CHAPTER

1

BIOLOGICAL ANTHROPOLOGY

Anthropologists study spiders, right?
—Anonymous Caller

If you asked twenty people to define anthropology, you would probably get twenty different answers. Anthropology is such a broad field that many people, understandably, are not sure just what an anthropologist studies. People have brought me rocks to identify and have asked me about the accuracy of the dinosaurs in *Jurassic Park*. One man even called me for information on black widow spiders—and he was referred to me by someone within the university where I teach.

In this chapter, we will define anthropology in general and then focus on the subfield of biological anthropology (also called *bioanthropology* or *physical anthropology*). Because fieldwork—where anthropologists make their observations and collect their data—is perhaps the best-known aspect of anthropology and is the part that attracts many students to the discipline, I will begin with a brief description of two of my fieldwork experiences.

As you read, consider the following questions:

What is anthropology, and what are its subfields?

What is biological anthropology?

How does the scientific method operate?

In what way is bioanthropology a science?

What are belief systems, and what is their relationship to scientific knowledge?

IN THE FIELD: DOING BIOLOGICAL ANTHROPOLOGY

The wheat fields on either side of the long, straight road in western Saskatchewan, Canada, stretched as far as the eye could see. I found myself wishing, on that June day in 1973, that the road went on just as far. I was on my way to visit with my first real anthropological subjects, a colony of people belonging to a 475-year-old religious denomination called the Hutterian Brethren, or Hutterites.

Up to this point, I had not felt much anxiety about the visit. Accounts by other anthropologists of their contacts with Amazon jungle warriors and New Guinea headhunters made my situation seem rather safe. The Hutterites are, after all, people who share my European American cultural heritage, speak English (among other languages), and practice a form of Christianity that emphasizes pacifism and tolerance.

At this point, though, those considerations, no matter how reassuring they should have been, didn't help. Nor did the fact that I was accompanied by the wife of a local wheat farmer who was well known and liked by the people of this colony. I simply had that unnamed fear that affects nearly all anthropologists under these first-contact circumstances.

Finally, the road we traveled—which had turned from blacktop to dirt about 10 miles back—curved abruptly to the right and crested a hill. I saw below us, at the literal end of the road, a neat collection of twenty or so white buildings surrounded by acres of cultivated fields. This was the Hutterite colony, or *Bruderhof,* the "place where the brethren live" (Figure 1.1).

As we drove into the colony, not a soul was in sight. My companion explained that it was a religious holiday that required all but essential work to cease. Everyone was indoors observing the holiday, but the colony minister and colony boss had agreed to see me.

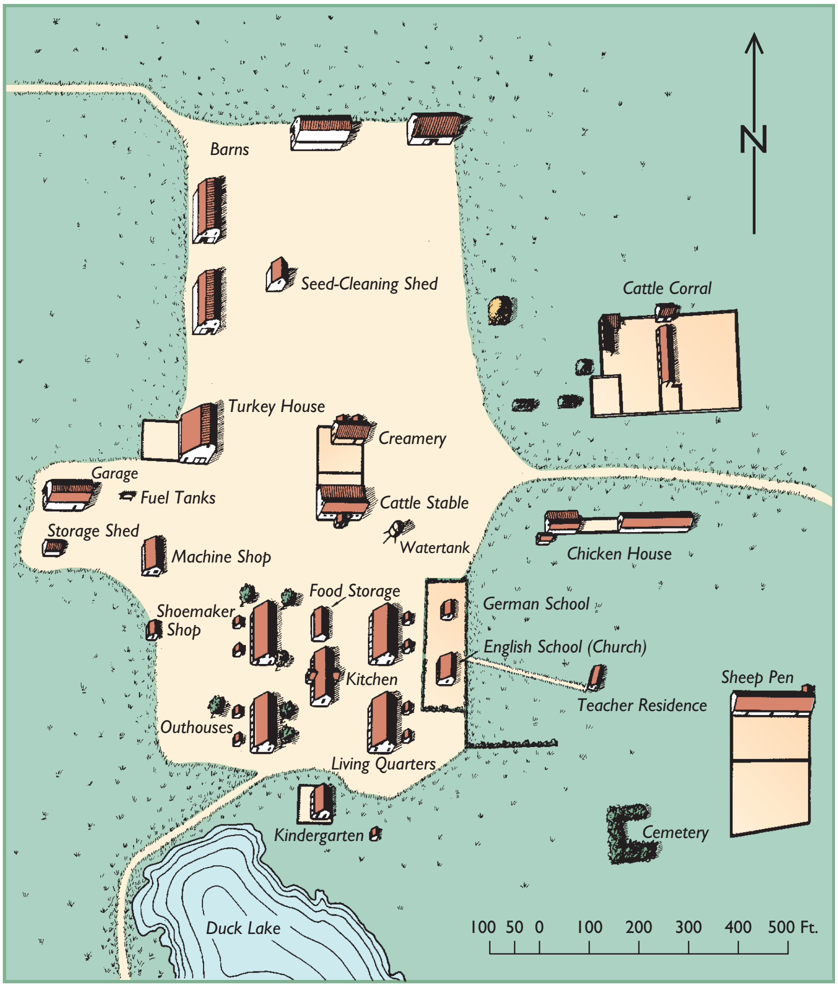

FIGURE 1.1
Diagram of a typical Hutterite colony. The variety of buildings and their functions are indicative of the Hutterites' attempt to keep their colonies self-sufficient and separate from the outside world.

FIGURE 1.2
Hutterite women in typical dress.

We entered one of the smaller buildings, which I recognized from pictures and diagrams of "typical" colonies as one of the residential buildings. The interior was darkened in keeping with the holiday. A few minutes later, having gotten my bearings, I explained the reason for my visit to two men and a woman.

The men were dressed in the Hutterite fashion—black trousers and coats and white shirts—and they wore beards, a sign of marriage. The older, gray-haired man was the colony minister. The younger man, who happened to be his son, was the colony boss. The woman, the minister's wife, also dressed in the conservative style of the Hutterites and related groups. She wore a nearly full-length sleeveless dress with a white blouse underneath. Her head was covered by a polka-dot kerchief, or *shawl,* as they call it (Figure 1.2).

