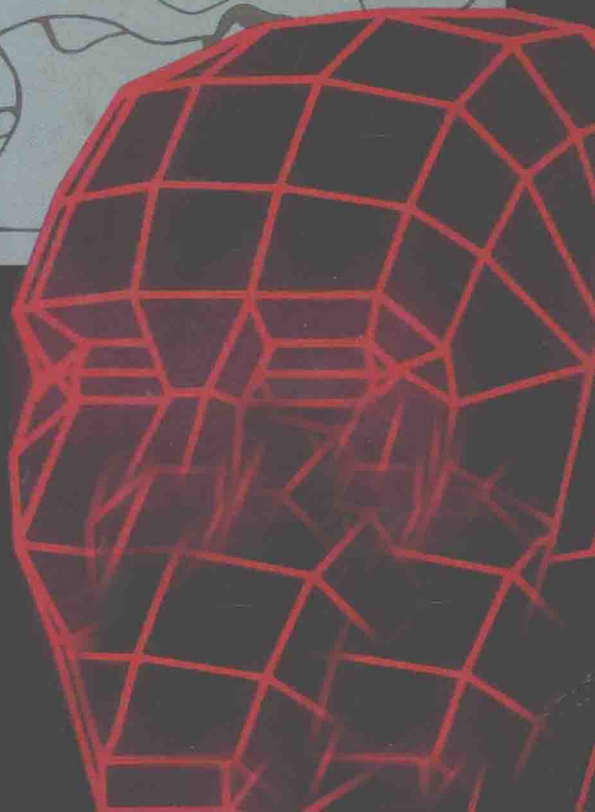
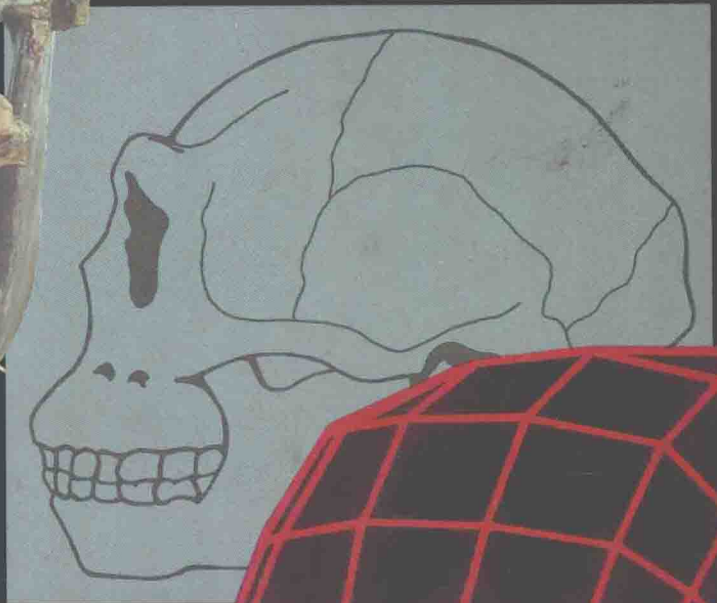


PHYSICAL ANTHROPOLOGY

Philip L. Stein
Bruce M. Rowe



FOURTH EDITION

PHYSICAL ANTHROPOLOGY

FOURTH EDITION

Philip L. Stein
Bruce M. Rowe
Los Angeles Pierce College

McGraw-Hill Publishing Company

New York St. Louis San Francisco Auckland Bogotá Caracas
Hamburg Lisbon London Madrid Mexico Milan
Montreal New Delhi Oklahoma City Paris San Juan
São Paulo Singapore Sydney Tokyo Toronto

See Acknowledgments on pages 496-501.
Copyrights included on this page by reference.

This book was set in Times Roman by the College Composition Unit
in cooperation with York Graphic Services, Inc.
The editors were Judith R. Cornwell and David Dunham;
the production supervisor was Leroy A. Young.
The cover was designed by Caliber Design Planning, Inc.
New drawings were done by J & R Services, Inc.
Arcata Graphics/Halliday was printer and binder.

PHYSICAL ANTHROPOLOGY

Copyright © 1989, 1982, 1978, 1974 by McGraw-Hill, Inc. All rights reserved. Printed in the
United States of America. Except as permitted under the United States Copyright Act of 1976,
no part of this publication may be reproduced or distributed in any form or by any means, or
stored in a data base or retrieval system, without the prior written permission of the publisher.

