BRVGS World History Summer Work

Dear Parents and Students: Welcome to the Blue Ridge Virginia Governor's School! We hope you will find BRVGS to be challenging, inspiring and enjoyable.

Because we have a great deal of information to go through in your first year of BRVGS, we require that students do summer work ***before the start of the school year.***

Please do not put this off until the last minute. You will find time management important in BRVGS and should work to get assignments done well ahead of deadlines.

Instructions for accessing the work are below on this page.

This work should be turned in to your class teacher on the first day of school.

All responses should be in your own words, handwritten on paper, and any resources used should be cited.

If you have received this work by mail, all linked materials will be included in your packet.

If you have questions about this work, or if you do not have computer or internet access, please contact BRVGS Director Wanda Elliott at welliott@brvgs.k12.va.us

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PART 1 - Thinking Like a Historian

A. Your first summer reading assignment is an article by Sam Wineburg, called "Thinking Like a Historian" (starts on page 4 of this packet)

B. Once you have read the article, answer the questions below in your own words:

1. What is the difference between Kevin's perception of "what history is" and the perception of the author of this article?
2. What does a "persuasive opinion" in history need, in order to be valid?
3. What kinds of questions do historians need to ask in a "historical approach"?
4. What 6 things should students do to "think historically"? Provide a BRIEF explanation for each.
5. Why is it important for students (and teachers!) to learn to "think like a historian"?

C. Next you will need to define some important terms for history. You can use online resources or a dictionary - **but do <u>not</u> copy!** These definitions should be written in your own words, as much as possible and the source must be cited.

1. Chronology
2. Source
3. Primary Source
4. Secondary Source

5. Artifact
6. Evidence
7. Questions
8. Fact
9. Opinion
10. Hypothesis (theory)
11. Bias
12. Interpretation
13. Causation
14. Generalization

Part 2 - Guns, Germs, and Steel

Your main reading for the summer is an excerpt from a book called Guns, Germs and Steel, by Jared Diamond. This book tells the story of why civilizations and cultures developed differently in different places. While it is not an easy book, it is a very good start to understand how history is studied. You will find links to the Introduction and first two chapters, as well as to your study guide, below. Please answer all of the questions from your study guide. **These must be done before the first day of the school year, and will be graded for completion.**

Prologue: Yali's Question

1. What is "Yali's question" and how does the author rephrase it?
2. What are the objections to the question?
3. What does the author think of racial arguments?
4. Who does he think is smarter "modern stone age" people or industrial people?
5. What do IQ tests measure?
6. What 2 reasons might make New Guineans more intelligent than Europeans?
7. What does the author think of the climate argument?
8. What is a one sentence explanation of the book
9. What does the author hope to convince you, the reader, that history is not?

Chapter 1: Up to the Starting Line

10. What were the names of proto-humans? What important information can you find about each of them using other sources? (Write about a paragraph on each)
11. Study figure 1.1 - Where did humans originate?
12. What changes did what the author says was the Great leap forward bring?

13. What two big 1st's happened in New Guinea/Australia?
14. What two disadvantages did the Dodo, Moas, and giants of Australia have? How might this affect the humans who took over the land?

15. What happened in the Americas around 11,000 BC?
16. What evidence is there of pre-clovis sites? Is it convincing? Why?
17. What does the author mean by head start? Which continent do you think had an advantage in 11,000BC? Why?

Chapter 2: A Natural Experiment of History

18. How does the author explain the defeat of the Moriori?
19. Why did they evolve differently in 800 years? How did this affect the defeat of the Moriori? (Make sure you look at both the Moriori and the Maori)

20. What is population density? How different was this number in Polynesia?
21. What kinds of powers did the chiefs of Hawaii and Tonga have?
22. Which groups had more stuff? Why?
23. What caused Human societies to differ?

Again, if you have questions about this work, or if you do not have computer or internet access, please contact BRVGS Director Wanda Elliott at welliott@brvgs.k12.va.us

Good luck with this, and have a great summer!

Thinking Like a Historian

By Sam Wineburg

Historical Thinking: Memorizing Facts and Stuff?

When I recently asked Kevin, a sixteen-year-old high school junior, what he needed to do well in history class, he had little doubt: “A good memory.”

“Anything else?”

“Nope. Just memorize facts and stuff, know 'em cold, and when you get the test, give it all back to the teacher.”

“What about thinking? Does that have anything to do with history?”

“Nope. It's all pretty simple. Stuff happened a long time ago. People wrote it down. Others copied it and put it in a book. History!”

I've spent nearly 20 years studying how high school students learn history. Over the years I've met many Kevins, for whom the life has been sucked out of history, leaving only a grim list of names and dates. When confronted with the term “historical thinking,” many students scratch their heads in confusion, stumped by an alleged connection.

Historians as Detectives: Searching for Evidence Among Primary Sources

The funny thing is that when you ask historians what they do, a different picture emerges. They see themselves as detectives searching for evidence among primary sources to a mystery that can never be completely solved. Wouldn't this image be more enticing to a bored high school student? It would, and that's one reason why thinking like a historian deserves a place in the American classroom, the sooner the better.

To historians, history is an argument about what facts should or shouldn't mean. Even when historians are able to piece together the basic story of what happened, they rarely agree about what an event means or what caused it. Historians argue about the past's meaning and what it has to tell us in the present.

But, you may ask, if history has already happened, what's there to argue about? Plenty. Was the American Revolution a fight against tyranny or an attempt by the well bred to maintain their social status? Was the Cold War really a conflict of democracy versus communism or a struggle between two superpowers for dominance?

Divergent opinions swirl around these questions and other matters of unsettled history – opinions that get students talking, and thinking, and learning. But while everyone is entitled to an opinion, not every opinion deserves to be believed. In history, a persuasive opinion is one backed up by evidence.

What is Historical Thinking?

It would be easy to conclude that historians simply know more about American history than high school students do. But this isn't necessarily the case. Beyond highly specialized areas of concentrations, even doctoral level historians don't possess factual knowledge about every topic. What historians do have is a

“historical approach” to primary sources that is often taken for granted by those practiced in it. However, this approach unlocks a world closed to untutored readers.

For example, before approaching a document, historians come prepared with a list of questions—about author, context, time period—that form a mental framework for the details to follow. Most important of all, these questions transform the act of reading from passive reception to an engaged and passionate interrogation. If we want students to remember historical facts, this approach, not memorization, is the key.

Teaching Students to Think Historically

How can teachers help their students to begin thinking like historians? Teaching a way of thinking requires making thinking visible. We need to show students not only what historians think, but *how* they think, and then guide students as they learn to engage in this process.

Consider introducing students to several specific strategies for reading historical documents: sourcing, contextualizing, close reading, using background knowledge, reading the silences, and corroborating. Each strategy is defined below, followed by teaching ideas.

- **Sourcing:** Think about a document's author and its creation.

Select a historical document, such as a diary entry, letter or memo, and provide students with copies. Model for students how to scan the document for its attribution, often at the end, as a first step instead of reading the text from beginning to end. Demonstrate how to begin questioning the source by posing questions to the class: Who created this document? When? For what purpose? How trustworthy might this source be? Why?

- **Contextualizing:** Situate the document and its events in time and place.

Encourage students to brainstorm the document's historical context, piecing together major events, themes, and people that distinguish the era or period in which the document was created. List students’ responses for the class to add to and refer to during close reading.

- **Close reading**: Carefully consider what the document says and the language used to say it.

Teachers can model this strategy with a brief (90 seconds) “think-aloud” while reading the document to students. Try to verbalize every thought that comes to mind, no matter how trivial, as you try to make meaning of the document's account. For example, you may notice interesting words or phrases (“I’ve never heard that expression before”), consider contextual clues about time, place or people (“Hmm, that may be a reference to…”) or question facts, opinions and perspectives (“I wonder if that’s what really happened?”).

- **Using Background Knowledge:** Use historical information and knowledge to read and understand the document.

Encourage students to practice this strategy by pausing to ask as they read: What else do I know about this topic? What other knowledge do I possess that might apply?

- **Reading the Silences:** Identify what has been left out or is missing from the document by asking questions of its account.

After reading the document, ask students to think about what they did not hear. Prompt class discussion with questions: What is the document's author not mentioning? Whose voices are we not hearing in a particular document or historical account? Which perspectives are missing?

- **Corroborating:** Ask questions about important details across multiple sources to determine points of agreement and disagreement.

Ask students how they could proceed with this historical investigation: What questions arise, after careful reading and interpretation of the document? What other primary sources might corroborate or refute this interpretation? Have students discuss their responses in pairs and then share with the class.
You can also apply these strategies to reading textbooks. Textbooks offer an interpretation of history, but none gives us the final word. For example, textbook authors try to combine perspectives but they can never escape the fact that textbook is written by people living in a particular time and place. As such, textbooks record our contemporary (and unrecognized) assumptions, biases, and blind spots. One way to teach for historical thinking using a textbook is to have students compare its story of a historic event with evidence from primary sources. Another idea is to compare a current textbook's account of, say, the Spanish-American war with a textbook version written fifty or hundred years ago. Get students thinking with this question: "If history already happened, why does it keep changing?"

Any teacher's goal (and his or her students' goals) in reading and thinking like a historian should be to treat with skepticism any account that claims to present a full story of the past. Achieving this goal requires students to:

- Question the source
- Evaluate the evidence it offers for its assertions
- Read and consider the source more carefully than any historical account read before.

Why Teach Students to "Think Like Historians?"

Students need to be taught to "think like historians" not because they will become professional historians but precisely because most won't. The goals of school history are not vocational but to prepare students to tolerate complexity, to adapt to new situations, and to resist the first answer that comes to mind.

When a video uploaded from a cell phone in Tehran can be transmitted to San Francisco in half a second, history reminds us to start with basic questions: Who sent it? Can it be trusted? What did the camera angle miss? There's no shortage of forces telling students what to think. In this daily avalanche of information, students have never been in greater need of ways to make sense of it all.

Kevin's right: Without thinking, history is meaningless. But when you add thinking, especially the specific skills of "thinking historically," the past comes to life. In the end that is what reading, and thinking—and I would add, teaching—like a historian is all about.

Sam Wineburg, Stanford University, is the author of Historical Thinking and Other Unnatural Acts: Charting the Future of Teaching the Past, winner of the 2002 Frederick W. Ness Award for the "most important contribution to understanding the liberal arts" by the American Association of Colleges and Universities. He also directs the Library of Congress Teaching with Primary Sources (TPS) program at Stanford University. Learn more at http://sheg.stanford.edu.