My contacts, the wheat farmer and his wife, had arranged the visit and had already given the Hutterites an idea of what I wanted to do. But if the

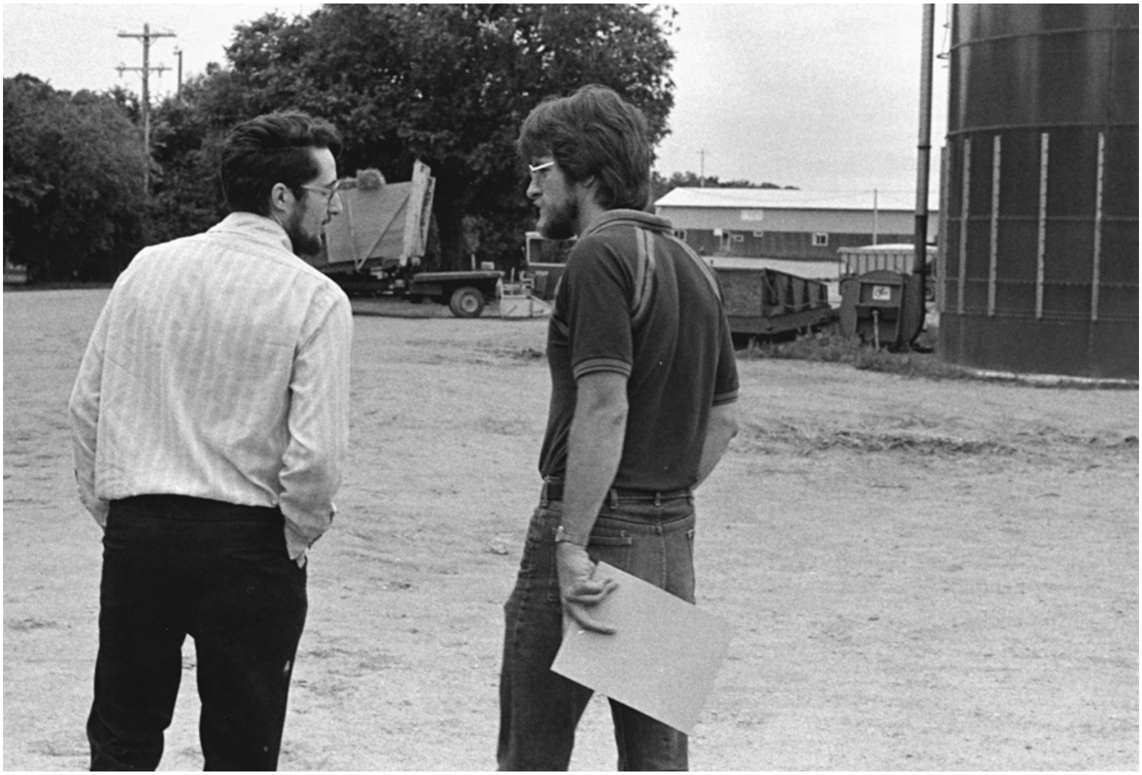

FIGURE 1.3
Author (*right*) and Hutterite informant. I already had the beard, but it was suggested that I keep it so that I would look more familiar to the Hutterite children.

colony members didn't like me or my planned study, they could still decline to cooperate. The three listened in silence as I went through my well-rehearsed explanation. When I had finished, they asked me only a few questions. Was I from the government? (My study involved using fingerprints as hereditary traits, and they apparently associated fingerprinting with law enforcement and personal identification.) Did I know Scripture? (My equivocal answer created no problem.) What would I use this study for? Was I going to write a book? Did I know so-and-so, who had been there two years ago and done medical examinations?

I expected them to confer with one another or ask me to come back when they had decided if they would allow me to conduct the study. Instead, the minister, who was clearly in charge, simply said, "Today is a holiday for us. Can you start tomorrow?"

And so, for the next month I took part in my personal version of fieldwork—taking fingerprints, recording family relationships, observing colony life, and getting to know the Hutterites of this and one other Canadian Bruderhof (Park 1979; Figure 1.3).

What exactly had brought me 1,300 miles from my university to the northern plains, to this isolated community of people whose way of life has changed little over the past 475 years and whose lifestyle and philosophy differ so much from those of North Americans in general? Essentially, it was the same thing that takes anthropologists to such locations as the highlands of New Guinea, the caves of the Pyrenees, and the street corners of New York City: the desire to learn something about the nature of the human species.

In my case, I was pursuing an interest I had developed early in graduate school—to study the processes of evolution and how they affect humans. I was curious about two of these processes: gene flow and genetic drift (see Chapter 4 for details). Both topics had been described half a century earlier, but their workings and importance, especially with regard to living human populations, were still poorly understood.

To examine the actions of these processes on human populations and to determine their roles in human evolution, I needed to find a human group with a few special characteristics. The group had to (1) be genetically isolated, (2) be fairly small as a whole but with large families, and (3) consist of individual populations that resulted from the splitting of earlier populations.

The Hutterites exhibited all these characteristics. (I'll elaborate later.) I discovered them through library research on genetically isolated groups. My opportunity to study them was greatly enhanced by a stroke of luck. A fellow graduate student was the daughter of the wheat farmer and his wife who became my "public relations advisors."

Exactly twenty years after my fieldwork with the Hutterites, I found myself standing over an open grave in an old cemetery in the wooded hills of northwest Connecticut. Our team of anthropologists was hoping to find the remains of a native Hawaiian who had been buried here in 1818 and who was now, after 175 years, going home.