2 3 4 5 6 7 8 9 0 HAL HAL 9 4 3 2 1 0 9

ISBN 0-07-061165-3

Library of Congress Cataloging-in-Publication Data

Stein, Philip L.

Physical anthropology.

Includes bibliographies and index.

1. Physical anthropology. I. Rowe, Bruce M.

II. Title.

GN60.S72 1989

573

88-13506

ISBN 0-07-061165-3

PHYSICAL ANTHROPOLOGY

**To our families
and in memory of
Eleanor Frances Blumenthal Rowe Michael**

PREFACE

The people of Western cultures have traditionally seen humans as the center of a universe created for humans to occupy, utilize, and control. Recently, however, the mass media's reports of overpopulation, drought and starvation, pollution, and social unrest have made it evident to many that humans are not above and beyond the influence of nature.

We are an integral part of the natural scheme. Our survival, like that of other organisms, depends upon maintaining a balance with the environments that support us. We are dependent upon the natural world, and when we ignore this dependence—by polluting the environment, for example—our survival itself is threatened.

Through its unique viewpoint—the holistic approach—anthropology provides insights into the dynamic interrelationships of the biological, environmental, cultural, and social aspects of human existence. Humans as biological beings cannot be studied apart from humans as cultural and social beings. By examining our biological limitations and potentials, we can gain a fuller understanding of how cultural innovations affect biology and environment. By discovering our relationships to the rest of the animal world and our evolutionary history, we can appreciate more clearly our place in nature and the requirements for persistence.

The subject of anthropology is humankind, an unbelievably complex product of the evolutionary process—organisms that celebrate birth, form complex social bonds, and sometimes consider death to be a transition to a new life. With a large brain and precise hand movements, humans have created, destroyed, and rebuilt monuments to individuals, governments, and gods. Humans also have invented slavery, racial stereotypes, pollution, and wars.

This text is concerned with physical anthropology, the study of the biological nature of humankind. The first two chapters deal with the nature of an-

thropology, particularly physical anthropology, and certain basic philosophical concerns. This is followed by the development of basic concepts necessary for a proper understanding of evolutionary theory. Next, the problems of growth and development, adaptations, and human variation are explored. We then focus on humankind's relationship with the animal world, especially with our closest living relatives, the primates. Through comparative studies of these forms—prosimians, monkeys, and apes—anthropology attempts to reconstruct many aspects of human evolution. Then we take a detailed look at the fossil record, the physical remains of human evolutionary history. The text concludes with a consideration of our evolutionary present and future.

The twentieth century is characterized by a rapid accumulation of new information in areas of scientific investigation. It seems as if a week does not go by without a journal report of some major new data or hypothesis of relevance to physical anthropology. In the past several years new discoveries in the areas of genetics, primatology, and paleoanthropology have had a major impact on our concepts of human evolution and behavior.

As a result of these new data and ideas many changes and additions have been made in the fourth edition of this text. We have updated the genetics material, especially in the area of genetic engineering. Genetic procedures that were the stuff of science fiction when the first edition of this book was published are now science fact. One of these genetic procedures is the production of new life forms. In 1988, the first mammals, mice with altered genetics, were patented. We have described new data on primate behavior and ideas on the classification of primates. The last few years have been an exciting time for paleoanthropologists. Newly found fossils have changed many of our ideas about the relationship of various fossil populations to each other and about the course of human evolution.

In addition to general updating, we have added some new features to this edition. Many boxes scattered throughout the text address controversial issues (such as evolution versus creationism, and genetic engineering), elaborate on text material (such as exercises in population genetics), deal with recent discoveries (as with the "Genetic Recipe for Humankind"), and explore the uses of physical anthropological data (such as "The Anthropologist as Detective"). We have also added end-of-the-chapter Study Questions, which we hope will aid the student in focusing on the important concepts in each chapter.

Workbook in Physical Anthropology has been a supplement to this text since the first edition. For the first time, this workbook has been combined with a study guide. The workbook exercises and the study guide reviews and self-tests will help students remember and understand the terminology and concepts of each chapter of the text.

A book does not develop in a vacuum. We wish to acknowledge those who have counseled, encouraged, and aided us in the tasks of reviewing, typing, and photography. First, we would like to thank the following persons who read all or portions of the manuscripts or aided in their development: Everett and Janet Frost, Mildred Dickeman, Leslie Aiello, Rita Castellano, Glenn A.