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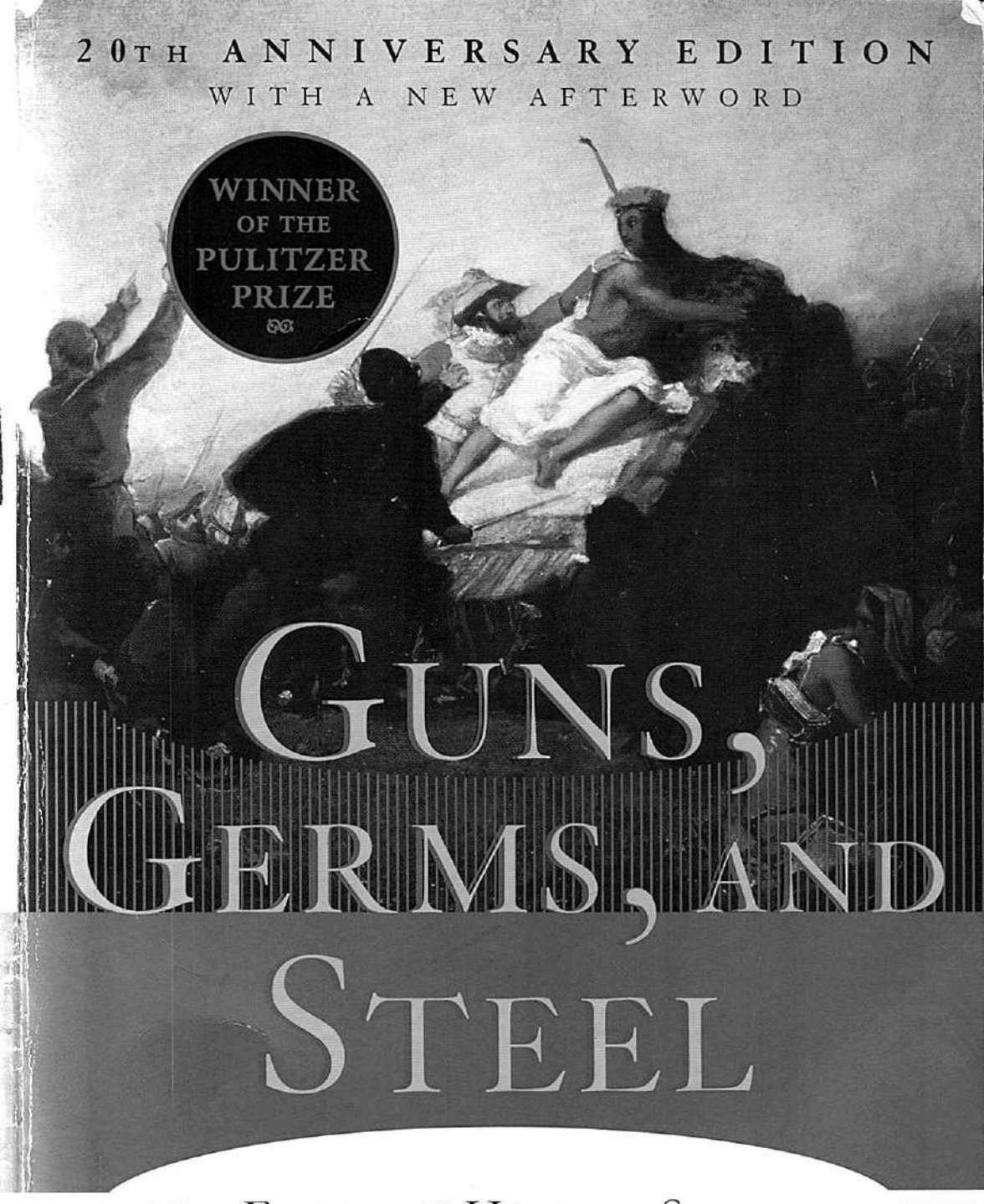

GUNS, GERMS, AND STEEL

The FATES *of* HUMAN SOCIETIES

JARED DIAMOND

GUNS, GERMS, AND STEEL

THE FATES OF HUMAN SOCIETIES

Jared Diamond

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To Esa, Kariniga, Omwai, Paran, Sauakari, Wiwor,
and all my other New Guinea friends and teachers—
masters of a difficult environment

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PROLOGUE

YALI'S QUESTION

WE ALL KNOW THAT HISTORY HAS PROCEEDED VERY differently for peoples from different parts of the globe. In the 13,000 years since the end of the last Ice Age, some parts of the world developed literate industrial societies with metal tools, other parts developed only nonliterate farming societies, and still others retained societies of hunter-gatherers with stone tools. Those historical inequalities have cast long shadows on the modern world, because the literate societies with metal tools have conquered or exterminated the other societies. While those differences constitute the most basic fact of world history, the reasons for them remain uncertain and controversial. This puzzling question of their origins was posed to me 25 years ago in a simple, personal form.

In July 1972 I was walking along a beach on the tropical island of New Guinea, where as a biologist I study bird evolution. I had already heard about a remarkable local politician named Yali, who was touring the district then. By chance, Yali and I were walking in the same direction on that day, and he overtook me. We walked together for an hour, talking during the whole time.

Yali radiated charisma and energy. His eyes flashed in a mesmerizing way. He talked confidently about himself, but he also asked lots of probing questions and listened intently. Our conversation began with a subject then on every New Guinean's mind—the rapid pace of political developments. Papua

New Guinea, as Yali's nation is now called, was at that time still administered by Australia as a mandate of the United Nations, but independence was in the air. Yali explained to me his role in getting local people to prepare for self-government.

After a while, Yali turned the conversation and began to quiz me. He had never been outside New Guinea and had not been educated beyond high school, but his curiosity was insatiable. First, he wanted to know about my work on New Guinea birds (including how much I got paid for it). I explained to him how different groups of birds had colonized New Guinea over the course of millions of years. He then asked how the ancestors of his own people had reached New Guinea over the last tens of thousands of years, and how white Europeans had colonized New Guinea within the last 200 years.

The conversation remained friendly, even though the tension between the two societies that Yali and I represented was familiar to both of us. Two centuries ago, all New Guineans were still "living in the Stone Age." That is, they still used stone tools similar to those superseded in Europe by metal tools thousands of years ago, and they dwelt in villages not organized under any centralized political authority. Whites had arrived, imposed centralized government, and brought material goods whose value New Guineans instantly recognized, ranging from steel axes, matches, and medicines to clothing, soft drinks, and umbrellas. In New Guinea all these goods were referred to collectively as "cargo."

Many of the white colonialists openly despised New Guineans as "primitive." Even the least able of New Guinea's white "masters," as they were still called in 1972, enjoyed a far higher standard of living than New Guineans, higher even than charismatic politicians like Yali. Yet Yali had quizzed lots of whites as he was then quizzing me, and I had quizzed lots of New Guineans. He and I both knew perfectly well that New Guineans are on the average at least as smart as Europeans. All those things must have been on Yali's mind when, with yet another penetrating glance of his flashing eyes, he asked me, "Why is it that you white people developed so much cargo and brought it to New Guinea, but we black people had little cargo of our own?"

It was a simple question that went to the heart of life as Yali experienced it. Yes, there still is a huge difference between the lifestyle of the average New Guinean and that of the average European or American. Comparable differences separate the lifestyles of other peoples of the world as well. Those huge disparities must have potent causes that one might think would be obvious.

Yet Yali's apparently simple question is a difficult one to answer. I didn't

have an answer then. Professional historians still disagree about the solution; most are no longer even asking the question. In the years since Yali and I had that conversation, I have studied and written about other aspects of human evolution, history, and language. This book, written twenty-five years later, attempts to answer Yali.

ALTHOUGH YALI'S QUESTION concerned only the contrasting lifestyles of New Guineans and of European whites, it can be extended to a larger set of contrasts within the modern world. Peoples of Eurasian origin, especially those still living in Europe and eastern Asia, plus those transplanted to North America, dominate the modern world in wealth and power. Other peoples, including most Africans, have thrown off European colonial domination but remain far behind in wealth and power. Still other peoples, such as the aboriginal inhabitants of Australia, the Americas, and southernmost Africa, are no longer even masters of their own lands but have been decimated, subjugated, and in some cases even exterminated by European colonialists.

Thus, questions about inequality in the modern world can be reformulated as follows. Why did wealth and power become distributed as they now are, rather than in some other way? For instance, why weren't Native Americans, Africans, and Aboriginal Australians the ones who decimated, subjugated, or exterminated Europeans and Asians?

We can easily push this question back one step. As of the year A.D. 1500, when Europe's worldwide colonial expansion was just beginning, peoples on different continents already differed greatly in technology and political organization. Much of Europe, Asia, and North Africa was the site of metal-equipped states or empires, some of them on the threshold of industrialization. Two Native American peoples, the Aztecs and the Incas, ruled over empires with stone tools. Parts of sub-Saharan Africa were divided among small states or chiefdoms with iron tools. Most other peoples—including all those of Australia and New Guinea, many Pacific islands, much of the Americas, and small parts of sub-Saharan Africa—lived as farming tribes or even still as hunter-gatherer bands using stone tools.

Of course, those technological and political differences as of A.D. 1500 were the immediate cause of the modern world's inequalities. Empires with steel weapons were able to conquer or exterminate tribes with weapons of

stone and wood. How, though, did the world get to be the way it was in A.D. 1500?

Once again, we can easily push this question back one step further, by drawing on written histories and archaeological discoveries. Until the end of the last Ice Age, around 11,000 B.C., all peoples on all continents were still hunter-gatherers. Different rates of development on different continents, from 11,000 B.C. to A.D. 1500, were what led to the technological and political inequalities of A.D. 1500. While Aboriginal Australians and many Native Americans remained hunter-gatherers, most of Eurasia and much of the Americas and sub-Saharan Africa gradually developed agriculture, herding, metallurgy, and complex political organization. Parts of Eurasia, and one area of the Americas, independently developed writing as well. However, each of these new developments appeared earlier in Eurasia than elsewhere. For instance, the mass production of bronze tools, which was just beginning in the South American Andes in the centuries before A.D. 1500, was already established in parts of Eurasia over 4,000 years earlier. The stone technology of the Tasmanians, when first encountered by European explorers in A.D. 1642, was simpler than that prevalent in parts of Upper Paleolithic Europe tens of thousands of years earlier.

Thus, we can finally rephrase the question about the modern world's inequalities as follows: why did human development proceed at such different rates on different continents? Those disparate rates constitute history's broadest pattern and my book's subject.

While this book is thus ultimately about history and prehistory, its subject is not of just academic interest but also of overwhelming practical and political importance. The history of interactions among disparate peoples is what shaped the modern world through conquest, epidemics, and genocide. Those collisions created reverberations that have still not died down after many centuries, and that are actively continuing in some of the world's most troubled areas today.

For example, much of Africa is still struggling with its legacies from recent colonialism. In other regions—including much of Central America, Mexico, Peru, New Caledonia, the former Soviet Union, and parts of Indonesia—civil unrest or guerrilla warfare pits still-numerous indigenous populations against governments dominated by descendants of invading conquerors. Many other indigenous populations—such as native Hawaiians, Aboriginal Australians, native Siberians, and Indians in the United States, Canada, Brazil, Argentina, and Chile—became so reduced in numbers by genocide and disease that they are now greatly outnumbered by the descendants of invad-

ers. Although thus incapable of mounting a civil war, they are nevertheless increasingly asserting their rights.

In addition to these current political and economic reverberations of past collisions among peoples, there are current linguistic reverberations—especially the impending disappearance of most of the modern world's 6,000 surviving languages, becoming replaced by English, Chinese, Russian, and a few other languages whose numbers of speakers have increased enormously in recent centuries. All these problems of the modern world result from the different historical trajectories implicit in Yali's question.

BEFORE SEEKING ANSWERS to Yali's question, we should pause to consider some objections to discussing it at all. Some people take offense at the mere posing of the question, for several reasons.