A few weeks earlier, Nick Bellantoni, the Connecticut State Archaeologist (and a former student of mine), had called me with a fascinating story. In 1808 a young Hawaiian named Opukahaia (pronounced *oh-poo-kah-hah-ee,'-ah*) escaped the tribal warfare that had killed his family by swimming out to a Yankee whaling vessel, where he was taken on board as a cabin boy. Two years (and many adventures) later, he ended up at Yale University in New Haven, Connecticut. He took the name Henry, converted to Christianity, and became a Congregational minister who helped build a missionary school in Cornwall, Connecticut. His dream was to return to Hawaii and to take his new faith to the people there (see his portrait in Figure 1.6).

FIGURE 1.4
Headstone of Henry Opukahaia.

Sadly, Henry's dream was never realized. He died in a typhoid epidemic in 1818 at the age of 26, but his vision inspired the missionary movement that was to change the history of the Hawaiian Islands forever. His grave in Cornwall became a shrine both for the people of his adopted land and for visiting Hawaiians, who would leave offerings atop his platform-style headstone (Figure 1.4).

Nearly two centuries after his death, a living relative of Henry's had a dream that she would honor Henry's final wish to return to his native land. After almost a year of raising funds and making the necessary arrangements, her dream was to come true. And this is where anthropology comes in.

Old New England cemeteries tended to be inexact in the placement of headstones relative to the bodies buried beneath them, and the acidic New England soil is unkind to organic remains. Both logically and legally, this was a job for the state archaeologist, and Nick wanted my help in recovering and identifying whatever remains we might be lucky enough to find. He also wanted my help, it turned out, in moving several tons of stone.

Henry's tomb had been carefully and lovingly assembled by the people of Cornwall. They had placed the inscribed headstone on a pedestal of

FIGURE 1.5
Nick Bellantoni excavating the grave of Henry Opukahaia. The pattern on the floor of the excavation marks the coffin outline.

fieldstone and mortar. We dismantled this with care, labeling each stone and diagramming its position, since it was to be rebuilt in Hawaii by a stonemason. Under the pedestal and going down about 3 feet into the ground, we uncovered three more layers of fieldstone, which acted as a foundation for the monument and protection for the coffin and the remains we hoped were still below. When all the stones had been removed and we were into a layer of sandy soil, Nick worked alone, delicately scraping away the dirt inch by inch (Figure 1.5).

Late on the second day of our excavation, the remnants of the coffin came into view. In fact, the wooden coffin itself had long since decayed. All that was left was the dark stain of its outline in the soil. We began to despair of finding much else, but an hour later Nick's trowel grazed something hard, and in a few minutes the apparent remains of Henry Opukahaia saw the light of day for the first time in 175 years.

We soon learned that the skeleton was virtually complete. But was it *Henry*? As Nick slowly freed each bone from the soil and handed it up to me (see chapter-opener photograph), we recorded it and compared it with

FIGURE 1.6
Reverend David Hirano, from Hawaii, speaks over the remains of Henry Opukahaia at his "homegoing" celebration in Cornwall, Connecticut. The *koa*-wood coffin, *ti* leaves, and flowered *lei* all have symbolic meaning in Hawaiian culture.

what we knew of Henry from written descriptions and a single portrait. The skeleton was clearly that of a male and, at first glance, conformed to that of a person in his late 20s of about the right size. Henry had been described as being "a little under 6 feet," and the long bones of the arms and legs appeared to be just a bit shorter than mine (I'm 6 feet 1 inch), though much more robust. The skull, however, confirmed our identification. As the dirt was brushed away, the face of Henry Opukahaia emerged, the very image of his portrait. (The family has requested that, for religious reasons, photographs of Henry's remains not be published.)

We spent two more days with the bones, this time in the garage of a Hartford funeral home. We cleaned, photographed, measured, and described each bone. Finally, we placed each bone in its proper anatomical position in spaces cut into heavy foam rubber that lined the bottom of a *koa*-wood coffin, specially made and shipped from Hawaii. The following Sunday, we attended a memorial service in Cornwall, and then Henry's remains began their long journey back home (Figure 1.6).

WHAT IS BIOLOGICAL ANTHROPOLOGY?

My experiences as a biological anthropologist range from examining the esoteric detail of evolutionary theory to using my knowledge of the human skeleton for a very personal endeavor. These are just two examples of the many things that biological anthropologists do.

Biological anthropology (or **bioanthropology** or **physical anthropology**) needs to be defined within the context of anthropology as a whole, and doing this is both simple and complex. **Anthropology,** in general, is defined as the study of the human species. Simply put, anthropologists study the human species as any zoologist would study an animal **species.** We look into every aspect of the biology of our subject—genetics, anatomy, physiology, behavior, environment, adaptations, and evolutionary history—stressing the interrelationships among these aspects.

This kind of approach—examining a subject by focusing on the interrelationships among its parts—is called **holistic.** The holistic approach is the hallmark of anthropology. We understand that all the facets of our species—our biology, our behavior, our past, and our present—interact to make us what we are. But some topics are so complex that they need to be studied separately—just as you may be taking courses in history, economics, psychology, art, anatomy, and so on. What anthropologists do, though, is seek the connections among these subjects, for in real life they are not absolutely separate.

But here's where it gets complicated. The most characteristic feature of our species' behavior is **culture,** and cultural behavior is not programmed in our genes, as is, for example, much of the behavior of birds and virtually all of the behavior of ants. Human culture is learned. We have a biological potential for cultural behavior in general, but exactly *how* we behave comes to us through all our experiences. Take language, for example. All humans are born with the ability to learn a language, but it is the language spoken by our respective families and our broader cultures that determines what language we will speak.

Moreover, cultural knowledge involves not just specific facts but also ideas, concepts, generalizations, and abstractions. For example, you were able to speak your native language fairly fluently before you were ever formally taught the particulars of its grammar. You did this by making your own generalizations from the raw data you heard and the rules they followed, that is, from the speech of others and from trying to make yourself understood. Even now when you speak, you are applying those generalizations to new situations. And each situation—every conversation you have, every essay you write, every book you read—is a new situation.

biological anthropology A subfield of anthropology that studies humans as a biocultural species.

bioanthropology Another name for biological anthropology.

physical anthropology The traditional name for biological anthropology.

anthropology The holistic study of the human species.

species A group of organisms that can produce fertile offspring among themselves but not with members of other groups.

holistic Assuming an interrelationship among the parts of a subject.

culture Ideas and behaviors that are learned and shared. Nonbiological means of adaptation.

