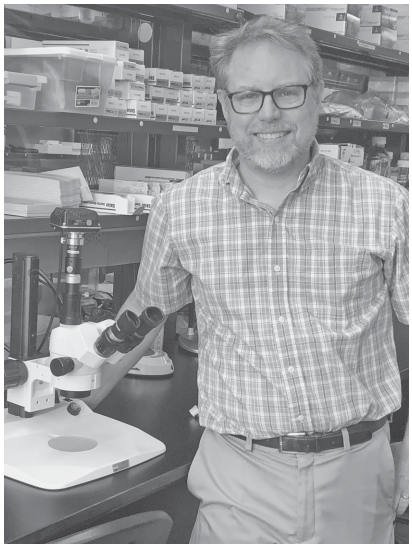

Photo 1.1 Biological anthropologist Philip Reno has a special interest in human evolution. Along with his colleagues, he has identified gene "switches" that activate proteins to make a brain or bone or hair.

Source: P. Reno.

DNA (Deoxyribonucleic Acid) is the chemical name for the molecule that carries genetic instructions in all living things. Mitochondria are important DNA-bearing units lying outside a cell's nucleus that provide the cell with energy and regulate metabolism. Based on their analysis of mitochondrial DNA collected from the placentas of babies born throughout Asia, Africa, Europe, and from Native Americans, Rebecca Cann and her colleagues suggest that all present-day *Homo sapiens* shared a female ancestor who lived in Africa about 188,000 years ago (Cann 1988: 127–143). The significance of mitochondrial DNA lies in the fact that it is passed unchanged through each generation from mother to daughter and thus is unlike the DNA within the cell's nucleus, which undergoes change and replacement during sexual reproduction. Noting that mitochondrial DNA changes slowly and only by mutation, the researchers created a "molecular clock" that they estimated moved at a rate of change of 1% every million years. The fact that mitochondrial DNA in African populations displays much more mutation-induced variability indicates that this population must have been antecedent or ancestral to all other human populations.

Much recent research on DNA includes the mapping of the entire human genome, or the 1.5 million base pair DNA sequences that contain all the information held in the chromosomes that govern how an organism develops. Much of the analysis of DNA has been automated to the extent that any individual with access to the internet can (for a fee) acquire a description of their individual genetic lineage in the form of a chart of where your ancestors most likely originated rather than a family genealogy using names and birth and death dates. Even human chromosomes are now better understood than just a few years ago, and it is possible to trace male lineages, the Y-chromosome marker, in a similar, albeit much simpler and easier manner than that which Cann pioneered. Once again, the "Out of Africa" hypothesis is confirmed. Large-scale migrations of modern humans can similarly be mapped, showing, for example, that modern humans did not move directly into Europe from Africa but passed through parts of Arabia, now desert but at that time better watered, and then through Central Asia to circle back to the Middle East and Europe. Tracing these migrations frequently involves identifying the spread of mutations from a single "founder" through successive generations and migrations among continents (Drayna 2005: 79–85). For example, a mutation affecting the HbS blood gene (or so-called sickle cell gene) has occurred five times (as far as is known) in ancestral populations in Arabia-India, Senegal, Benin-Cameroon, and among Bantu-speakers in south central Africa. Carriers of one of these variants have now dispersed throughout the world. The mutation itself spread because of its ability to confer some protection against malaria despite deleterious effects for some carriers. About 8% of African Americans carry at least one copy of this sickle cell mutation.

An important consequence of genome studies is that what had been assumed to be fundamental genetic differences among species are now understood to be far less significant than had been thought. While it was long recognized that we are closely related to chimpanzees, few could have suspected that our genomes are virtually identical. More surprising, we share 88% of our genes with rodents and 60% with chickens, so the puzzle is what exactly makes us, rather than chimps, human? Clues are provided by studies of identical twins whose DNA is, appropriately, identical. Some twins may develop diseases inherited from his/her parents while their sibling does not, such as childhood diabetes or schizophrenia (Gibbs 2005: 107–113). It is not just an individual's genes that account for this, but also how these genes are regulated and expressed. Gibbs aptly terms this "volume controls for genes" (ibid.: 110). The study of the regulation of gene expression is called epigenetics and has emerged among evolutionary biologists as a window on the interface between nature and nurture—that is, how our genome reacts to our environment. The medical applications are potentially huge, as also are the implications for understanding the rapid appearance in hominins of brain complexity sufficient to produce language. Epigenetic processes, although still little understood, work more rapidly in producing traits that can be passed on to offspring than can natural selection acting on genes alone, which respond to relatively rare mutations.