One objection goes as follows. If we succeed in explaining how some people came to dominate other people, may this not seem to justify the domination? Doesn't it seem to say that the outcome was inevitable, and that it would therefore be futile to try to change the outcome today? This objection rests on a common tendency to confuse an explanation of causes with a justification or acceptance of results. What use one makes of a historical explanation is a question separate from the explanation itself. Understanding is more often used to try to alter an outcome than to repeat or perpetuate it. That's why psychologists try to understand the minds of murderers and rapists, why social historians try to understand genocide, and why physicians try to understand the causes of human disease. Those investigators do not seek to justify murder, rape, genocide, and illness. Instead, they seek to use their understanding of a chain of causes to interrupt the chain.

Second, doesn't addressing Yali's question automatically involve a Eurocentric approach to history, a glorification of western Europeans, and an obsession with the prominence of western Europe and Europeanized America in the modern world? Isn't that prominence just an ephemeral phenomenon of the last few centuries, now fading behind the prominence of Japan and Southeast Asia? In fact, most of this book will deal with peoples other than Europeans. Rather than focus solely on interactions between Europeans and non-Europeans, we shall also examine interactions between different non-European peoples—especially those that took place within sub-Saharan Africa, Southeast Asia, Indonesia, and New Guinea, among peoples native to those areas. Far from glorifying peoples of western European origin, we

shall see that most basic elements of their civilization were developed by other peoples living elsewhere and were then imported to western Europe.

Third, don't words such as "civilization," and phrases such as "rise of civilization," convey the false impression that civilization is good, tribal hunter-gatherers are miserable, and history for the past 13,000 years has involved progress toward greater human happiness? In fact, I do not assume that industrialized states are "better" than hunter-gatherer tribes, or that the abandonment of the hunter-gatherer lifestyle for iron-based statehood represents "progress," or that it has led to an increase in human happiness. My own impression, from having divided my life between United States cities and New Guinea villages, is that the so-called blessings of civilization are mixed. For example, compared with hunter-gatherers, citizens of modern industrialized states enjoy better medical care, lower risk of death by homicide, and a longer life span, but receive much less social support from friendships and extended families. My motive for investigating these geographic differences in human societies is not to celebrate one type of society over another but simply to understand what happened in history.

DOES YALI'S QUESTION really need another book to answer it? Don't we already know the answer? If so, what is it?

Probably the commonest explanation involves implicitly or explicitly assuming biological differences among peoples. In the centuries after A.D. 1500, as European explorers became aware of the wide differences among the world's peoples in technology and political organization, they assumed that those differences arose from differences in innate ability. With the rise of Darwinian theory, explanations were recast in terms of natural selection and of evolutionary descent. Technologically primitive peoples were considered evolutionary vestiges of human descent from apelike ancestors. The displacement of such peoples by colonists from industrialized societies exemplified the survival of the fittest. With the later rise of genetics, the explanations were recast once again, in genetic terms. Europeans became considered genetically more intelligent than Africans, and especially more so than Aboriginal Australians.

Today, segments of Western society publicly repudiate racism. Yet many (perhaps most!) Westerners continue to accept racist explanations privately or subconsciously. In Japan and many other countries, such explanations are still advanced publicly and without apology. Even educated white Americans,

Europeans, and Australians, when the subject of Australian Aborigines comes up, assume that there is something primitive about the Aborigines themselves. They certainly look different from whites. Many of the living descendants of those Aborigines who survived the era of European colonization are now finding it difficult to succeed economically in white Australian society.

A seemingly compelling argument goes as follows. White immigrants to Australia built a literate, industrialized, politically centralized, democratic state based on metal tools and on food production, all within a century of colonizing a continent where the Aborigines had been living as tribal hunter-gatherers without metal for at least 40,000 years. Here were two successive experiments in human development, in which the environment was identical and the sole variable was the people occupying that environment. What further proof could be wanted to establish that the differences between Aboriginal Australian and European societies arose from differences between the peoples themselves?

The objection to such racist explanations is not just that they are loathsome, but also that they are wrong. Sound evidence for the existence of human differences in intelligence that parallel human differences in technology is lacking. In fact, as I shall explain in a moment, modern "Stone Age" peoples are on the average probably more intelligent, not less intelligent, than industrialized peoples. Paradoxical as it may sound, we shall see in Chapter 15 that white immigrants to Australia do not deserve the credit usually accorded to them for building a literate industrialized society with the other virtues mentioned above. In addition, peoples who until recently were technologically primitive—such as Aboriginal Australians and New Guineans—routinely master industrial technologies when given opportunities to do so.

An enormous effort by cognitive psychologists has gone into the search for differences in IQ between peoples of different geographic origins now living in the same country. In particular, numerous white American psychologists have been trying for decades to demonstrate that black Americans of African origins are innately less intelligent than white Americans of European origins. However, as is well known, the peoples compared differ greatly in their social environment and educational opportunities. This fact creates double difficulties for efforts to test the hypothesis that intellectual differences underlie technological differences. First, even our cognitive abilities as adults are heavily influenced by the social environment that we experienced during childhood, making it hard to discern any influence of preexisting

genetic differences. Second, tests of cognitive ability (like IQ tests) tend to measure cultural learning and not pure innate intelligence, whatever that is. Because of those undoubted effects of childhood environment and learned knowledge on IQ test results, the psychologists' efforts to date have not succeeded in convincingly establishing the postulated genetic deficiency in IQs of nonwhite peoples.

My perspective on this controversy comes from 33 years of working with New Guineans in their own intact societies. From the very beginning of my work with New Guineans, they impressed me as being on the average more intelligent, more alert, more expressive, and more interested in things and people around them than the average European or American is. At some tasks that one might reasonably suppose to reflect aspects of brain function, such as the ability to form a mental map of unfamiliar surroundings, they appear considerably more adept than Westerners. Of course, New Guineans tend to perform poorly at tasks that Westerners have been trained to perform since childhood and that New Guineans have not. Hence when unschooled New Guineans from remote villages visit towns, they look stupid to Westerners. Conversely, I am constantly aware of how stupid I look to New Guineans when I'm with them in the jungle, displaying my incompetence at simple tasks (such as following a jungle trail or erecting a shelter) at which New Guineans have been trained since childhood and I have not.

It's easy to recognize two reasons why my impression that New Guineans are smarter than Westerners may be correct. First, Europeans have for thousands of years been living in densely populated societies with central governments, police, and judiciaries. In those societies, infectious epidemic diseases of dense populations (such as smallpox) were historically the major cause of death, while murders were relatively uncommon and a state of war was the exception rather than the rule. Most Europeans who escaped fatal infections also escaped other potential causes of death and proceeded to pass on their genes. Today, most live-born Western infants survive fatal infections as well and reproduce themselves, regardless of their intelligence and the genes they bear. In contrast, New Guineans have been living in societies where human numbers were too low for epidemic diseases of dense populations to evolve. Instead, traditional New Guineans suffered high mortality from murder, chronic tribal warfare, accidents, and problems in procuring food.

Intelligent people are likelier than less intelligent ones to escape those causes of high mortality in traditional New Guinea societies. However, the differential mortality from epidemic diseases in traditional European socie-

ties had little to do with intelligence, and instead involved genetic resistance dependent on details of body chemistry. For example, people with blood group B or O have a greater resistance to smallpox than do people with blood group A. That is, natural selection promoting genes for intelligence has probably been far more ruthless in New Guinea than in more densely populated, politically complex societies, where natural selection for body chemistry was instead more potent.

Besides this genetic reason, there is also a second reason why New Guineans may have come to be smarter than Westerners. Modern European and American children spend much of their time being passively entertained by television, radio, and movies. In the average American household, the TV set is on for seven hours per day. In contrast, traditional New Guinea children have virtually no such opportunities for passive entertainment and instead spend almost all of their waking hours actively doing something, such as talking or playing with other children or adults. Almost all studies of child development emphasize the role of childhood stimulation and activity in promoting mental development, and stress the irreversible mental stunting associated with reduced childhood stimulation. This effect surely contributes a non-genetic component to the superior average mental function displayed by New Guineans.

That is, in mental ability New Guineans are probably genetically superior to Westerners, and they surely are superior in escaping the devastating developmental disadvantages under which most children in industrialized societies now grow up. Certainly, there is no hint at all of any intellectual *dis*advantage of New Guineans that could serve to answer Yali's question. The same two genetic and childhood developmental factors are likely to distinguish not only New Guineans from Westerners, but also hunter-gatherers and other members of technologically primitive societies from members of technologically advanced societies in general. Thus, the usual racist assumption has to be turned on its head. Why is it that Europeans, despite their likely genetic disadvantage and (in modern times) their undoubted developmental disadvantage, ended up with much more of the cargo? Why did New Guineans wind up technologically primitive, despite what I believe to be their superior intelligence?

A GENETIC EXPLANATION ISN'T the only possible answer to Yali's question. Another one, popular with inhabitants of northern Europe, invokes

the supposed stimulatory effects of their homeland's cold climate and the inhibitory effects of hot, humid, tropical climates on human creativity and energy. Perhaps the seasonally variable climate at high latitudes poses more diverse challenges than does a seasonally constant tropical climate. Perhaps cold climates require one to be more technologically inventive to survive, because one must build a warm home and make warm clothing, whereas one can survive in the tropics with simpler housing and no clothing. Or the argument can be reversed to reach the same conclusion: the long winters at high latitudes leave people with much time in which to sit indoors and invent.

Although formerly popular, this type of explanation, too, fails to survive scrutiny. As we shall see, the peoples of northern Europe contributed nothing of fundamental importance to Eurasian civilization until the last thousand years; they simply had the good luck to live at a geographic location where they were likely to receive advances (such as agriculture, wheels, writing, and metallurgy) developed in warmer parts of Eurasia. In the New World the cold regions at high latitude were even more of a human backwater. The sole Native American societies to develop writing arose in Mexico south of the Tropic of Cancer; the oldest New World pottery comes from near the equator in tropical South America; and the New World society generally considered the most advanced in art, astronomy, and other respects was the Classic Maya society of the tropical Yucatán and Guatemala in the first millennium A.D.

Still a third type of answer to Yali invokes the supposed importance of lowland river valleys in dry climates, where highly productive agriculture depended on large-scale irrigation systems that in turn required centralized bureaucracies. This explanation was suggested by the undoubted fact that the earliest known empires and writing systems arose in the Tigris and Euphrates Valleys of the Fertile Crescent and in the Nile Valley of Egypt. Water control systems also appear to have been associated with centralized political organization in some other areas of the world, including the Indus Valley of the Indian subcontinent, the Yellow and Yangtze Valleys of China, the Maya lowlands of Mesoamerica, and the coastal desert of Peru.

However, detailed archaeological studies have shown that complex irrigation systems did not *accompany* the rise of centralized bureaucracies but *followed* after a considerable lag. That is, political centralization arose for some other reason and then permitted construction of complex irrigation systems. None of the crucial developments preceding political centralization in those same parts of the world were associated with river valleys or with

complex irrigation systems. For example, in the Fertile Crescent food production and village life originated in hills and mountains, not in lowland river valleys. The Nile Valley remained a cultural backwater for about 3,000 years after village food production began to flourish in the hills of the Fertile Crescent. River valleys of the southwestern United States eventually came to support irrigation agriculture and complex societies, but only after many of the developments on which those societies rested had been imported from Mexico. The river valleys of southeastern Australia remained occupied by tribal societies without agriculture.