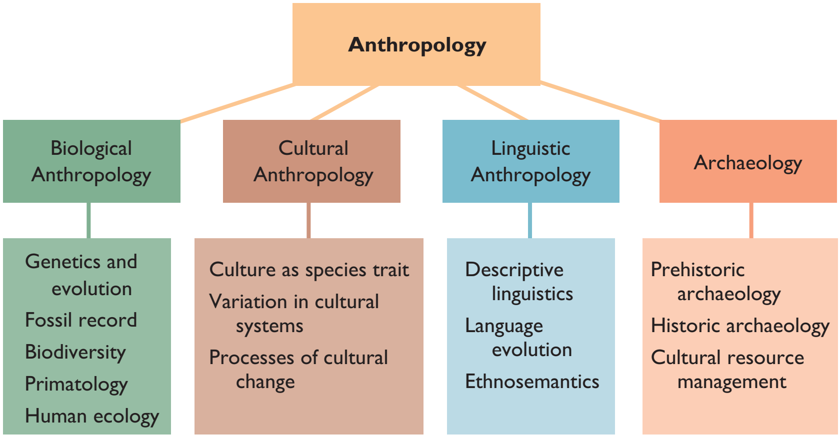

FIGURE 1.7
Major subfields of anthropology with some of their topics. The topics of each subfield may be applied to various social issues (see Chapter 15); this is collectively called *applied anthropology.*

In addition, because culture exists in the context of human social interactions, it must be shared among members of a social group. The complexity of cultural ideas requires this sharing to involve symbols—agreed-upon representations of concepts and abstractions. Human language, of course, is symbolic, as are many visual aspects of our cultures.

In short, culture is highly variable and flexible. It differs from society to society, from environment to environment, and from one time period to another. It even differs in its details from one individual to another. We continually modify our cultural behaviors to fit the unique circumstances of our lives.

So another characteristic of the field of anthropology is its **biocultural** approach. That is, anthropology seeks to describe and explain the interactions between our nature as a biological species and the cultural behavior that is our species' most striking and important trait. We will encounter many examples of these interactions as we continue.

But all these different dimensions make the study of the human species complex and challenging, and so anthropology, the discipline that takes on this challenge, is typically divided into a number of subfields (Figure 1.7). Biological anthropology looks at our species from a biological point of view. This includes all the topics covered in this book. **Cultural anthropology** is the study of culture as a characteristic of our species and of the variation in cultural expression among human groups. This includes human language, although sometimes **linguistic anthropology** is considered a separate subfield. **Archaeology** is the study of the human cultural past and the reconstruction of past cultural systems. It also involves the techniques used to recover, preserve, and interpret the material remains of the past. The theoretical basis for

biocultural Focusing on the interaction of biology and culture.

cultural anthropology A subfield of anthropology that focuses on human cultural behavior and cultural systems and the variation in cultural expression among human groups.

linguistic anthropology A subfield of anthropology that studies language as a human characteristic and attempts to explain the differences among languages and the relationship between a language and the society that uses it.

archaeology A subfield of anthropology that studies the human cultural past and the reconstruction of past cultural systems.

these activities is the study of the relationship of material culture with cultural systems as a whole.

Each subfield has many specialties. For biological anthropology, these specialties are best expressed in terms of the questions we seek to answer about human biology:

1. What are the biological characteristics that define the human species? How do our genes code for these characteristics? Just how much do genes contribute to our traits? How much are traits shaped by the environment? How does evolution work, and how does it apply to us? (These were the questions I was pursuing in my study of the Hutterites.)
2. What is the physical record of our evolution? This is the specialty referred to as **paleoanthropology,** the study of human fossils based on our knowledge of skeletal biology, or **osteology.**
3. What sort of biological diversity do we see in our species today? How did it evolve? What do the variable traits mean for other aspects of our lives? What do they *not* mean?
4. What can we learn about the biology of our close relatives, the nonhuman **primates,** and what can it tell us about ourselves? This specialty is called **primatology.**
5. What do we know about **human ecology,** the relationships between humans and their environments?
6. How can we apply all this knowledge to matters of current concern? This is often called **applied anthropology** and can refer to all the subfields. (The exhumation of Henry Opukahaia is an example.)

Individual biological anthropologists undertake numerous and diverse studies. I took fingerprints of members of a centuries-old Christian group to learn something about the processes of evolution that have affected our species. Paleoanthropologist Donald Johanson was with the team that discovered and identified the famous fossil "Lucy," a 3.2-million-year-old human ancestor. Paleontologist Elwyn Simons studies fossils of nonhuman primates that go even further back in evolutionary time—to the dawn of the apes more than 30 million years ago. Other anthropologists study living nonhuman primates. Shirley Strum, Barbara Smuts, and Linda Fedigan, for example, have all observed troops of baboons to understand what their behavior can tell us about our own.

Clyde Snow is a **forensic anthropologist.** He applies his knowledge of the human skeleton to solving crimes and identifying missing persons. He has worked to identify the remains of death-squad victims in

paleoanthropology A specialty that studies the human fossil record.

osteology The study of the structure, function, and evolution of the skeleton.

primates Large-brained, mostly tree-dwelling mammals with three-dimensional color vision and grasping hands. Humans are primates.

primatology A specialty that studies nonhuman primates.

human ecology A specialty that studies the relationships between humans and their environments.

applied anthropology Anthropology used to address current practical problems and concerns.

forensic anthropologist A scientist who applies anthropology to legal matters.

Argentina and has tried (so far without success) to locate the bones of Butch Cassidy and the Sundance Kid in Bolivia.