Gorelick, Van K. Hainline, Ronald Farrar, Robert L. Pence, Eleanor F. Michael, Arnold L. Freed, M.D., Gail Kennedy, Mary L. Walek, Robert L. Blakely, Karen Kovac, Roland A. Gangloff, Vinson Sutlive, Allen C. Beck, Robert L. Van Burkleo, Philip G. Grant, Douglas R. Givens, Paul E. Simonds, L. Lewis Johnson, Mark E. Harlan, and Mary Jean Livingston. Reviewers for this fourth edition were: Russell L. Ciochon, University of Iowa; Daniel Evett, Ithaca College; Marc Feldesman, Portland State University; Joseph Guillotte III, University of New Orleans; Gail Kennedy, University of California—Los Angeles; Edward E. Myers, Chaffey College; Peter S. Rodman, University of California—Davis; Irwin Rovner, North Carolina State University; J. Richard Shenkel, University of New Orleans; and Tim White, University of California—Berkeley. Second, we would like to pay tribute to the memory of the late Ronald D. Kissack, the editor of the first edition, in deep appreciation of his faith and encouragement. We also wish to thank our editors of the second edition, Lyle Linder and Laura Warner; the editors of the third edition, Marian D. Provenzano and Stephen Wagley; and the editors of the fourth edition, Judith Cornwell and David Dunham; and our production supervisor, Leroy Young. Finally, special thanks go to Rick Freed and Dodie Stoneburner for much of the original photography, to Carol Stein for reading the manuscript and proofreading, to Rebecca Stein for typing and proofreading, and to Christine L. Rowe for proofreading the manuscript and making many valuable suggestions.

Philip L. Stein

Bruce M. Rowe

CONTENTS

PREFACE	xi
1 Investigating the Nature of Humankind	1
THE NATURE OF HUMANKIND	1
WHAT IS ANTHROPOLOGY?	15
Box 1-1 Human Flexibility and Endurance	16
Box 1-2 Making Things Fit	22
2 Prerequisites to the Development of an Evolutionary Theory	24
EARLY VIEWS ON THE ESSENCE OF HUMANS, NATURE, AND TIME	24
THE NATURE OF SCIENCE	26
Box 2-1 Science, Religion, and Political Intrigue—The Trial of Galileo	26
Box 2-2 1860, 1925, 1987—Evolution versus Creationism	34
3 Human Genetics	43
NINETEENTH-CENTURY STUDIES OF HEREDITY	44
THE STUDY OF HUMAN GENETICS	49
Box 3-1 Mendel and the Creative Interpretation of Data	46
Box 3-2 Genetic Disease, Genetic Counseling, and Probability	57
4 Cytogenetics and Molecular Genetics	60
CYTOGENETICS	60
THE MOLECULAR BASIS OF HEREDITY	74
Box 4-1 The Genetic Recipe for Humankind	83
Box 4-2 The Control of Human Biological Evolution	84
5 Population Genetics	91
A MODEL OF POPULATION GENETICS	91

MECHANISMS OF EVOLUTIONARY CHANGE	99
Box 5-1 Population Genetics: Exercises	96
Box 5-2 Assortative Mating in the United States: Race and Religion	109
6 Natural Selection and the Origin of Species	112
NATURAL SELECTION	112
THE ORIGIN OF SPECIES	125
Box 6-1 Kin Selection	124
Box 6-2 The Implications of Sociobiology	126
Box 6-3 Eugenics and the Reduction of Variability	137
7 Human Growth and Development and Human Adjustment to Different Environments	139
THE NATURE OF HUMAN GROWTH AND DEVELOPMENT	139
HUMAN ADAPTABILITY: ADJUSTMENTS	151
Box 7-1 Aging	140
Box 7-2 Advice to Those Traveling to High-Altitude Areas	158
8 Human Adaptations and Human Variability	162
HUMAN VARIABILITY	162
THE CLASSIFICATION OF HUMAN GROUPS	177
Box 8-1 Are the Japanese, on the Average, Smarter than Americans?	187
9 People's Place in Nature	192
TAXONOMY	192
PEOPLE AND THE ANIMAL WORLD	197
Box 9-1 The Living Past	203
Box 9-2 Were Dinosaurs "Warm-Blooded"?	205
10 The Living Primates	211
THE PRIMATE ORDER	211
A SURVEY OF LIVING PRIMATES	217
Box 10-1 Tree Shrews: A Problem of Taxonomy	219
Box 10-2 Vanishing Primates	236
11 Primate Behavior	238
STUDIES OF PRIMATE BEHAVIOR	238
HUMAN BEHAVIOR IN PERSPECTIVE	256
Box 11-1 The Discovery of Toolmaking in Chimpanzees	254
Box 11-2 Intelligence in Nonhuman Primates	271
12 Comparative Anatomy: The Skeleton	275
AN INTRODUCTION TO SKELETAL ANATOMY	276
COMPARATIVE ANATOMY OF LOCOMOTION AND MANIPULATION	285
COMPARATIVE ANATOMY OF THE SKULL	299
Box 12-1 The Anthropologist as Detective	287
Box 12-2 Humans as Erect Biped	297