Yet another type of explanation lists the immediate factors that enabled Europeans to kill or conquer other peoples—especially European guns, infectious diseases, steel tools, and manufactured products. Such an explanation is on the right track, as those factors demonstrably *were* directly responsible for European conquests. However, this hypothesis is incomplete, because it still offers only a proximate (first-stage) explanation identifying immediate causes. It invites a search for ultimate causes: why were Europeans, rather than Africans or Native Americans, the ones to end up with guns, the nastiest germs, and steel?

While some progress has been made in identifying those ultimate causes in the case of Europe's conquest of the New World, Africa remains a big puzzle. Africa is the continent where protohumans evolved for the longest time, where anatomically modern humans may also have arisen, and where native diseases like malaria and yellow fever killed European explorers. If a long head start counts for anything, why didn't guns and steel arise first in Africa, permitting Africans and their germs to conquer Europe? And what accounts for the failure of Aboriginal Australians to pass beyond the stage of hunter-gatherers with stone tools?

Questions that emerge from worldwide comparisons of human societies formerly attracted much attention from historians and geographers. The best-known modern example of such an effort was Arnold Toynbee's 12-volume *Study of History*. Toynbee was especially interested in the internal dynamics of 23 advanced civilizations, of which 22 were literate and 19 were Eurasian. He was less interested in prehistory and in simpler, nonliterate societies. Yet the roots of inequality in the modern world lie far back in prehistory. Hence Toynbee did not pose Yali's question, nor did he come to grips with what I see as history's broadest pattern. Other available books on world history similarly tend to focus on advanced literate Eurasian civilizations of the last 5,000 years; they have a very brief treatment of pre-Columbian

Native American civilizations, and an even briefer discussion of the rest of the world except for its recent interactions with Eurasian civilizations. Since Toynbee's attempt, worldwide syntheses of historical causation have fallen into disfavor among most historians, as posing an apparently intractable problem.

Specialists from several disciplines have provided global syntheses of their subjects. Especially useful contributions have been made by ecological geographers, cultural anthropologists, biologists studying plant and animal domestication, and scholars concerned with the impact of infectious diseases on history. These studies have called attention to parts of the puzzle, but they provide only pieces of the needed broad synthesis that has been missing.

Thus, there is no generally accepted answer to Yali's question. On the one hand, the proximate explanations are clear: some peoples developed guns, germs, steel, and other factors conferring political and economic power before others did; and some peoples never developed these power factors at all. On the other hand, the ultimate explanations—for example, why bronze tools appeared early in parts of Eurasia, late and only locally in the New World, and never in Aboriginal Australia—remain unclear.

Our present lack of such ultimate explanations leaves a big intellectual gap, since the broadest pattern of history thus remains unexplained. Much more serious, though, is the moral gap left unfilled. It is perfectly obvious to everyone, whether an overt racist or not, that different peoples have fared differently in history. The modern United States is a European-molded society, occupying lands conquered from Native Americans and incorporating the descendants of millions of sub-Saharan black Africans brought to America as slaves. Modern Europe is not a society molded by sub-Saharan black Africans who brought millions of Native Americans as slaves.

These results are completely lopsided: it was not the case that 51 percent of the Americas, Australia, and Africa was conquered by Europeans, while 49 percent of Europe was conquered by Native Americans, Aboriginal Australians, or Africans. The whole modern world has been shaped by lopsided outcomes. Hence they must have inexorable explanations, ones more basic than mere details concerning who happened to win some battle or develop some invention on one occasion a few thousand years ago.

It *seems* logical to suppose that history's pattern reflects innate differences among people themselves. Of course, we're taught that it's not polite to say so in public. We read of technical studies claiming to demonstrate inborn differences, and we also read rebuttals claiming that those studies suffer from

technical flaws. We see in our daily lives that some of the conquered peoples continue to form an underclass, centuries after the conquests or slave imports took place. We're told that this too is to be attributed not to any biological shortcomings but to social disadvantages and limited opportunities.

Nevertheless, we have to wonder. We keep seeing all those glaring, persistent differences in peoples' status. We're assured that the seemingly transparent biological explanation for the world's inequalities as of A.D. 1500 is wrong, but we're not told what the correct explanation is. Until we have some convincing, detailed, agreed-upon explanation for the broad pattern of history, most people will continue to suspect that the racist biological explanation is correct after all. That seems to me the strongest argument for writing this book.

AUTHORS ARE REGULARLY asked by journalists to summarize a long book in one sentence. For this book, here is such a sentence: "History followed different courses for different peoples because of differences among peoples' environments, not because of biological differences among peoples themselves."

Naturally, the notion that environmental geography and biogeography influenced societal development is an old idea. Nowadays, though, the view is not held in esteem by historians; it is considered wrong or simplistic, or it is caricatured as environmental determinism and dismissed, or else the whole subject of trying to understand worldwide differences is shelved as too difficult. Yet geography obviously has *some* effect on history; the open question concerns how much effect, and whether geography can account for history's broad pattern.

The time is now ripe for a fresh look at these questions, because of new information from scientific disciplines seemingly remote from human history. Those disciplines include, above all, genetics, molecular biology, and biogeography as applied to crops and their wild ancestors; the same disciplines plus behavioral ecology, as applied to domestic animals and their wild ancestors; molecular biology of human germs and related germs of animals; epidemiology of human diseases; human genetics; linguistics; archaeological studies on all continents and major islands; and studies of the histories of technology, writing, and political organization.

This diversity of disciplines poses problems for would-be authors of a book aimed at answering Yali's question. The author must possess a range of exper-

tise spanning the above disciplines, so that relevant advances can be synthesized. The history and prehistory of each continent must be similarly synthesized. The book's subject matter is history, but the approach is that of science—in particular, that of historical sciences such as evolutionary biology and geology. The author must understand from firsthand experience a range of human societies, from hunter-gatherer societies to modern space-age civilizations.

These requirements seem at first to demand a multi-author work. Yet that approach would be doomed from the outset, because the essence of the problem is to develop a unified synthesis. That consideration dictates single authorship, despite all the difficulties that it poses. Inevitably, that single author will have to sweat copiously in order to assimilate material from many disciplines, and will require guidance from many colleagues.

My background had led me to several of these disciplines even before Yali put his question to me in 1972. My mother is a teacher and linguist; my father, a physician specializing in the genetics of childhood diseases. Because of my father's example, I went through school expecting to become a physician. I had also become a fanatical bird-watcher by the age of seven. It was thus an easy step, in my last undergraduate year at university, to shift from my initial goal of medicine to the goal of biological research. However, throughout my school and undergraduate years, my training was mainly in languages, history, and writing. Even after deciding to obtain a Ph.D. in physiology, I nearly dropped out of science during my first year of graduate school to become a linguist.

Since completing my Ph.D. in 1961, I have divided my scientific research efforts between two fields: molecular physiology on the one hand, evolutionary biology and biogeography on the other hand. As an unforeseen bonus for the purposes of this book, evolutionary biology is a historical science forced to use methods different from those of the laboratory sciences. That experience has made the difficulties in devising a scientific approach to human history familiar to me. Living in Europe from 1958 to 1962, among European friends whose lives had been brutally traumatized by 20th-century European history, made me start to think more seriously about how chains of causes operate in history's unfolding.

For the last 33 years my fieldwork as an evolutionary biologist has brought me into close contact with a wide range of human societies. My specialty is bird evolution, which I have studied in South America, southern Africa, Indonesia, Australia, and especially New Guinea. Through living with native peoples of these areas, I have become familiar with many technologically

primitive human societies, from those of hunter-gatherers to those of tribal farmers and fishing peoples who depended until recently on stone tools. Thus, what most literate people would consider strange lifestyles of remote prehistory are for me the most vivid part of my life. New Guinea, though it accounts for only a small fraction of the world's land area, encompasses a disproportionate fraction of its human diversity. Of the modern world's 6,000 languages, 1,000 are confined to New Guinea. In the course of my work on New Guinea birds, my interests in language were rekindled, by the need to elicit lists of local names of bird species in nearly 100 of those New Guinea languages.

Out of all those interests grew my most recent book, a nontechnical account of human evolution entitled *The Third Chimpanzee*. Its Chapter 14, called "Accidental Conquerors," sought to understand the outcome of the encounter between Europeans and Native Americans. After I had completed that book, I realized that other modern, as well as prehistoric, encounters between peoples raised similar questions. I saw that the question with which I had wrestled in that Chapter 14 was in essence the question Yali had asked me in 1972, merely transferred to a different part of the world. And so at last, with the help of many friends, I shall attempt to satisfy Yali's curiosity—and my own.

THIS BOOK'S CHAPTERS are divided into four parts. Part 1, entitled "From Eden to Cajamarca," consists of three chapters. Chapter 1 provides a whirlwind tour of human evolution and history, extending from our divergence from apes, around 7 million years ago, until the end of the last Ice Age, around 13,000 years ago. We shall trace the spread of ancestral humans, from our origins in Africa to the other continents, in order to understand the state of the world just before the events often lumped into the term "rise of civilization" began. It turns out that human development on some continents got a head start in time over developments on others.

Chapter 2 prepares us for exploring effects of continental environments on history over the past 13,000 years, by briefly examining effects of island environments on history over smaller time scales and areas. When ancestral Polynesians spread into the Pacific around 3,200 years ago, they encountered islands differing greatly in their environments. Within a few millennia that single ancestral Polynesian society had spawned on those diverse islands a range of diverse daughter societies, from hunter-gatherer tribes to proto-

empires. That radiation can serve as a model for the longer, larger-scale, and less understood radiation of societies on different continents since the end of the last Ice Age, to become variously hunter-gatherer tribes and empires.

The third chapter introduces us to collisions between peoples from different continents, by retelling through contemporary eyewitness accounts the most dramatic such encounter in history: the capture of the last independent Inca emperor, Atahuallpa, in the presence of his whole army, by Francisco Pizarro and his tiny band of conquistadores, at the Peruvian city of Cajamarca. We can identify the chain of proximate factors that enabled Pizarro to capture Atahuallpa, and that operated in European conquests of other Native American societies as well. Those factors included Spanish germs, horses, literacy, political organization, and technology (especially ships and weapons). That analysis of proximate causes is the easy part of this book; the hard part is to identify the ultimate causes leading to them and to the actual outcome, rather than to the opposite possible outcome of Atahuallpa's coming to Madrid and capturing King Charles I of Spain.

Part 2, entitled "The Rise and Spread of Food Production" and consisting of Chapters 4–10, is devoted to what I believe to be the most important constellation of ultimate causes. Chapter 4 sketches how food production—that is, the growing of food by agriculture or herding, instead of the hunting and gathering of wild foods—ultimately led to the immediate factors permitting Pizarro's triumph. But the rise of food production varied around the globe. As we shall see in Chapter 5, peoples in some parts of the world developed food production by themselves; some other peoples acquired it in prehistoric times from those independent centers; and still others neither developed nor acquired food production prehistorically but remained hunter-gatherers until modern times. Chapter 6 explores the numerous factors driving the shift from the hunter-gatherer lifestyle toward food production, in some areas but not in others.

Chapters 7, 8, and 9 then show how crops and livestock came in prehistoric times to be domesticated from ancestral wild plants and animals, by incipient farmers and herders who could have had no vision of the outcome. Geographic differences in the local suites of wild plants and animals available for domestication go a long way toward explaining why only a few areas became independent centers of food production, and why it arose earlier in some of those areas than in others. From those few centers of origin, food production spread much more rapidly to some areas than to others. A major factor contributing to those differing rates of spread turns out to have been

the orientation of the continents' axes: predominantly west–east for Eurasia, predominantly north–south for the Americas and Africa (Chapter 10).