Melvin Konner has examined the lifestyles of contemporary **hunter-gatherers,** including their diet and exercise, to show how those lifestyles differ (mostly for the better) from those of people in industrial societies.

We'll discuss these people and their studies, and many more, as we survey the field of bioanthropology. As we do, keep in mind that what connects these varied activities is their focus on *learning about human beings as a biocultural species*.

The studies of bioanthropologists are also connected in that they are all scientific. In many cases, they may not seem to fit the common conception of science. Most anthropologists don't wear white lab coats or work with test tubes and chemicals. Many anthropologists study things that can't be directly observed in nature or re-created in the lab because they happened in the past. But bioanthropology *is* a science, just as much as chemistry, physics, and biology. We'll see how this is so, and we'll also look at some nonscientific ways in which people try to understand their world.

BIOANTHROPOLOGY AND SCIENCE

A popular image of a scientist is that of a walking encyclopedia. Science is often seen as fact collecting. While it's fair to say that scientists know a lot of facts, so do a lot of other people. Winners on the TV quiz show *Jeopardy* are not usually professional scientists.

Facts are certainly important to science. They are the raw material of science, the data scientists use, collected through observation and experimentation. But the goal of science is to relate and unify facts in order to generate, eventually, broad principles known as **theories. Science,** in other words, is a method of inquiry, a way of answering questions about the world. But how does science work? Is science the only valid and logical method for explaining the world around us?

The Scientific Method

The world is full of things that need explaining. We might wonder about the behavior of a bird, the origin of the stars in the night sky, the identity of a fossil skeleton, the social interaction of students in a college classroom, or the ritual warfare of a society in highland New Guinea. As people, we strive to understand such phenomena, to know why and

hunter-gatherers Societies that rely on naturally occurring sources of food.

theory A well-supported general idea that explains a large set of factual patterns and predicts other patterns.

science The method of inquiry that requires the generation, testing, and acceptance or rejection of hypotheses.

how these things occur. As scientists, we must answer these questions according to a special set of rules—the **scientific method.**

The scientific method involves a cycle of steps, and in reality, one may begin anywhere on the cycle. The most basic step is asking the questions we wish to answer or describing the observations we wish to explain. We then look for patterns, connections, and associations so that we can generate educated guesses as to possible explanations. These educated guesses are called **hypotheses.** In other words, we try to formulate a *general* explanatory principle that will account for the *specific* pieces of real data we have observed and want to explain. This process of reasoning is called **induction.**

Next comes the essence—indeed the defining characteristic—of science. We must attempt to either support or refute our hypothesis by testing it. Tests may take many forms, depending on what we are trying to explain, but basically we reverse the process of induction and go from the general back to the specific by making predictions: *If* our general hypothesis is correct, *then* what other specific things should we observe? This process is called **deduction.** For example, we look for:

Repetition: Does the same phenomenon occur over and over?

Universality: Does the phenomenon occur under all conditions? If we vary some aspect of the situation, will the phenomenon still occur? How might different situations change the phenomenon?

Explanations for exceptions: Can we account for cases where the phenomenon doesn't appear to occur?

New data: Does new information support or contradict our hypothesis?

If we find one piece of evidence that conclusively refutes our hypothesis, the hypothesis is disproved. (But even then, the hypothesis may not be dismissed entirely. Newton's hypothesis that light consists of particles was discounted for centuries until twentieth-century quantum mechanics showed light to, in fact, be particles that have the properties of waves.) But if a hypothesis passes every test we put it to, we elevate it to a *working hypothesis* and use it as a basis for further induction and testing. Notice that I didn't say we *prove* a hypothesis. Good science is skeptical, always looking for new evidence, always open to and, indeed, inviting change. The best we should honestly say about most hypotheses is that, so far, no evidence has been found that *disproves* them.

When, through this process, we have generated an integrated body of ideas forming a general concept that coordinates, explains, and interprets a wide range of factual patterns in a given area, we refer to this body of ideas as a theory. In science, *theory* is a positive term. Theories are called *theories*

scientific method The process of conducting scientific inquiry.

hypotheses Educated guesses to explain natural phenomena.

induction Developing a general explanation from specific observations.

deduction Suggesting specific data that would be found if a hypothesis were true.

because they are general ideas that explain a large number of phenomena and are themselves made up of interacting and well-supported hypotheses. All the facts of biology, for instance, make sense within the general theory of evolution—that all life has a common ancestry and that living forms change over time and give rise to new forms by various natural processes.

We don't stop when we have developed a theory, however. No theory is complete. For example, some force we call *gravity* exists, and we know so much about it that we can accurately predict phenomena—from the motion of stars and planets to the trajectory of spacecraft. But we still don't understand how gravity works and how it originated and separated from the other forces of nature. In other words, we still have hypotheses to test to arrive at a complete theory of gravity.

Another popular conception of science is that it studies only visible, tangible, present-day things—chemicals, living organisms, planets and stars. But notice that gravity is neither visible nor tangible. We can't see gravity, but we know it exists because all our deductive predictions support its existence. We see gravity work every time we drop an object or jump up in the air and come back down to earth instead of flying off into space. We logically predict that if gravity is the property of objects with mass, the bigger the object the more its gravity. We saw this clearly when we watched the astronauts walk around on the moon; they were literally lighter (about one-sixth their earthly weight) because the moon, being smaller than the earth, has less gravity. We also see the increased effects of the gravity of very massive objects (Figure 1.8). We can even explain exceptions *within the context of our general idea*. The reason a helium-filled balloon seems to violate gravity can be explained by the existing theory of gravity: helium is less dense than the surrounding air and so responds relatively less to the earth's gravity. In other words, the helium is lighter than the surrounding air and so a slightly greater pressure on the bottom of the balloon than on the top causes the balloon to rise.

Similarly, past events can't be seen or touched. They can't be experimented on directly or repeated exactly. The evolution of plants and animals is an example. But again, we know that evolution occurs because the theory has passed all our tests. The theory of evolution explains observations of the real world. We have observed everything we predicted we would *if* evolution occurred. (We'll look more closely at how science has generated and supported the theory of evolution in Chapter 3.)