Box 12-3 The Ultrastructure of Tooth Enamel	305
13 Brains, Embryos, Molecules, and Chromosomes	308
COMPARATIVE ANATOMY OF THE BRAIN	308
COMPARATIVE ONTOGENY	314
MOLECULAR BIOLOGY AND CYTOGENETICS	318
Box 13-1 Hemispheric Asymmetry—One Brain or Two?	311
Box 13-2 Blood Types among the Primates	321
14 The Record of the Past	331
FOSSILS AND THEIR INTERPRETATION	332
GEOLOGIC TIME	342
Box 14-1 What Is a Million?	343
Box 14-2 The Piltdown Skull	346
15 The Early Primate Fossil Record	359
EARLY TERTIARY FOSSIL PRIMATES	360
THE FOSSIL HOMINOIDEA	368
Box 15-1 <i>Gigantopithecus</i>	371
16 <i>Australopithecus</i>	377
THE AUSTRALOPITHECUS FINDS	378
THE MORPHOLOGY OF THE GENUS AUSTRALOPITHECUS	388
Box 16-1 How Old Was the Taung Baby?	379
17 The Early Members of the Genus <i>Homo</i>	396
THE EARLY HOMO FOSSIL RECORD	396
THE CULTURES OF HOMO HABILIS AND HOMO ERECTUS	411
Box 17-1 The Disappearance of the Zhoukoudian Fossils	404
18 <i>Homo Sapiens</i>	422
THE NEANDERTALS	423
HOMO SAPIENS OF THE LATE UPPER PLEISTOCENE	440
Box 18-1 Shanidar I and Paleopathology	443
Box 18-2 Teeth and Tongues: Native American Ancestry	446
19 The Continuing Human Story	457
POST-PLEISTOCENE HOMO SAPIENS	457
WILL THERE BE A NEXT MILLION YEARS?	472
APPLICATION OF ANTHROPOLOGICAL KNOWLEDGE	475
Box 19-1 Additional Problems for Modern People	467
GLOSSARY	478
GLOSSARY OF NAMES OF FOSSIL PRIMATE GENERA AND SPECIES	494
ACKNOWLEDGMENTS	496
INDEX	503

Investigating the Nature of Humankind

It is dangerous to show man too clearly how much he resembles the beast without at the same time showing him his greatness. It is also dangerous to allow him too clear a vision of his greatness without his baseness. It is even more dangerous to leave him in ignorance of both. But it is very profitable to show him both.

Blaise Pascal (1623–1662)

What is it to be human? This question has been satisfactorily answered for some, has puzzled others, and has tormented many. Plato defined people as “bipeds without feathers,” an amusing image but also an early attempt at classifying people as animals. Mark Twain observed, “Man is the only animal that blushes—or needs to.” He recognized the human social consciousness, the ability to be embarrassed. An anonymous author wrote, “Man is the only animal that eats when he is not hungry, drinks when he is not thirsty, and makes love at all seasons.”

Physical anthropology is concerned with two fundamental questions: What is it to be human, and what is the nature of humankind? The attempt to solve these puzzles throws light on the even more intriguing question: What am I?

THE NATURE OF HUMANKIND

Of Termites and People

The investigation of these queries will begin with a comparison and contrast of the behavior of termites and people. Like humans, termites survive through complex patterns of social behavior, but the bases of the human and termite patterns differ.

napoleosis

Termites A motherless world awaits. Emerging from their pupae, termites need no pampering, no tutelage. Nature is complete in preparing various castes of termites with all the equipment and behavior they need to fulfill their respective functions.