Thus, Chapter 3 sketched the immediate factors behind Europe's conquest of Native Americans, and Chapter 4 the development of those factors from the ultimate cause of food production. In Part 3 ("From Food to Guns, Germs, and Steel," Chapters 11–14), the connections from ultimate to proximate causes are traced in detail, beginning with the evolution of germs characteristic of dense human populations (Chapter 11). Far more Native Americans and other non-Eurasian peoples were killed by Eurasian germs than by Eurasian guns or steel weapons. Conversely, few or no distinctive lethal germs awaited would-be European conquerors in the New World. Why was the germ exchange so unequal? Here, the results of recent molecular biological studies are illuminating in linking germs to the rise of food production, in Eurasia much more than in the Americas.

Another chain of causation led from food production to writing, possibly the most important single invention of the last few thousand years (Chapter 12). Writing has evolved de novo only a few times in human history, in areas that had been the earliest sites of the rise of food production in their respective regions. All other societies that have become literate did so by the diffusion of writing systems or of the idea of writing from one of those few primary centers. Hence, for the student of world history, the phenomenon of writing is particularly useful for exploring another important constellation of causes: geography's effect on the ease with which ideas and inventions spread.

What holds for writing also holds for technology (Chapter 13). A crucial question is whether technological innovation is so dependent on rare inventor-geniuses, and on many idiosyncratic cultural factors, as to defy an understanding of world patterns. In fact, we shall see that, paradoxically, this large number of cultural factors makes it easier, not harder, to understand world patterns of technology. By enabling farmers to generate food surpluses, food production permitted farming societies to support full-time craft specialists who did not grow their own food and who developed technologies.

Besides sustaining scribes and inventors, food production also enabled farmers to support politicians (Chapter 14). Mobile bands of hunter-gatherers are relatively egalitarian, and their political sphere is confined to the band's own territory and to shifting alliances with neighboring bands. With the rise of dense, sedentary, food-producing populations came the rise of chiefs, kings, and bureaucrats. Such bureaucracies were essential not only to gov-

erning large and populous domains but also to maintaining standing armies, sending out fleets of exploration, and organizing wars of conquest.

Part 4 ("Around the World in Six Chapters," Chapters 15–20) applies the lessons of Parts 2 and 3 to each of the continents and some important islands. Chapter 15 examines the history of Australia itself, and of the large island of New Guinea, formerly joined to Australia in a single continent. The case of Australia, home to the recent human societies with the simplest technologies, and the sole continent where food production did not develop indigenously, poses a critical test of theories about intercontinental differences in human societies. We shall see why Aboriginal Australians remained hunter-gatherers, even while most peoples of neighboring New Guinea became food producers.

Chapters 16 and 17 integrate developments in Australia and New Guinea into the perspective of the whole region encompassing the East Asian mainland and Pacific islands. The rise of food production in China spawned several great prehistoric movements of human populations, or of cultural traits, or of both. One of those movements, within China itself, created the political and cultural phenomenon of China as we know it today. Another resulted in a replacement, throughout almost the whole of tropical Southeast Asia, of indigenous hunter-gatherers by farmers of ultimately South Chinese origin. Still another, the Austronesian expansion, similarly replaced the indigenous hunter-gatherers of the Philippines and Indonesia and spread out to the most remote islands of Polynesia, but was unable to colonize Australia and most of New Guinea. To the student of world history, all those collisions among East Asian and Pacific peoples are doubly important: they formed the countries where one-third of the modern world's population lives, and in which economic power is increasingly becoming concentrated; and they furnish especially clear models for understanding the histories of peoples elsewhere in the world.

Chapter 18 returns to the problem introduced in Chapter 3, the collision between European and Native American peoples. A summary of the last 13,000 years of New World and western Eurasian history makes clear how Europe's conquest of the Americas was merely the culmination of two long and mostly separate historical trajectories. The differences between those trajectories were stamped by continental differences in domesticable plants and animals, germs, times of settlement, orientation of continental axes, and ecological barriers.

The history of sub-Saharan Africa (Chapter 19) offers striking similarities

as well as contrasts with New World history. The same factors that molded Europeans' encounters with Africans molded their encounters with Native Americans as well. But Africa also differed from the Americas in all these factors. As a result, European conquest did not create widespread or lasting European settlement of sub-Saharan Africa, except in the far south. Of more lasting significance was a large-scale population shift within Africa itself, the Bantu expansion. It proves to have been triggered by many of the same causes that played themselves out at Cajamarca, in East Asia, on Pacific islands, and in Australia and New Guinea.

I harbor no illusions that these chapters have succeeded in explaining the histories of all the continents for the past 13,000 years. Obviously, that would be impossible to accomplish in a single book even if we did understand all the answers, which we don't. At best, this book identifies several constellations of environmental factors that I believe provide a large part of the answer to Yali's question. Recognition of those factors emphasizes the unexplained residue, whose understanding will be a task for the future.

The Epilogue, entitled "The Future of Human History as a Science," lays out some pieces of the residue, including the problem of the differences between different parts of Eurasia, the role of cultural factors unrelated to environment, and the role of individuals. Perhaps the biggest of these unsolved problems is to establish human history as a historical science, on a par with recognized historical sciences such as evolutionary biology, geology, and climatology. The study of human history does pose real difficulties, but those recognized historical sciences encounter some of the same challenges. Hence the methods developed in some of these other fields may also prove useful in the field of human history.

Already, though, I hope to have convinced you, the reader, that history is not "just one damn fact after another," as a cynic put it. There really are broad patterns to history, and the search for their explanation is as productive as it is fascinating.

CHAPTER 1

UP TO THE STARTING LINE

A SUITABLE STARTING POINT FROM WHICH TO COMPARE historical developments on the different continents is around 11,000 B.C.* This date corresponds approximately to the beginnings of village life in a few parts of the world, the first undisputed peopling of the Americas, the end of the Pleistocene Era and last Ice Age, and the start of what geologists term the Recent Era. Plant and animal domestication began in at least one part of the world within a few thousand years of that date. As of then, did the people of some continents already have a head start or a clear advantage over peoples of other continents?

If so, perhaps that head start, amplified over the last 13,000 years, provides the answer to Yali's question. Hence this chapter will offer a whirlwind tour of human history on all the continents, for millions of years, from our

* Throughout this book, dates for about the last 15,000 years will be quoted as so-called calibrated radiocarbon dates, rather than as conventional, uncalibrated radiocarbon dates. The difference between the two types of dates will be explained in Chapter 5. Calibrated dates are the ones believed to correspond more closely to actual calendar dates. Readers accustomed to uncalibrated dates will need to bear this distinction in mind whenever they find me quoting apparently erroneous dates that are older than the ones with which they are familiar. For example, the date of the Clovis archaeological horizon in North America is usually quoted as around 9000 B.C. (11,000 years ago), but I quote it instead as around 11,000 B.C. (13,000 years ago), because the date usually quoted is uncalibrated.

origins as a species until 13,000 years ago. All that will now be summarized in less than 20 pages. Naturally, I shall gloss over details and mention only what seem to me the trends most relevant to this book.

Our closest living relatives are three surviving species of great ape: the gorilla, the common chimpanzee, and the pygmy chimpanzee (also known as bonobo). Their confinement to Africa, along with abundant fossil evidence, indicates that the earliest stages of human evolution were also played out in Africa. Human history, as something separate from the history of animals, began there about 7 million years ago (estimates range from 5 to 9 million years ago). Around that time, a population of African apes broke up into several populations, of which one proceeded to evolve into modern gorillas, a second into the two modern chimps, and the third into humans. The gorilla line apparently split off slightly before the split between the chimp and the human lines.

Fossils indicate that the evolutionary line leading to us had achieved a substantially upright posture by around 4 million years ago, then began to increase in body size and in relative brain size around 2.5 million years ago. Those protohumans are generally known as *Australopithecus africanus*, *Homo habilis*, and *Homo erectus*, which apparently evolved into each other in that sequence. Although *Homo erectus*, the stage reached around 1.7 million years ago, was close to us modern humans in body size, its brain size was still barely half of ours. Stone tools became common around 2.5 million years ago, but they were merely the crudest of flaked or battered stones. In zoological significance and distinctiveness, *Homo erectus* was more than an ape, but still much less than a modern human.

All of that human history, for the first 5 or 6 million years after our origins about 7 million years ago, remained confined to Africa. The first human ancestor to spread beyond Africa was *Homo erectus*, as is attested by fossils discovered on the Southeast Asian island of Java and conventionally known as Java man (see Figure 1.1). The oldest Java "man" fossils—of course, they may actually have belonged to a Java woman—have usually been assumed to date from about a million years ago. However, it has recently been argued that they actually date from 1.8 million years ago. (Strictly speaking, the name *Homo erectus* belongs to these Javan fossils, and the African fossils classified as *Homo erectus* may warrant a different name.) At present, the earliest unquestioned evidence for humans in Europe stems from around half a million years ago, but there are claims of an earlier presence. One would certainly assume that the colonization of Asia also permitted the simultaneous colonization of Europe, since Eurasia is a single landmass not bisected by major barriers.

That illustrates an issue that will recur throughout this book. Whenever

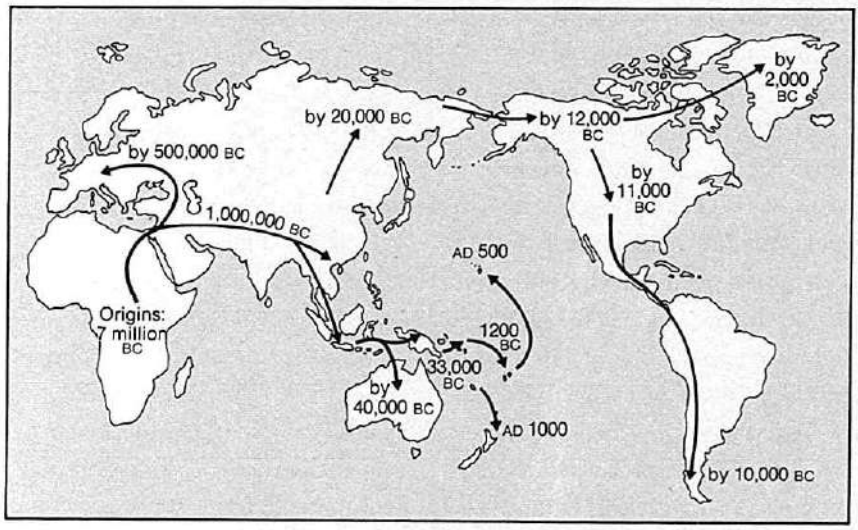

Figure 1.1. The spread of humans around the world.

some scientist claims to have discovered "the earliest X"—whether X is the earliest human fossil in Europe, the earliest evidence of domesticated corn in Mexico, or the earliest anything anywhere—that announcement challenges other scientists to beat the claim by finding something still earlier. In reality, there must be some truly "earliest X," with all claims of earlier X's being false. However, as we shall see, for virtually any X, every year brings forth new discoveries and claims of a purported still earlier X, along with refutations of some or all of previous years' claims of earlier X. It often takes decades of searching before archaeologists reach a consensus on such questions.