I noted earlier that scientists may begin their investigations at any step in the cycle of the scientific method. For instance, we might have

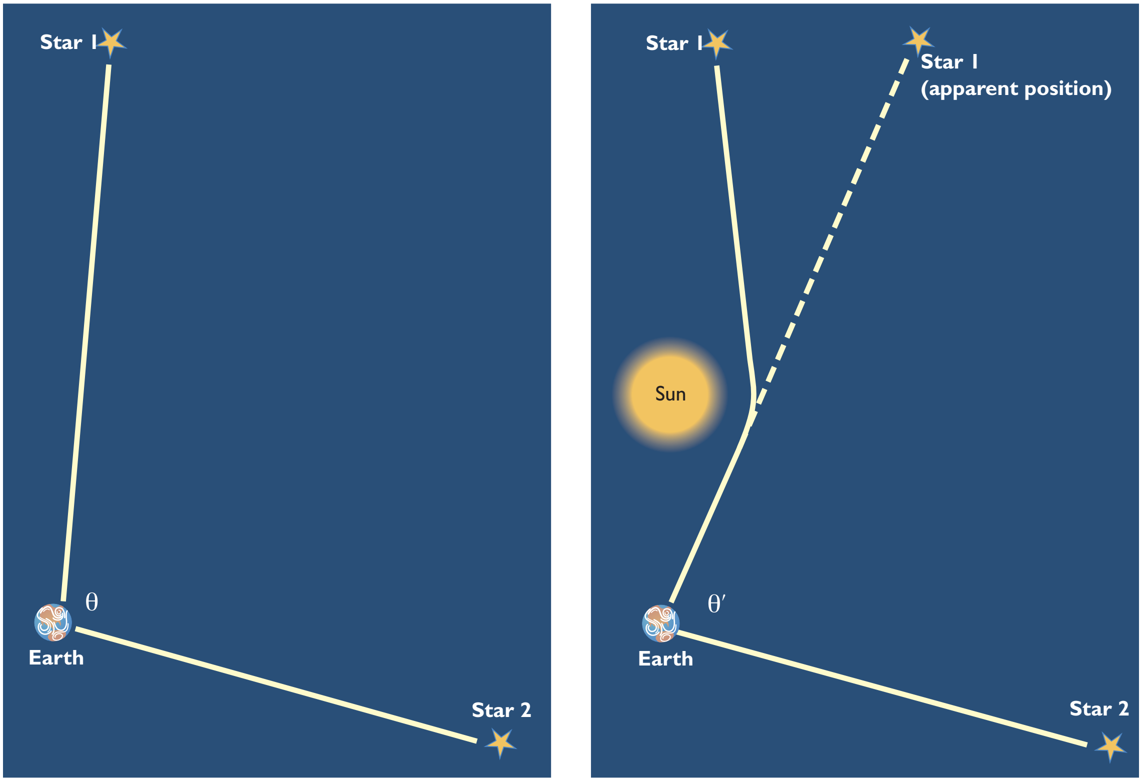

FIGURE 1.8
Light bent by gravity. Einstein predicted in 1905 that a strong gravitational field could bend light. His prediction was verified in 1919, when light from stars that should have been blocked by the sun could be seen during a solar eclipse. The effect is greatly exaggerated in these drawings.

a flash of inspiration for some overarching concept that might explain many different phenomena. In other words, we might dream up a potential theory. We then, of course, would have to go through all the other steps: making observations, generating individual hypotheses, and testing those hypotheses. As an example, Albert Einstein was pondering the nature of light waves when he came up with the idea that energy has mass, his famous formula $E = mc^2$. It was only later that this relationship was experimentally verified and all its implications and applications were understood.

Finally, we must acknowledge that scientists are members of their societies and participants in their cultures, and science is always conducted within the context of a particular culture at a particular point in time. Thus, science—as objective as we try to make it—is always constrained by what we already know, by what we still don't know, by the technology available to us to gather and test data, by existing theories, and even by certain influential social or cultural trends.

For example, I remember back in the mid-1950s, when one of my elementary school teachers pointed out that the east coast of South America and the west coast of Africa seemed to potentially fit together like a giant jigsaw puzzle (Figure 1.9). Of course, she had said, there's no