However, human origins have long been and continue to be the subject of controversy. What is known? While australopithecines flourished from about 3.5 million years, they do not seem to have spread throughout the Old World. *Homo erectus* had a significantly larger cranial capacity and a far larger stature and developed much more elaborate stone hand axes, which, together with the use of fire, enabled them to colonize much of the Pleistocene Old World that was not glaciated. They seem to have flourished in the Caucasus long before the advent of modern humans. Discoveries in Morocco and Ethiopia seem to furnish quite clear proof that anatomically modern humans and Neanderthals originated in Africa, replaced the earlier hominins and spread out to colonize the entire world (Clark et al. 2003; Gibbons 2003; Richter et al. 2017; White et al. 2003). And the last common ancestor of all the early hominin cousins may have walked the earth 800,000 years ago (Stringer cited in Barras 2022).

It must be kept in mind that those features we often use to describe different peoples of the world—skin color, eye color and shape, stature, and hair color and texture—are all the products of very recent and minor adaptations and are continually changing in every human population. A closely related issue is the question of how many of our antecedent hominins lived at any given time. Today, of course, there is only one species of

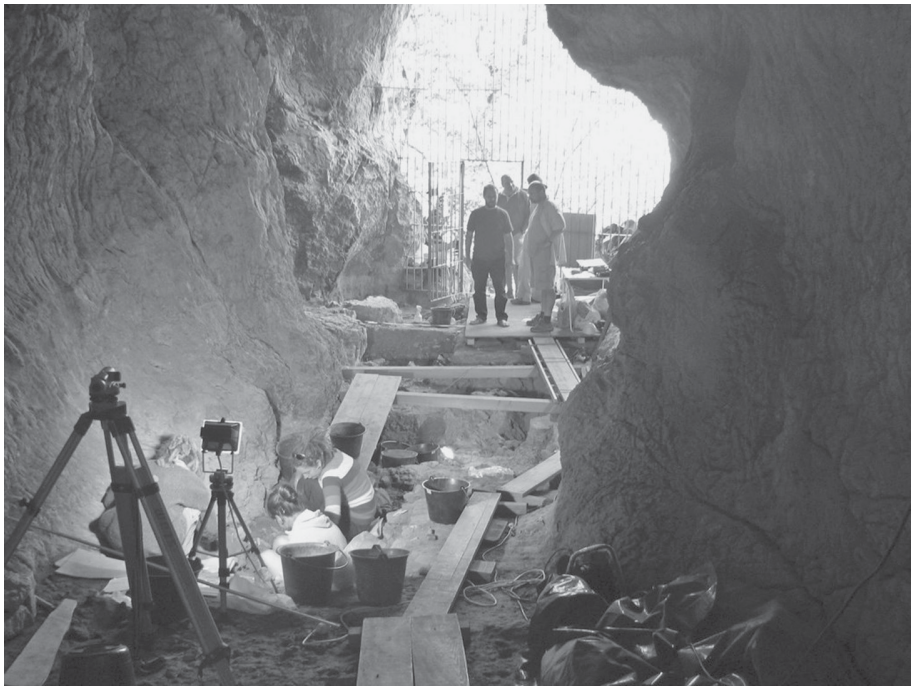

Photo 1.2 Excavations in the Grotte du Noisetier in the Hautes-Pyrénées, Southern France. Beginning in 2004 an interdisciplinary research team made several discoveries related to the Neanderthal Mousterian culture, including three juvenile Neanderthal teeth, the only Neanderthal biological remains found in the Pyrenees.