By about half a million years ago, human fossils had diverged from older *Homo erectus* skeletons in their enlarged, rounder, and less angular skulls. African and European skulls of half a million years ago were sufficiently similar to skulls of us moderns that they are classified in our species, *Homo sapiens*, instead of in *Homo erectus*. This distinction is arbitrary, since *Homo erectus* evolved into *Homo sapiens*. However, these early *Homo sapiens* still differed from us in skeletal details, had brains significantly smaller than ours, and were grossly different from us in their artifacts and behavior. Modern stone-tool-making peoples, such as Yali's great-grandparents, would have scorned the stone tools of half a million years ago as very crude. The only other significant addition to our ancestors' cultural repertoire that can be documented with confidence around that time was the use of fire.

No art, bone tool, or anything else has come down to us from early *Homo sapiens* except for their skeletal remains, plus those crude stone tools. There were still no humans in Australia, for the obvious reason that it would have taken boats to get there from Southeast Asia. There were also no humans anywhere in the Americas, because that would have required the occupation of the nearest part of the Eurasian continent (Siberia), and possibly boat-building skills as well. (The present, shallow Bering Strait, separating Siberia from Alaska, alternated between a strait and a broad intercontinental bridge of dry land, as sea level repeatedly rose and fell during the Ice Ages.) However, boat building and survival in cold Siberia were both still far beyond the capabilities of early *Homo sapiens*.

After half a million years ago, the human populations of Africa and western Eurasia proceeded to diverge from each other and from East Asian populations in skeletal details. The population of Europe and western Asia between 130,000 and 40,000 years ago is represented by especially many skeletons, known as Neanderthals and sometimes classified as a separate species, *Homo neanderthalensis*. Despite being depicted in innumerable cartoons as apelike brutes living in caves, Neanderthals had brains slightly larger than our own. They were also the first humans to leave behind strong evidence of burying their dead and caring for their sick. Yet their stone tools were still crude by comparison with modern New Guineans' polished stone axes and were usually not yet made in standardized diverse shapes, each with a clearly recognizable function.

The few preserved African skeletal fragments contemporary with the Neanderthals are more similar to our modern skeletons than to Neanderthal skeletons. Even fewer preserved East Asian skeletal fragments are known, but they appear different again from both Africans and Neanderthals. As for the lifestyle at that time, the best-preserved evidence comes from stone artifacts and prey bones accumulated at southern African sites. Although those Africans of 100,000 years ago had more modern skeletons than did their Neanderthal contemporaries, they made essentially the same crude stone tools as Neanderthals, still lacking standardized shapes. They had no preserved art. To judge from the bone evidence of the animal species on which they preyed, their hunting skills were unimpressive and mainly directed at easy-to-kill, not-at-all-dangerous animals. They were not yet in the business of slaughtering buffalo, pigs, and other dangerous prey. They couldn't even catch fish: their sites immediately on the seacoast lack fish bones and fishhooks. They and their Neanderthal contemporaries still rank as less than fully human.

Human history at last took off around 50,000 years ago, at the time of

what I have termed our Great Leap Forward. The earliest definite signs of that leap come from East African sites with standardized stone tools and the first preserved jewelry (ostrich-shell beads). Similar developments soon appear in the Near East and in southeastern Europe, then (some 40,000 years ago) in southwestern Europe, where abundant artifacts are associated with fully modern skeletons of people termed Cro-Magnons. Thereafter, the garbage preserved at archaeological sites rapidly becomes more and more interesting and leaves no doubt that we are dealing with biologically and behaviorally modern humans.

Cro-Magnon garbage heaps yield not only stone tools but also tools of bone, whose suitability for shaping (for instance, into fishhooks) had apparently gone unrecognized by previous humans. Tools were produced in diverse and distinctive shapes so modern that their functions as needles, awls, engraving tools, and so on are obvious to us. Instead of only single-piece tools such as hand-held scrapers, multipiece tools made their appearance. Recognizable multipiece weapons at Cro-Magnon sites include harpoons, spear-throwers, and eventually bows and arrows, the precursors of rifles and other multipiece modern weapons. Those efficient means of killing at a safe distance permitted the hunting of such dangerous prey as rhinos and elephants, while the invention of rope for nets, lines, and snares allowed the addition of fish and birds to our diet. Remains of houses and sewn clothing testify to a greatly improved ability to survive in cold climates, and remains of jewelry and carefully buried skeletons indicate revolutionary aesthetic and spiritual developments.

Of the Cro-Magnons' products that have been preserved, the best known are their artworks: their magnificent cave paintings, statues, and musical instruments, which we still appreciate as art today. Anyone who has experienced firsthand the overwhelming power of the life-sized painted bulls and horses in the Lascaux Cave of southwestern France will understand at once that their creators must have been as modern in their minds as they were in their skeletons.

Obviously, some momentous change took place in our ancestors' capabilities between about 100,000 and 50,000 years ago. That Great Leap Forward poses two major unresolved questions, regarding its triggering cause and its geographic location. As for its cause, I argued in my book *The Third Chimpanzee* for the perfection of the voice box and hence for the anatomical basis of modern language, on which the exercise of human creativity is so dependent. Others have suggested instead that a change in brain organization around that time, without a change in brain size, made modern language possible.

As for the site of the Great Leap Forward, did it take place primarily in

one geographic area, in one group of humans, who were thereby enabled to expand and replace the former human populations of other parts of the world? Or did it occur in parallel in different regions, in each of which the human populations living there today would be descendants of the populations living there before the leap? The rather modern-looking human skulls from Africa around 100,000 years ago have been taken to support the former view, with the leap occurring specifically in Africa. Molecular studies (of so-called mitochondrial DNA) were initially also interpreted in terms of an African origin of modern humans, though the meaning of those molecular findings is currently in doubt. On the other hand, skulls of humans living in China and Indonesia hundreds of thousands of years ago are considered by some physical anthropologists to exhibit features still found in modern Chinese and in Aboriginal Australians, respectively. If true, that finding would suggest parallel evolution and multiregional origins of modern humans, rather than origins in a single Garden of Eden. The issue remains unresolved.

The evidence for a localized origin of modern humans, followed by their spread and then their replacement of other types of humans elsewhere, seems strongest for Europe. Some 40,000 years ago, into Europe came the Cro-Magnons, with their modern skeletons, superior weapons, and other advanced cultural traits. Within a few thousand years there were no more Neanderthals, who had been evolving as the sole occupants of Europe for hundreds of thousands of years. That sequence strongly suggests that the modern Cro-Magnons somehow used their far superior technology, and their language skills or brains, to infect, kill, or displace the Neanderthals, leaving behind little or no evidence of hybridization between Neanderthals and Cro-Magnons.

THE GREAT LEAP FORWARD coincides with the first proven major extension of human geographic range since our ancestors' colonization of Eurasia. That extension consisted of the occupation of Australia and New Guinea, joined at that time into a single continent. Many radiocarbon-dated sites attest to human presence in Australia/New Guinea between 40,000 and 30,000 years ago (plus the inevitable somewhat older claims of contested validity). Within a short time of that initial peopling, humans had expanded over the whole continent and adapted to its diverse habitats, from the tropical rain forests and high mountains of New Guinea to the dry interior and wet southeastern corner of Australia.

During the Ice Ages, so much of the oceans' water was locked up in gla-

ciers that worldwide sea levels dropped hundreds of feet below their present stand. As a result, what are now the shallow seas between Asia and the Indonesian islands of Sumatra, Borneo, Java, and Bali became dry land. (So did other shallow straits, such as the Bering Strait and the English Channel.) The edge of the Southeast Asian mainland then lay 700 miles east of its present location. Nevertheless, central Indonesian islands between Bali and Australia remained surrounded and separated by deepwater channels. To reach Australia / New Guinea from the Asian mainland at that time still required crossing a minimum of eight channels, the broadest of which was at least 50 miles wide. Most of those channels divided islands visible from each other, but Australia itself was always invisible from even the nearest Indonesian islands, Timor and Tanimbar. Thus, the occupation of Australia / New Guinea is momentous in that it demanded watercraft and provides by far the earliest evidence of their use in history. Not until about 30,000 years later (13,000 years ago) is there strong evidence of watercraft anywhere else in the world, from the Mediterranean.

Initially, archaeologists considered the possibility that the colonization of Australia / New Guinea was achieved accidentally by just a few people swept to sea while fishing on a raft near an Indonesian island. In an extreme scenario the first settlers are pictured as having consisted of a single pregnant young woman carrying a male fetus. But believers in the fluke-colonization theory have been surprised by recent discoveries that still other islands, lying to the east of New Guinea, were colonized soon after New Guinea itself, by around 35,000 years ago. Those islands were New Britain and New Ireland, in the Bismarck Archipelago, and Buka, in the Solomon Archipelago. Buka lies out of sight of the closest island to the west and could have been reached only by crossing a water gap of about 100 miles. Thus, early Australians and New Guineans were probably capable of intentionally traveling over water to visible islands, and were using watercraft sufficiently often that the colonization of even invisible distant islands was repeatedly achieved unintentionally.

The settlement of Australia / New Guinea was perhaps associated with still another big first, besides humans' first use of watercraft and first range extension since reaching Eurasia: the first mass extermination of large animal species by humans. Today, we regard Africa as *the* continent of big mammals. Modern Eurasia also has many species of big mammals (though not in the manifest abundance of Africa's Serengeti Plains), such as Asia's rhinos and elephants and tigers, and Europe's moose and bears and (until classical times) lions. Australia / New Guinea today has no equally large mammals,

in fact no mammal larger than 100-pound kangaroos. But Australia / New Guinea formerly had its own suite of diverse big mammals, including giant kangaroos, rhinolike marsupials called diprotodonts and reaching the size of a cow, and a marsupial "leopard." It also formerly had a 400-pound ostrich-like flightless bird, plus some impressively big reptiles, including a one-ton lizard, a giant python, and land-dwelling crocodiles.

All of those Australian / New Guinean giants (the so-called megafauna) disappeared after the arrival of humans. While there has been controversy about the exact timing of their demise, several Australian archaeological sites, with dates extending over tens of thousands of years, and with prodigiously abundant deposits of animal bones, have been carefully excavated and found to contain not a trace of the now extinct giants over the last 35,000 years. Hence the megafauna probably became extinct soon after humans reached Australia.

The near-simultaneous disappearance of so many large species raises an obvious question: what caused it? An obvious possible answer is that they were killed off or else eliminated indirectly by the first arriving humans. Recall that Australian / New Guinean animals had evolved for millions of years in the absence of human hunters. We know that Galápagos and Antarctic birds and mammals, which similarly evolved in the absence of humans and did not see humans until modern times, are still incurably tame today. They would have been exterminated if conservationists had not imposed protective measures quickly. On other recently discovered islands where protective measures did not go into effect quickly, exterminations did indeed result: one such victim, the dodo of Mauritius, has become virtually a symbol for extinction. We also know now that, on every one of the well-studied oceanic islands colonized in the prehistoric era, human colonization led to an extinction spasm whose victims included the moas of New Zealand, the giant lemurs of Madagascar, and the big flightless geese of Hawaii. Just as modern humans walked up to unafraid dodos and island seals and killed them, prehistoric humans presumably walked up to unafraid moas and giant lemurs and killed them too.