No decision has to be made as to who does what. The termites' division of labor is programmed from the start. Once their reproductive organs begin to function, the reproductive castes do nothing but produce new offspring. They do not even feed themselves.

The egg-laying queen attains a volume many times larger than that of her subjects (Figure 1-1). The bulkiness of this egg-laying machine often prevents her from moving under her own



FIGURE 1-1 *Termite colony.* Subterranean termite queen surrounded by workers of various ages.

power. In times of danger, the workers roll their valuable procreator into a royal cell and seal it in order to protect her.

The soldier caste is specialized for the protection of the termite city. The blind, wingless, sterile soldiers cannot even attempt a coup d'état, nor can they desert the citizens for whom they provide protection. Even if their lack of sight and wings did not prevent their escape, the size of their jaws would. These viselike mandibles are more than 500 times as large as those of the other castes; they render the soldiers incapable of feeding themselves.

The reproductive castes and the soldiers are dependent upon the workers for food. Workers, like soldiers, are totally blind and incapable of reproduction. They tunnel to subterra-

nean sources of cellulose and ingest this food. The cellulose is then digested by microscopic organisms that reside in special organs in the termite body. After conversion of the cellulose, the usable nutrients are regurgitated into the mouths of reproductive individuals and soldiers.

When the total population of any caste becomes too large for peak functioning of the community, the workers are programmed through inborn mechanisms to stop feeding the unwanted. Without the adult workers' help, the individuals of the other castes, along with "infant" workers, are doomed. This innate reaction of the workers keeps the population size in balance.

Through their mindless efficiency the termites have done well. They have existed longer, are more widely distributed, and are more numerous than humans. The termites, through inborn mechanisms, have solved the problems of population control and starvation that continue to baffle human societies. The termites' behavior pattern has proved to be one of the many successful modes of survival.

People as Hunter-Gatherers Children born into the San society of South Africa are completely dependent upon their families for food. While they are very young, their mothers' milk is their primary source of nourishment. Later their fathers, uncles, and brothers will supply them with meat; their mothers, aunts, and sisters will supply them with wild plant foods. Not until the children are 5 or 6, perhaps much older, will they contribute to the group's subsistence.

Until they marry, children live in the camps of their parents, learning the rules by which they must live. In order to survive, they must listen well to the elders, who have experienced nature with its rewards and punishments (Figure 1-2).

The children grow and develop. They learn that it is the responsibility of the males to pro-



FIGURE 1-2 *San family.* Human survival depends on the prolonged protection and tutelage of offspring. Family ties can last a lifetime.

vide the camp with meat, and they develop hunting skills by playing games as well as by watching and listening to their fathers and uncles. The boys learn that it will be their responsibility as adults to protect their groups from the wrongdoings of other groups.

The children observe that females are the gatherers. Collecting roots, nuts, berries, stems, and leaves for the day's meal, the women supply the camp with the majority of its food. Their gathering activities account for up to 80 percent of the food by weight.¹ Elizabeth Marshall Thomas describes the actions of San women in the following excerpt:

Dasino, Twikwe, Tsetchwe walked in front, each with a digging-stick thrust in her belt like an enormous knife, each wearing a heavy cape, and Tsetchwe carrying her baby, who rode, carefree

and swinging his feet, on her shoulder....We walked until we came to a patch of tsama melons, perhaps twenty of them lying together, shiny, smooth, and green in the grass....The women stopped and began to gather up the green melons....[Later, after finding evidence of a deeply buried root, Thomas observed the results of Twikwe's labor.] She had made a hole three feet deep, a foot across, and at the bottom, dim in shadow, lay an immense gray root wedged securely between two stones....Again she bent over the hole, leaning over so far that her head came between her knees, and grasped the huge root with both hands. She tugged so hard that I heard her joints crack, but the root was wedged and she couldn't move it....We would leave it.²

The Human Dimension Human life depends on technology. A person stripped of clothes, shelter, tools, and weapons has no chance in

¹ R. B. Lee, "What Hunters Do for a Living, or How to Make Out on Scarce Resources," in R. B. Lee and L. DeVore (eds.), *Man the Hunter* (Chicago: Aldine, 1968), 30–48.

² Elizabeth Marshall Thomas, *The Harmless People* (New York: Knopf, 1958), 103–104, 108–109. Copyright 1958 by Alfred A. Knopf. Used with permission of the publisher.

this world; it is a place in which biological equipment alone is not sufficient for survival. Human beings substitute spears for long canine teeth, fire for fur; they use technological achievements to compensate for the lack of in-born adaptations.