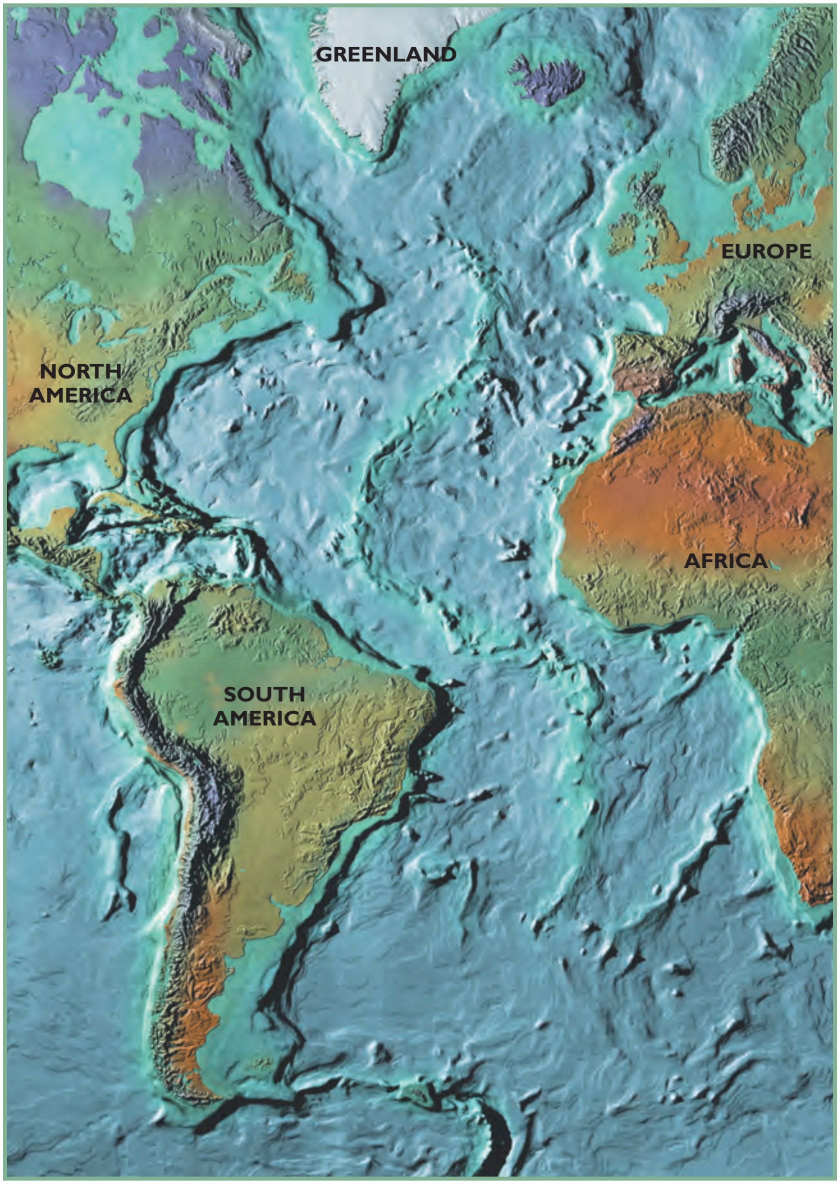

FIGURE 1.9
Topographic map of the Atlantic Ocean floor showing the correlating outlines of the edges of the Eastern and Western Hemispheres. Also shown is the Mid-Atlantic Ridge—evidence for the plate tectonics that pushed the once-connected continents apart.

way the continents could move around, so it must just be a coincidence. In fact, she was reflecting our scientific knowledge of the time. There was plenty of geological and fossil evidence suggesting that the continents had moved around, but we knew of no way then that such movement could possibly occur. Although the idea of continental drift had been proposed in 1912, there was no mechanism to explain it. Beginning in the 1960s, however, new technologies gave us new evidence that provided such a mechanism. We now have a well-verified theory of continental drift by the process of plate tectonics.

An interesting example of an influential social trend comes from a hypothesized explanation for the famous Salem witch trials in Massachusetts in 1692, when a group of young girls accused some adults of witchcraft, with the result that twenty people were executed. The hypothesis suggested that the people of Salem had consumed bread made from grains tainted with ergot, a fungus that contains alkaloids, some of which are derivatives of lysergic acid, which in turn is used in the synthesis of the hallucinogenic drug LSD. In other words, maybe the young girls who made the witchcraft accusations were inadvertently having an "acid trip." Not surprisingly, this explanation arose and found popularity in the 1960s, a period associated in part with the so-called drug culture. Although the idea showed up as recently as 2001 in a public television documentary, there is no evidence to support it.

These examples show us why scientific skepticism is so important and why we should always question and re-examine even our most well-supported ideas. Science answers questions about our lives and about the world in which we live; however, for an answer to be defined as scientific, it must be testable—and must be tested. Put another way, it must be possible to find data that would *disprove* it. For an answer to be accepted, it must pass all tests and be refuted by none.

Belief Systems

Some questions about the world, even in a technologically complex society like ours, remain beyond the scope of science. Scientific inquiry, as powerful and important as it is, doesn't answer everything. Although we have some well-established theories about how the universe evolved once it began, the ultimate origin of the universe remains, for the moment at least, outside the realm of science. For most human societies throughout most of our species' history, many questions could not be addressed scientifically.

Nor does science tell us how to behave. In our society, for example, we treat medical matters scientifically. But science does not, and cannot, inform us how best to apply medical knowledge. Who should practice medicine? How are medical practitioners trained and administered by society? How should they be compensated? What should their relationship be with their patients? Is everyone equally entitled to medical care? Society and the medical profession answer these questions through laws and regulations. For example, one version of the Hippocratic oath (there are several forms) taken by doctors says, in part, "I will not permit considerations of religion, nationality, race, party politics or social standing to intervene between my duty and my patient."

Finally, there are questions that can never be answered by science—matters such as the meaning of life, the existence of a higher power, the proper social relationships among people within a society, or the purpose of one's own life.

All these sorts of questions are addressed by **belief systems**—religions, philosophies, ethics, morals, and laws. Belief systems differ from science in that they cannot be tested, cannot be disproved. Their truths are taken on faith, and that, of course, is the source of their power. They provide stable bases for our behavior, for explanations of what is beyond our science, and for the broad, existential questions of life.

Belief systems change, but they change only when *we* decide to change them, either as a society or as individuals. Two of us with opposite views on the existence of a supreme being could debate the issue endlessly, but no scientific test could support or refute either view. If I were to change my mind on the matter, it would be because of a personal decision. The supreme being is not to be found in a test tube or seen through a telescope.

Belief systems don't apply only to these big questions. I had a friend in graduate school from a West African society that is polygynous—men may have several wives. Having more than one wife is normal in his society, whereas in mine, one wife (at least one at a time) is the norm. We discussed the pros and cons of these two systems at length one day, but we never, of course, arrived at any "answer." His belief was the norm for his society as was mine for my society. We each took it on faith that this was so.

Although we often perceive science and belief systems as being eternally and inevitably at odds with one another, nothing could be further from the truth. Conflicts arise among facets of all societies. But it should be apparent that for a society to function, it needs both scientific knowledge and beliefs, because neither by itself addresses all the questions.

belief systems Ideas that are taken on faith and cannot be scientifically tested.

Contemporary Reflections

Evolution a Fact, a Theory, or Just a Hypothesis?