Hence one hypothesis for the demise of Australia's and New Guinea's giants is that they met the same fate around 40,000 years ago. In contrast, most big mammals of Africa and Eurasia survived into modern times, because they had coevolved with protohumans for hundreds of thousands or millions of years. They thereby enjoyed ample time to evolve a fear of humans, as our ancestors' initially poor hunting skills slowly improved. The

dodo, moas, and perhaps the giants of Australia / New Guinea had the misfortune suddenly to be confronted, without any evolutionary preparation, by invading modern humans possessing fully developed hunting skills.

However, the overkill hypothesis, as it is termed, has not gone unchallenged for Australia / New Guinea. Critics emphasize that, as yet, no one has documented the bones of an extinct Australian / New Guinean giant with compelling evidence of its having been killed by humans, or even of its having lived in association with humans. Defenders of the overkill hypothesis reply: you would hardly expect to find kill sites if the extermination was completed very quickly and long ago, such as within a few millennia some 40,000 years ago. The critics respond with a countertheory: perhaps the giants succumbed instead to a change in climate, such as a severe drought on the already chronically dry Australian continent. The debate goes on.

Personally, I can't fathom why Australia's giants should have survived innumerable droughts in their tens of millions of years of Australian history, and then have chosen to drop dead almost simultaneously (at least on a time scale of millions of years) precisely and just coincidentally when the first humans arrived. The giants became extinct not only in dry central Australia but also in drenching wet New Guinea and southeastern Australia. They became extinct in every habitat without exception, from deserts to cold rain forest and tropical rain forest. Hence it seems to me most likely that the giants were indeed exterminated by humans, both directly (by being killed for food) and indirectly (as the result of fires and habitat modification caused by humans). But regardless of whether the overkill hypothesis or the climate hypothesis proves correct, the disappearance of all of the big animals of Australia / New Guinea had, as we shall see, heavy consequences for subsequent human history. Those extinctions eliminated all the large wild animals that might otherwise have been candidates for domestication, and left native Australians and New Guineans with not a single native domestic animal.

THUS, THE COLONIZATION of Australia / New Guinea was not achieved until around the time of the Great Leap Forward. Another extension of human range that soon followed was the one into the coldest parts of Eurasia. While Neanderthals lived in glacial times and were adapted to the cold, they penetrated no farther north than northern Germany and Kiev. That's not surprising, since Neanderthals apparently lacked needles, sewn clothing, warm houses, and other technology essential to survival in the

coldest climates. Anatomically modern peoples who did possess such technology had expanded into Siberia by around 20,000 years ago (there are the usual much older disputed claims). That expansion may have been responsible for the extinction of Eurasia's woolly mammoth and woolly rhinoceros.

With the settlement of Australia/New Guinea, humans now occupied three of the five habitable continents. (Throughout this book, I count Eurasia as a single continent, and I omit Antarctica because it was not reached by humans until the 19th century and has never had any self-supporting human population.) That left only two continents, North America and South America. They were surely the last ones settled, for the obvious reason that reaching the Americas from the Old World required either boats (for which there is no evidence even in Indonesia until 40,000 years ago and none in Europe until much later) in order to cross by sea, or else it required the occupation of Siberia (unoccupied until about 20,000 years ago) in order to cross the Bering land bridge.

However, it is uncertain when, between about 14,000 and 35,000 years ago, the Americas were first colonized. The oldest unquestioned human remains in the Americas are at sites in Alaska dated around 12,000 B.C., followed by a profusion of sites in the United States south of the Canadian border and in Mexico in the centuries just before 11,000 B.C. The latter sites are called Clovis sites, named after the type site near the town of Clovis, New Mexico, where their characteristic large stone spearpoints were first recognized. Hundreds of Clovis sites are now known, blanketing all 48 of the lower U.S. states south into Mexico. Unquestioned evidence of human presence appears soon thereafter in Amazonia and in Patagonia. These facts suggest the interpretation that Clovis sites document the Americas' first colonization by people, who quickly multiplied, expanded, and filled the two continents.

One might at first be surprised that Clovis descendants could reach Patagonia, lying 8,000 miles south of the U.S.-Canada border, in less than a thousand years. However, that translates into an average expansion of only 8 miles per year, a trivial feat for a hunter-gatherer likely to cover that distance even within a single day's normal foraging.

One might also at first be surprised that the Americas evidently filled up with humans so quickly that people were motivated to keep spreading south toward Patagonia. That population growth also proves unsurprising when one stops to consider the actual numbers. If the Americas eventually came to hold hunter-gatherers at an average population density of somewhat under one person per square mile (a high value for modern hunter-gatherers), then the whole

area of the Americas would eventually have held about 10 million hunter-gatherers. But even if the initial colonists had consisted of only 100 people and their numbers had increased at a rate of only 1.1 percent per year, the colonists' descendants would have reached that population ceiling of 10 million people within a thousand years. A population growth rate of 1.1 percent per year is again trivial: rates as high as 3.4 percent per year have been observed in modern times when people colonized virgin lands, such as when the HMS *Bounty* mutineers and their Tahitian wives colonized Pitcairn Island.

The profusion of Clovis hunters' sites within the first few centuries after their arrival resembles the site profusion documented archaeologically for the more recent discovery of New Zealand by ancestral Maori. A profusion of early sites is also documented for the much older colonization of Europe by anatomically modern humans, and for the occupation of Australia/New Guinea. That is, everything about the Clovis phenomenon and its spread through the Americas corresponds to findings for other, unquestioned virgin-land colonizations in history.

What might be the significance of Clovis sites' bursting forth in the centuries just before 11,000 B.C., rather than in those before 16,000 or 21,000 B.C.? Recall that Siberia has always been cold, and that a continuous ice sheet stretched as an impassable barrier across the whole width of Canada during much of the Pleistocene Ice Ages. We have already seen that the technology required for coping with extreme cold did not emerge until after anatomically modern humans invaded Europe around 40,000 years ago, and that people did not colonize Siberia until 20,000 years later. Eventually, those early Siberians crossed to Alaska, either by sea across the Bering Strait (only 50 miles wide even today) or else on foot at glacial times when Bering Strait was dry land. The Bering land bridge, during its millennia of intermittent existence, would have been up to a thousand miles wide, covered by open tundra, and easily traversable by people adapted to cold conditions. The land bridge was flooded and became a strait again most recently when sea level rose after around 14,000 B.C. Whether those early Siberians walked or paddled to Alaska, the earliest secure evidence of human presence in Alaska dates from around 12,000 B.C.

Soon thereafter, a north–south ice-free corridor opened in the Canadian ice sheet, permitting the first Alaskans to pass through and come out into the Great Plains around the site of the modern Canadian city of Edmonton. That removed the last serious barrier between Alaska and Patagonia for modern humans. The Edmonton pioneers would have found the Great Plains

teeming with game. They would have thrived, increased in numbers, and gradually spread south to occupy the whole hemisphere.

One other feature of the Clovis phenomenon fits our expectations for the first human presence south of the Canadian ice sheet. Like Australia / New Guinea, the Americas had originally been full of big mammals. About 15,000 years ago, the American West looked much as Africa's Serengeti Plains do today, with herds of elephants and horses pursued by lions and cheetahs, and joined by members of such exotic species as camels and giant ground sloths. Just as in Australia / New Guinea, in the Americas most of those large mammals became extinct. Whereas the extinctions took place probably before 30,000 years ago in Australia, they occurred around 17,000 to 12,000 years ago in the Americas. For those extinct American mammals whose bones are available in greatest abundance and have been dated especially accurately, one can pinpoint the extinctions as having occurred around 11,000 B.C. Perhaps the two most accurately dated extinctions are those of the Shasta ground sloth and Harrington's mountain goat in the Grand Canyon area; both of those populations disappeared within a century or two of 11,100 B.C. Whether coincidentally or not, that date is identical, within experimental error, to the date of Clovis hunters' arrival in the Grand Canyon area.

The discovery of numerous skeletons of mammoths with Clovis spearpoints between their ribs suggests that this agreement of dates is not a coincidence. Hunters expanding southward through the Americas, encountering big animals that had never seen humans before, may have found those American animals easy to kill and may have exterminated them. A countertheory is that America's big mammals instead became extinct because of climate changes at the end of the last Ice Age, which (to confuse the interpretation for modern paleontologists) also happened around 11,000 B.C.

Personally, I have the same problem with a climatic theory of megafaunal extinction in the Americas as with such a theory in Australia / New Guinea. The Americas' big animals had already survived the ends of 22 previous Ice Ages. Why did most of them pick the 23rd to expire in concert, in the presence of all those supposedly harmless humans? Why did they disappear in all habitats, not only in habitats that contracted but also in ones that greatly expanded at the end of the last Ice Age? Hence I suspect that Clovis hunters did it, but the debate remains unresolved. Whichever theory proves correct, most large wild mammal species that might otherwise have later been domesticated by Native Americans were thereby removed.

Also unresolved is the question whether Clovis hunters really were the

first Americans. As always happens whenever anyone claims the first anything, claims of discoveries of pre-Clovis human sites in the Americas are constantly being advanced. Every year, a few of those new claims really do appear convincing and exciting when initially announced. Then the inevitable problems of interpretation arise. Were the reported tools at the site really tools made by humans, or just natural rock shapes? Are the reported radiocarbon dates really correct, and not invalidated by any of the numerous difficulties that can plague radiocarbon dating? If the dates are correct, are they really associated with human products, rather than just being a 15,000-year-old lump of charcoal lying next to a stone tool actually made 9,000 years ago?

To illustrate these problems, consider the following typical example of an often quoted pre-Clovis claim. At a Brazilian rock shelter named Pedra Furada, archaeologists found cave paintings undoubtedly made by humans. They also discovered, among the piles of stones at the base of a cliff, some stones whose shapes suggested the possibility of their being crude tools. In addition, they came upon supposed hearths, whose burnt charcoal yielded radiocarbon dates of around 35,000 years ago. Articles on Pedra Furada were accepted for publication in the prestigious and highly selective international scientific journal *Nature*.

But none of those rocks at the base of the cliff is an obviously human-made tool, as are Clovis points and Cro-Magnon tools. If hundreds of thousands of rocks fall from a high cliff over the course of tens of thousands of years, many of them will become chipped and broken when they hit the rocks below, and some will come to resemble crude tools chipped and broken by humans. In western Europe and elsewhere in Amazonia, archaeologists have radiocarbon-dated the actual pigments used in cave paintings, but that was not done at Pedra Furada. Forest fires occur frequently in the vicinity and produce charcoal that is regularly swept into caves by wind and streams. No evidence links the 35,000-year-old charcoal to the undoubted cave paintings at Pedra Furada. Although the original excavators remain convinced, a team of archaeologists who were not involved in the excavation but receptive to pre-Clovis claims recently visited the site and came away unconvinced.

The North American site that currently enjoys the strongest credentials as a possible pre-Clovis site is Meadowcroft rock shelter, in Pennsylvania, yielding reported human-associated radiocarbon dates of about 16,000 years ago. At Meadowcroft no archaeologist denies that many human artifacts do occur in many carefully excavated layers. But the oldest radiocarbon dates don't make sense, because the plant and animal species associated with them are species liv-

ing in Pennsylvania in recent times of mild climates, rather than species expected for the glacial times of 16,000 years ago. Hence one has to suspect that the charcoal samples dated from the oldest human occupation levels consist of post-Clovis charcoal infiltrated with older carbon. The strongest pre-Clovis candidate in South America is the Monte Verde site, in southern Chile, dated to at least 15,000 years ago. It too now seems convincing to many archaeologists, but caution is warranted in view of all the previous disillusionments.