Nevertheless, survival is only a part-time task. Humans take time to ponder the nature of the universe as well as their own nature. They paint pictures and dedicate them to their sacred spirits. Thoughts of awe, understanding, fear, and contentment occupy their minds, and their ideas are transmittable. Thoughts, through language, enter the minds of others, and there they incubate to new heights of development.

Termites are mindless machines; they have no choice of which route they will travel. Nevertheless, they have been extremely successful in their adaptations to a variety of habitats. Humans, on the other hand, are dependent on learned behavior. In fact, the emergence of the human species and its continuance are dependent upon what is called *culture*.

The Culture Concept

Culture is one of those words that everyone uses but almost everyone uses differently. A person may say, "Those people belong to the Art Society; they certainly are cultured." To the anthropologist there is one thing culture is not, and that is a level of sophistication or formal education. Culture is not something that one person has and another does not.

Anthropologists have defined culture in hundreds of ways. Fortunately, most definitions have points in common, and these points are included in our definition. Culture is learned, nonrandom, systematic behavior that is transmitted from person to person and from generation to generation.

Culture Is Learned Culture is learned, not *innate*. Innate means "biologically determined, coded by the hereditary material." When ter-

mites emerge from their pupae, workers, soldiers, and queens crawl away to their respective predetermined tasks. They are innately equipped to brave the hazards of their environment. Humans do not function in this manner. A baby abandoned at birth has *no* chance of surviving by itself. In fact, most 6- or 7-year-olds would probably perish if left to their own resources.

What would we be without culture? There are people without culture who can be observed in back wards of mental institutions.³ They have virtually no mental functions. We refer not to persons with such afflictions as schizophrenia or paranoia, but to those individuals who have virtually no potential to learn. They cannot speak or feed themselves, nor can they be toilet-trained or taught to dress. From one day to the next they do not recognize people they have lived with for years. Without the potential for culture, such a person is an incomplete being, having the body of a person but lacking a functioning mind.

Culture Is Nonrandom, Systematic Behavior

Culture is patterned in two ways. First, culture is nonrandom behavior; that is, specific actions or thoughts are usually the same in particular situations. For example, in Western societies when two people meet, they usually shake hands. A specific behavior pattern, such as shaking hands, in a particular situation, such as two people meeting, is called a *norm*. A norm is the most frequent behavior that the members of a group will show in a given situation.

Second, culture is patterned in the sense that it is systematic; that is, one aspect of behavior is related to all others. Taken together, they form a *system*. A system is a collection of parts that are interrelated so that a change in any one part brings about changes in the others. In ad-

³ C. MacAndrew and R. Edgerton, "The Everyday Life of Institutionalized 'Idiots,'" *Human Organization*, 23 (1964), 312-318.

dition, a group's cultural traditions and the way in which they relate to each other reflect certain underlying principles about the basic characteristics of people and nature.

Culture Is Transmittable Culture is transmittable; it spreads. You can teach Fido to respond to his name and other verbal commands, but this "vocabulary" is not going to be used to discuss world problems with other dogs on the block. The dog has certainly learned something, but it has learned it as a result of a reward which was given in response to a stimulus. It is our assumption that no great mental processes, no interpretations, were involved. With humans, on the other hand, information is learned, stored in the cortex of the brain, interpreted, and then transmitted to other people. The person doing the transmitting may accomplish it directly or, for that matter, may even bring it about indirectly after death. A dead person's ideas and accomplishments are passed on through those who knew the person or through written records and other documentation. This process continues, so that knowledge builds on information from past generations. In societies with writing, each generation can continue to influence future generations indefinitely. A particular culture is the result, therefore, of its history as well as its present state. Although there is now evidence that certain nonhuman animals also possess some ability to pass on acquired behavior (Chapter 11),⁴ none have developed this ability to the same degree as humans.

Two Aspects of Culture There are two aspects of the cultural phenomenon. First, culture is an *extrasomatic* adaptation to an environment. Nonhuman animals usually adapt to their environments through changes in their *somatic* form. Somatic means "bodily," so a somatic

change would be an alteration in the body. An extrasomatic change, therefore, would be a change in *behavior*.