Source: Ludomir R. Lozny.

hominins—ourselves. But even as recently as 40,000 years ago, Neanderthals, Denisovans, and at least one more "cousin" population known now only from its DNA are likely to have coexisted for a very substantial time with *Homo sapiens*. A skull rediscovered in Harbin, China, nicknamed the Dragon Man, may point to the missing cousin (Barras 2022; DeSilva 2021; Jacops et al. 2019; Krasue et al. 2010; Sykes 2021; Tattersall 2000). The names of fossil strains of human ancestors are of less importance than the story they tell of a common and complex worldwide ancestry. Moreover, there is no such thing as a modern or "more adapted" feature as opposed to some trait supposedly "left behind." *Homo sapiens* facial structure, for example, is far more reminiscent of our very early hominin ancestors than that worn by our fellow primates today.

Thus, for much of our history, there is evidence that "we were not alone" and that at certain periods more than one distinct hominin species coexisted and inter-bred. The minor differences we now see among human beings are the products of behavioral or cultural adaptation. Many anthropologists currently speculate that ultimate dominance of modern hominins was the result of the invention of language, our peculiar mode of symbolic communication that makes possible our mode of reasoning and in turn our behavioral flexibility.

Box 1.1 Neanderthals, Our Undervalued Cousins

One often underestimated ancestral cousin of modern humans, Neanderthals, are the most widely recognized population stemming from the adaptive radiation out of Africa into Eurasia. Very closely related to *Homo sapiens*, Neanderthals occupied a highly diverse environment far greater in area than the Chinese and Roman Empires put together at their maximum distribution, flourishing between 250,000 years and ca. 35,000–40,000 years ago. Of course, it is misleading to compare a biologically defined population's range to the politically integrated entities of the modern world, but with hindsight and the aid of science we now know that western Eurasia was long the homeland of humans distinct in some respects from those in other parts of the world. Neanderthals are recent examples of these populations that extend back to *Homo antecessor*, living in Spain over 800,000 years ago, and *Homo heidelbergensis* across Europe after 450,000 B.C. Check: Clearly

modern humans now found across Eurasia have a challenge if we hope to match the endurance-measured success of our close cousins. Although distinctive in some physical characteristics, these early Europeans were not isolated from the rest of humanity. The ancestors of modern humans co-existed with and interbred with Neanderthals for approximately 90 millennia, perhaps learning from its original inhabitants how to thrive in diverse and often challenging European environments. An interesting find in Portugal at the end of the twentieth century revealed the fossilized remains, dated to about 27,000 years ago, of a boy aged between four and five with both modern human and Neanderthal features—a modern chin but the shorter body proportions of a Neanderthal (Duarte et al. 1999; Zilhão 2000). Paleoanthropologists believe this and other similar skeletal discoveries provide direct evidence of interbreeding between Neanderthals and early humans.

In the fast-evolving scientific field of hominid paleontology, narratives interpreting the prehistoric record can be rapidly outdated by new discoveries. Even for a hominin as well-studied as Neanderthals, the sparse and fragmented nature of the evidence makes writing about the behavior and life ways of these widely dispersed and now extinct human cousins challenging, This is made all the more difficult by the recognition that diverse and evolving cultural traditions across the enormous expanse of time and space the Neanderthals occupied enabled a wide range of localized adaptations that are can only be faintly glimpsed in the archaeological remains. Rebecca Wragg Sykes (2021) demonstrates why the immense temporal and spatial span of occupation is relevant to understanding current human ecology. She shows that contrary to earlier stereotypes the Neanderthals were not specialized biologically or culturally to only living in high altitude or cold weather conditions but thrived in highly diverse environments ranging across deep Alpine forests, sub-tropical climes, temperate seashores, open temperate plains, marshlands, and various habitats in between. Physically, Neanderthals are clearly human but have distinct characteristics typical of a population long endemic to a single geographical region. As Frank Livingston, late of the University of Michigan well known for his work on sickle cell anemia and malaria, liked to say: "A Neanderthal travelling in the NYC subway system would not occasion comment." True enough, we are sure, but their slightly shorter and strikingly strong, robust bodies, and face with little forehead, a distinct bony crown over the eyes, and lack of prominent chin would stand out from most subway riders.