It may surprise you that the answer is "all of the above." Evolution, as a broad topic, incorporates theory, fact, *and* hypothesis. This is because the scientific method is not a nice, neat, linear series of steps from first specific observation to final all-encompassing theory. Rather, science works in a cycle, and the inductive and deductive reasoning of science is applied constantly to the different aspects of the same general subject. Data and hypotheses are always being re-examined, and each theory itself becomes a new observation to be questioned, tested, explained, and possibly changed.

A theory is a well-supported idea that explains a set of observed phenomena. Evolution is a theory in that all our observations of life on earth—fossils, the geological formations in which they are found, and the biology of living creatures—make sense and find explanation within the concept of evolution, the idea that living things change through time and that organisms are related as in a huge branching bush, with existing species giving rise to new species.

Moreover, there is so much evidence in support of evolution that this tried-and-tested theory may reasonably be considered a fact. Of course, new data could conceivably change that, but with an idea as well supported as evolution, it is highly unlikely. A good analogy is the accepted fact that the earth revolves around the sun and not, as people thought for so long, the other way around. But how do we *know* the earth revolves around the sun? It certainly appears upon daily observation to do just the opposite. We accept the heliocentric (sun-centered) theory because there is so much data in its support. It makes so much sense and explains so many other phenomena that we consider it a fact and take it for granted, never giving it much thought on a regular basis. I would be very surprised to read in tomorrow's newspaper that some new evidence refuted the idea. Similarly, that evolution occurs and accounts for the nature of life on earth is, for all intents and purposes, a fact.

But that fact poses more questions. A big one (the one that confronted Darwin) is *how* evolution takes place. The fact of evolution now becomes a new observation that requires explanation through the generation of new hypotheses and the subsequent testing and retesting of those hypotheses. Darwin proposed a mechanism he called *natural selection* and then, over many years, examined this hypothesis against real-world data. The mechanism of natural selection is now so well supported that we call it, too, a fact.

But an overall explanation for how evolution works—a theory (or set of theories) to explain the observed fact of evolution—is far from complete. We know that mechanisms in addition to natural selection contribute to evolution. The relative importance of all these mechanisms is still being debated. The broad picture of evolution—the "shape" of the family bush of living things—is a matter of much discussion. The specific genetic processes behind all evolutionary change are really only beginning to be revealed as new technologies are letting us look at the very code of life. In other words, we are still examining hypotheses to account for how evolution takes place and for what happened in evolutionary history.

Evolution—like any broad scientific idea—involves a complex and interacting web of facts, hypotheses, and theories. It is the never-ending nature of scientific inquiry that can make science so frustrating—but also so exciting and so important in the modern world.

SUMMARY

Anthropology is the holistic study of the human species from the biocultural perspective. Cultural anthropology studies human culture, cultural systems, and their variation. Our species' most characteristic feature today is our cultural behavior, which is expressed in a great variety of ways among different societies.

The majority of human cultural systems that ever existed did so in the past and so have left us only meager physical remains of their presence and nature. A second major subfield of anthropology recovers and interprets these remains; this subfield is archaeology.

Biological anthropology studies the human species the way biology studies any species, examining our biological characteristics, our evolution, our variation, our relationship with our environment, and our behavior, including our ability to have culture.

Bioanthropology, as a scientific discipline, asks questions about the human species and then attempts to answer them by proposing hypotheses and by testing those hypotheses, looking both for evidence in their support and for anything that would refute them.

Scientific knowledge is important for any society, but it must be mediated by the nonscientific values of belief systems—the untestable ideas of philosophy, law, and religion that are taken on faith. Societies need both science and belief systems, interacting in harmony, to fully function.

QUESTIONS FOR FURTHER THOUGHT

1. Anthropologists have special responsibilities when studying other human beings. What sorts of issues do you think I had to take into account when conducting my research among the Hutterites? What issues would have been involved in the exhumation of Henry Opukahaia? Consider another culture you are familiar with, and imagine what particular issues would be involved in studying it as an anthropologist.
2. Because of anthropology's wide scope of interests and its overlap with other scholarly disciplines, anthropologists have sometimes been described as "jacks of all trades and masters of none." How would you respond to this?

3. Our impression that science and belief systems are naturally at odds with one another comes largely from cases in which the two areas are forced into conflict—when, for example, a religious belief is said to refute a scientific idea or a scientific idea is said to undermine a belief. Can you give an example of such a conflict? How would you resolve the conflict, given what you now understand about these two areas of inquiry?

KEY TERMS

biological anthropology
bioanthropology
physical anthropology
anthropology
species
holistic
culture
biocultural
cultural anthropology
linguistic anthropology
archaeology
paleoanthropology
osteology
primates
primatology
human ecology
applied anthropology
forensic anthropologist
hunter-gatherers
theory
science
scientific method
hypotheses
induction
deduction
belief systems

SUGGESTED READINGS

For more personal experiences of biological anthropologists, see part 1 of my *Biological Anthropology: An Introductory Reader*, fourth edition. *(Complete publication details of the suggested readings appear in the "References.")*

For more information on the Hutterites, see John Hostetler's *Hutterite Society*.

For a longer discussion of the nature of science and the scientific method, see Kenneth L. Feder's *Frauds, Myths, and Mysteries: Science and Pseudoscience in Archaeology*, fifth edition, and for even more detail see *Understanding Scientific Reasoning*, by Ronald N. Giere. The relationship between science and belief systems is nicely covered by John Maynard Smith's article, "Science and Myth," in the November 1984 issue of *Natural History*. A more philosophical discussion can be found in *Rocks of Ages: Science and Religion in the Fullness of Life*, by Stephen Jay Gould.

The field of anthropology in general is covered in my *Introducing Anthropology: An Integrated Approach*, third edition, and in a collection of contemporary articles edited by Aaron Podolefsky and Peter Brown, *Applying Anthropology: An Introductory Reader,* fifth edition.

I've written an extended version of the story of Henry Opukahaia, "The Homegoing," which appears in *Lessons from the Past: An Introductory Reader in Archaeology,* by Kenneth L. Feder.

For an update on the Hutterites, see "Solace at Surprise Creek" by William Albert Allard in the June 2006 *National Geographic*.