Of course, somatic changes have been important in human evolution, and they partially account for why we no longer look like our distant ancestors. However, more than the human body evolved. The mind also developed to a point at which it is sometimes able to substitute cultural innovation for biological alteration. If you were to transplant a group of temperate-zone nonhuman animals to an arctic environment, they might all die. On the other hand, those that were somewhat different from the average, possibly by having more fur, might survive. But if you put people into the same environment, they might build an igloo, start a fire, or even kill a polar bear to make a coat.

The human biological potential for culture allows people to adjust to environments through culture as well as biology (see Box 1-1). This is one reason that the human species is so widely dispersed on earth. Humans have climbed to the top of the highest mountains with the aid of bottled oxygen and other supplies; they have descended to the deepest parts of the ocean by using bathyspheres; they have occupied every climatic zone by using appropriate clothing, shelter, and temperature-controlling devices. These types of adjustments have allowed humans the flexibility to challenge environments that would otherwise be unlivable. For example, humans, who like other animals need air to breathe, food to eat, and water to drink, can rocket into an airless, foodless, waterless environment. Permanent colonies in outer space appear to be a possibility of the not too distant future. Somatic features do not need to change to accomplish this. Instead, biological potential responds to the desires of a conquering mind.

Culture is a means of adaptation, but the phenomenon's second aspect is that a *particular* culture is also an environment. Examine the area in which you are reading this book. If it is your room, you may be surrounded by cur-

⁴ Topics to be developed later are indicated by parenthetical references to subsequent chapters.

BOX 1-1

HUMAN FLEXIBILITY AND ENDURANCE

One culture allows plural wives while another strictly prohibits such practices. One culture's economy is based on animal husbandry while another is based on a one plant crop economy. Cultures differ in their economic, political, religious, marital, and other sociocultural systems. This behavioral flexibility allows humans to adapt to virtually any environment. On the other hand, other species have very specific requirements for survival. Their survival mechanisms are fixed by biology; changes in their environment can mean extinction. Humans have invented aqua lungs, space ships, igloos, air conditioners, and appropriate clothing which allow them to move into environments for which they are not biologically adapted. The adjustments that humans make are primarily cultural.

In addition to flexibility or adaptability, individuals as well as cultures also display what might be called cultural endurance. If a problem cannot be solved immediately, an individual might devote his or her life to the problem. And if a life time is not enough, the next generation might take up the challenge. This determination is how many cures for diseases and the whole range of

technological advances often occur. No such persistence can be found anywhere else in the animal kingdom.

Unfortunately, humans have not been as successful at solving social problems as technological ones. Critical problems dealing with poverty, inhumane treatment of minorities, and the possibilities of nuclear war remain unsolved. The cultural flexibility and endurance of the human species is being tested like it never has before (Chapter 19).

Human cultural endurance and flexibility is paired with human physical endurance and flexibility. For instance, a human in excellent physical shape can run or walk much longer without resting than many other animals. This is partially due to an excellent physiological system for cooling down and regulating the body during long periods of physical stress (Chapter 9). Humans also have a flexible skeleton, which allows them to run, walk, jump, swing, hop, skip, swim, climb, and go through a whole range of movements. Although individual nonhuman species may have greater abilities in each of these activities, humans are the best "all-rounders."

Reference: A. Smith, *The Body* (New York: Viking, 1986). See pages 298–308 for a general discussion of human physical abilities.

tains, glass windows, plaster walls, light fixtures, and so on, all of which are cultural innovations. Even if you are reading outdoors, the bench you are sitting on, the buildings around you, and the smog in the air are all parts of the cultural environment. Even the grass and trees, if transplanted or sown by humans, are where they are because learned behavior allowed them to be put there. In either case, the room or the courtyard, your surroundings are basically made by human hands. In the room you may not even be able to hear or see or smell the natural environment.

The Relationship of Brain to Mind

The human mind consists of internalized cultural elements organized into an original per-

sonality. The mind has the potential to combine these elements into unique configurations that allow for the creativity and innovational ability of human thought.

The formation and development of the mind depend on the brain, specifically the *cerebral cortex*. The cerebral cortex is the part of the brain in which complex thought takes place and in which the highly efficient communication system, language, resides. Through the use of the symbolic logic of language and other appropriate mechanisms, such as memory and mental images, things are thought about that are not directly present or obvious (Chapter 11).

The brain is responsible for *all* levels of behavior beyond reflexes. One of these levels is *awareness*. Nonhumans may have a limited sense of self-awareness, as illustrated by the