Middle Paleolithic stone technology, sometimes referred as the *Mousterian* by archaeologists, has been closely scrutinized for over a century and a half; what is new is the amount of information that can now be derived from stone and bone. Without going into evidential details, current thinking now finds that a wide range of task-specific stone tools, including microlithic artifacts and compound tools, formerly thought to be *H. sapiens* inventions, such as arrow or spear points, were utilized by Neanderthals. The inventory of game hunted is impressive, reflecting a huge range of habitats, including mammoth, elephant, rhinoceros, bear, diverse large and powerful carnivores, horse, bison, deer as well as small game, birds, and a range of marine creatures. Humans world-wide had become keystone species by the time Neanderthals dominated Europe, and their environmental footprint was clearly significant. Even in mildly temperate climes, Wragg Sykes notes that each adult member of a group would require approximately the skins of 30 "deer-sized" animals per annum. To feed ten individuals for one week, she writes, would require 300,000 calories or the equivalent of three reindeer (141ff). Even this is not the complete nutritional story; in addition, members of the group would require the micronutrients such as fats, vitamins, and minerals. And the number of large prey would have to be doubled to acquire the necessary fat, brains, eyes, tongue, and marrow. Analyses of teeth indicate wear patterns indicative of large quantities of plant consumption or chewing related to processing for the making of cordage or strapping. Even within local groups, evidence points to significant individual variation (161, 192). Dentition analysis shows how individuals tore flesh from bone using their teeth as well as stone or flint. Wragg Sykes also writes that with Neanderthals may show evidence of the emergence of some craft specialists in the knapping of stone, woodwork, complex adhesive production (using bitumen and tree saps) and hide processing to produce leather (135). Fires maintained for warmth and cooking leave their datable presence in caves and shelters.

Any study of a human population, archaic or modern, needs integrated methods of observation and analysis as well as an important reminder of the fragility of any local settlement or system of sustenance. To get a sense of Neanderthal life Wragg Sykes discusses birthing, child-rearing, food procurement and preparation, crafts and material culture, cognitive development, and, of course, death. In each, the reader is drawn into the mechanics of observation and the newest techniques of DNA analysis and dating.

While generally nomadic, like all of humanity prior to farming and cities, it appears that most Neanderthal communities were fairly constrained in the movements, with less evidence of long-distance

sourcing of materials than hunting and gathering *Homo sapiens*. Domestic life to the extent it can be archaeologically recovered involved familial groupings, including care of incapacitated adults living with wounds or illness or reduced mobility and greater fragility associated with age. While an earlier argument for Neanderthal burials (Shanidar, Iraq) has been disputed such burials elsewhere have been carefully excavated. Moreover, there is indirect evidence of mourning for a dead child: a newborn infant's remains were discovered in France almost intact due to being deliberately buried and protected from potential predators. Also, in France, an authenticated male burial has recently been reported. The humans in each instance, and fully human is what the Neanderthals are shown to be, organized their living spaces, working or killing places, their trash, and their dead. Incipient artistic expression is seen in incisions in rocks carved in reoccurring patterns, and one cave site in France has an intriguing arrangement of stalactite-derived large stones situated in a circle. This seemingly indicates ceremonial or religious activities. The complexity of Neanderthal social life Wragg Sykes describes indicates they were linguistically capable, teaching and learning from each other as we do today.

Neanderthal life also had a darker side, with sites that indicate the consumption of conspecifics, or cannibalism. Long bone remains are broken to extract narrow, teeth marks on bones, skulls opened to access brains—all evidenced in antecedent hominins as well as wide-spread among *H. sapiens*. What is not clear is whether the practice was associated with mortuary rites (as is known ethnographically), driven by desperation and starvation, or simply motivated by culinary expediency and inclination. Importantly, however, in all recorded excavations only two unambiguous cases of Neanderthal-on-Neanderthal homicide are evident. Life in Eurasia was hard enough without inter-personal violence; bones from many sites show blunt trauma on their remains. Neanderthals were not just predators but prey as well. In 2021, evidence from a recently excavated cave site located north of Rome found that several adults and one child had been consumed (and possibly killed?) by hyenas (Papagianni and Morse 2018).

The entire genomes of some Neanderthals are now known, and the DNA evidence of interbreeding in the millennia of co-existence with *H. sapiens* is unmistakable. In the case of one Neanderthal jawbone, the owner had an *H. sapiens* ancestor six generations back. While the circumstances in which interbreeding took place remain unclear, the results are not: many people reading this (especially if they have any European ancestry) carry genetic material from these interactions. C. M. Barton presciently describes the end of the Neanderthal era not as a collapse or extinction but "… the result of Late Paleolithic globalization as Neanderthals were absorbed into pan-Eurasian genome and cultural sphere" (Barton et al. 2011: 722).

Moreover, our cousins and "ourselves" co-existed for far longer than what we call modern humans have been "alone." Theirs was not a struggle, as a poetic image might have it "… red in tooth and claw." It was a simple question of relative thriving or rates of reproduction. So, what gave *Homo sapiens sapiens* the edge? Carl Zimmer (2021) describes a newly found mutation or "glitch" in the DNA in the modern human brain that distinguishes our line from that of our now extinct cousins: without increasing the actual size of the brain, it spurred the growth of frontal lobe neurons used in the region of complex thought. While Neanderthals undoubtedly had language, our branch seemingly had a unique edge for communication and planning.

The Nature of Scientific Inquiry

Since our approach is rooted in science and evidence-based perspectives, it is useful at the onset to be clear as to what this means. In 1944, one of the founders of quantum mechanics, Erwin Schrodinger, wrote an influential book entitled *What is Life*. As science writer Jim Holt (2008: 17) paraphrases him:

> Living things are made of matter, Schrodinger observed, yet they seem to violate the laws of physics. One of the most basic of these laws is the second law of thermodynamics, a universal tendency towards disorder. Entropy – a mathematical measure of the disorder present in a system – is always on the rise. Left on their own, things fall apart, run down, become inert; they tend towards an equilibrial state of chaos and dissolution. This is a matter of cruel probability: as we all know from our own domestic lives, there are vastly more ways for things to be disordered than to be ordered, so it is far more likely that things will slip from orderly to disorderly rather than the reverse.

One clear implication of this observation is that all life on our planet is continually in a state of flux or transition. Secondly, stability, organization, and even continuity are simply artifacts of the time frame of the observer. And

Photo 1.3 By 20,000 years ago modern humans were well established worldwide and often displayed their self-awareness in symbolic expression—here late Paleolithic rock carvings near Baku, Azerbaijan.

Source: D. Bates.

thirdly, that all life on earth is bound up in arrangements that depend on our sun, or as Holt (2008: 18–19) somewhat lyrically describes it:

> Terrestrial nature drinks up the sky's orderliness in a beautifully simple way. During the day, the earth gets energy from the sun in the form of photons of visible light. At night, the same amount of energy is dumped back out into space in the form of infrared photons, otherwise known as radiant heat.

Entropy always increases in any system that is cut off from outside influence; every living organism is exchanging with its environment. Energy absorbed and utilized to perform work or to manufacture ordered organic compounds ultimately returns to the cosmos as less ordered energy or disordered waste. Plants on which directly or indirectly all or most terrestrial life depends absorb organic compounds from solar energy through photosynthesis. All life forms exist in an "open system" dependent on external sources of energy. Most descriptions of life forms are simplifications, treating these open systems as analytically closed—a convenience that sometimes unintentionally obscures the long-term dynamics of the phenomena studied. You might, with justification, say that we tend to study open systems with closed minds.

All science is focused on the description and explanation of natural phenomena. The researchers whose work we describe here generally agree that human biology and behavior are best studied as a scientific endeavor. While it is easy to become entangled in debate as to what exactly constitutes science and where its intellectual boundaries lie, it is not difficult to sketch what, in practice, it demands of us and what scientific thinking must avoid. Science, from the Latin *scientia,* is minimally defined as "knowing" or a "state of knowledge" as opposed to ignorance or misunderstanding. In practice, scientific knowledge is rooted in procedures and principles for the systematic pursuit of knowledge through observation and experiment. Emphasis on systematic is the key to understanding scientific method: that is, knowledge is gained not by mere luck, discovery based on religious prophecy, or random, open-ended musings, but through using one's capacity for rational thought and for observation. Science is a cumulative process of questioning received wisdom, of utilizing the observations of others, and seeking answers in the natural world. It also involves a seemingly confrontational mode of thinking achieved not simply through sound reasoning, but reason combined with a powerful skepticism (see, for example, Gabennesch 2006: 36ff). Maintaining a skeptical outlook can be challenging to one's own deeply held beliefs as well as the beliefs and assumptions of others, as is so clearly the case with biological evolution. Skepticism as a component