If there really were pre-Clovis people in the Americas, why is it still so hard to prove that they existed? Archaeologists have excavated hundreds of American sites unequivocally dating to between 2000 and 11,000 B.C., including dozens of Clovis sites in the North American West, rock shelters in the Appalachians, and sites in coastal California. Below all the archaeological layers with undoubted human presence, at many of those same sites, deeper older layers have been excavated and still yield undoubted remains of animals—but with no further evidence of humans. The weaknesses in pre-Clovis evidence in the Americas contrast with the strength of the evidence in Europe, where hundreds of sites attest to the presence of modern humans long before Clovis hunters appeared in the Americas around 11,000 B.C. Even more striking is the evidence from Australia / New Guinea, where there are barely one-tenth as many archaeologists as in the United States alone, but where those few archaeologists have nevertheless discovered over a hundred unequivocal pre-Clovis sites scattered over the whole continent.

Early humans certainly didn't fly by helicopter from Alaska to Meadowcroft and Monte Verde, skipping all the landscape in between. Advocates of pre-Clovis settlement suggest that, for thousands or even tens of thousands of years, pre-Clovis humans remained at low population densities or poorly visible archaeologically, for unknown reasons unprecedented elsewhere in the world. I find that suggestion infinitely more implausible than the suggestion that Monte Verde and Meadowcroft will eventually be reinterpreted, as have other claimed pre-Clovis sites. My feeling is that, if there really had been pre-Clovis settlement in the Americas, it would have become obvious at many locations by now, and we would not still be arguing. However, archaeologists remain divided on these questions.

The consequences for our understanding of later American prehistory remain the same, whichever interpretation proves correct. Either: the Americas were first settled around 11,000 B.C. and quickly filled up with people. Or else: the first settlement occurred somewhat earlier (most advocates of pre-Clovis settlement would suggest by 15,000 or 20,000 years ago, possi-

bly 30,000 years ago, and few would seriously claim earlier); but those pre-Clovis settlers remained few in numbers, or inconspicuous, or had little impact, until around 11,000 B.C. In either case, of the five habitable continents, North America and South America are the ones with the shortest human prehistories.

WITH THE OCCUPATION of the Americas, most habitable areas of the continents and continental islands, plus oceanic islands from Indonesia to east of New Guinea, supported humans. The settlement of the world's remaining islands was not completed until modern times: Mediterranean islands such as Crete, Cyprus, Corsica, and Sardinia between about 8500 and 4000 B.C.; Caribbean islands beginning around 4000 B.C.; Polynesian and Micronesian islands between 1200 B.C. and A.D. 1000; Madagascar sometime between A.D. 300 and 800; and Iceland in the ninth century A.D. Native Americans, possibly ancestral to the modern Inuit, spread throughout the High Arctic around 2000 B.C. That left, as the sole uninhabited areas awaiting European explorers over the last 700 years, only the most remote islands of the Atlantic and Indian Oceans (such as the Azores and Seychelles), plus Antarctica.

What significance, if any, do the continents' differing dates of settlement have for subsequent history? Suppose that a time machine could have transported an archaeologist back in time, for a world tour at around 11,000 B.C. Given the state of the world then, could the archaeologist have predicted the sequence in which human societies on the various continents would develop guns, germs, and steel, and thus predicted the state of the world today?

Our archaeologist might have considered the possible advantages of a head start. If that counted for anything, then Africa enjoyed an enormous advantage: at least 5 million more years of separate protohuman existence than on any other continent. In addition, if it is true that modern humans arose in Africa around 100,000 years ago and spread to other continents, that would have wiped out any advantages accumulated elsewhere in the meantime and given Africans a new head start. Furthermore, human genetic diversity is highest in Africa; perhaps more-diverse humans would collectively produce more-diverse inventions.

But our archaeologist might then reflect: what, really, does a "head start" mean for the purposes of this book? We cannot take the metaphor of a

footrace literally. If by head start you mean the time required to populate a continent after the arrival of the first few pioneering colonists, that time is relatively brief: for example, less than 1,000 years to fill up even the whole New World. If by head start you instead mean the time required to adapt to local conditions, I grant that some extreme environments did take time: for instance, 9,000 years to occupy the High Arctic after the occupation of the rest of North America. But people would have explored and adapted to most other areas quickly, once modern human inventiveness had developed. For example, after the ancestors of the Maori reached New Zealand, it apparently took them barely a century to discover all worthwhile stone sources; only a few more centuries to kill every last moa in some of the world's most rugged terrain; and only a few centuries to differentiate into a range of diverse societies, from that of coastal hunter-gatherers to that of farmers practicing new types of food storage.

Our archaeologist might therefore look at the Americas and conclude that Africans, despite their apparently enormous head start, would have been overtaken by the earliest Americans within at most a millennium. Thereafter, the Americas' greater area (50 percent greater than Africa's) and much greater environmental diversity would have given the advantage to Native Americans over Africans.

The archaeologist might then turn to Eurasia and reason as follows. Eurasia is the world's largest continent. It has been occupied for longer than any other continent except Africa. Africa's long occupation before the colonization of Eurasia a million years ago might have counted for nothing anyway, because protohumans were at such a primitive stage then. Our archaeologist might look at the Upper Paleolithic flowering of southwestern Europe between 20,000 and 12,000 years ago, with all those famous artworks and complex tools, and wonder whether Eurasia was already getting a head start then, at least locally.

Finally, the archaeologist would turn to Australia / New Guinea, noting first its small area (it's the smallest continent), the large fraction of it covered by desert capable of supporting few humans, the continent's isolation, and its later occupation than that of Africa and Eurasia. All that might lead the archaeologist to predict slow development in Australia / New Guinea.

But remember that Australians and New Guineans had by far the earliest watercraft in the world. They were creating cave paintings apparently at least as early as the Cro-Magnons in Europe. Jonathan Kingdon and Tim Flannery have noted that the colonization of Australia / New Guinea from

the islands of the Asian continental shelf required humans to learn to deal with the new environments they encountered on the islands of central Indonesia—a maze of coastlines offering the richest marine resources, coral reefs, and mangroves in the world. As the colonists crossed the straits separating each Indonesian island from the next one to the east, they adapted anew, filled up that next island, and went on to colonize the next island again. It was a hitherto unprecedented golden age of successive human population explosions. Perhaps those cycles of colonization, adaptation, and population explosion were what selected for the Great Leap Forward, which then diffused back westward to Eurasia and Africa. If this scenario is correct, then Australia / New Guinea gained a massive head start that might have continued to propel human development there long after the Great Leap Forward.

Thus, an observer transported back in time to 11,000 B.C. could not have predicted on which continent human societies would develop most quickly, but could have made a strong case for any of the continents. With hindsight, of course, we know that Eurasia was the one. But it turns out that the actual reasons behind the more rapid development of Eurasian societies were not at all the straightforward ones that our imaginary archaeologist of 11,000 B.C. guessed. The remainder of this book consists of a quest to discover those real reasons.

CHAPTER 2

A Natural Experiment of History

On the Chatham Islands, 500 miles east of New Zealand, centuries of independence came to a brutal end for the Moriori people in December 1835. On November 19 of that year, a ship carrying 500 Maori armed with guns, clubs, and axes arrived, followed on December 5 by a shipload of 400 more Maori. Groups of Maori began to walk through Moriori settlements, announcing that the Moriori were now their slaves, and killing those who objected. An organized resistance by the Moriori could still then have defeated the Maori, who were outnumbered two to one. However, the Moriori had a tradition of resolving disputes peacefully. They decided in a council meeting not to fight back but to offer peace, friendship, and a division of resources.

Before the Moriori could deliver that offer, the Maori attacked en masse. Over the course of the next few days, they killed hundreds of Moriori, cooked and ate many of the bodies, and enslaved all the others, killing most of them too over the next few years as it suited their whim. A Moriori survivor recalled, "[The Maori] commenced to kill us like sheep. . . . [We] were terrified, fled to the bush, concealed ourselves in holes underground, and in any place to escape our enemies. It was of no avail; we were discovered and killed—men, women, and children indiscriminately." A Maori conqueror explained, "We took possession . . . in accordance with our customs and we caught all the people. Not

one escaped. Some ran away from us, these we killed, and others we killed—but what of that? It was in accordance with our custom."

The brutal outcome of this collision between the Moriori and the Maori could have been easily predicted. The Moriori were a small, isolated population of hunter-gatherers, equipped with only the simplest technology and weapons, entirely inexperienced at war, and lacking strong leadership or organization. The Maori invaders (from New Zealand's North Island) came from a dense population of farmers chronically engaged in ferocious wars, equipped with more-advanced technology and weapons, and operating under strong leadership. Of course, when the two groups finally came into contact, it was the Maori who slaughtered the Moriori, not vice versa.

The tragedy of the Moriori resembles many other such tragedies in both the modern and the ancient world, pitting numerous well-equipped people against few ill-equipped opponents. What makes the Maori-Moriori collision grimly illuminating is that both groups had diverged from a common origin less than a millennium earlier. Both were Polynesian peoples. The modern Maori are descendants of Polynesian farmers who colonized New Zealand around A.D. 1000. Soon thereafter, a group of those Maori in turn colonized the Chatham Islands and became the Moriori. In the centuries after the two groups separated, they evolved in opposite directions, the North Island Maori developing more-complex and the Moriori less-complex technology and political organization. The Moriori reverted to being hunter-gatherers, while the North Island Maori turned to more intensive farming.

Those opposite evolutionary courses sealed the outcome of their eventual collision. If we could understand the reasons for the disparate development of those two island societies, we might have a model for understanding the broader question of differing developments on the continents.

MORIORI AND MAORI history constitutes a brief, small-scale natural experiment that tests how environments affect human societies. Before you read a whole book examining environmental effects on a very large scale—effects on human societies around the world for the last 13,000 years—you might reasonably want assurance, from smaller tests, that such effects really are significant. If you were a laboratory scientist studying rats, you might perform such a test by taking one rat colony, distributing groups of those ancestral rats among many cages with differing environments, and coming back many rat generations later to see what had happened. Of course, such purposeful experiments cannot be

carried out on human societies. Instead, scientists must look for "natural experiments," in which something similar befell humans in the past.

Such an experiment unfolded during the settlement of Polynesia. Scattered over the Pacific Ocean beyond New Guinea and Melanesia are thousands of islands differing greatly in area, isolation, elevation, climate, productivity, and geological and biological resources (Figure 2.1). For most of human history those islands lay far beyond the reach of watercraft. Around 1200 B.C. a group of farming, fishing, seafaring people from the Bismarck Archipelago north of New Guinea finally succeeded in reaching some of those islands. Over the following centuries their descendants colonized virtually every habitable scrap of land in the Pacific. The process was mostly complete by A.D. 500, with the last few islands settled around or soon after A.D. 1000.

Thus, within a modest time span, enormously diverse island environments were settled by colonists all of whom stemmed from the same founding population. The ultimate ancestors of all modern Polynesian populations shared essentially the same culture, language, technology, and set of domesticated plants and animals. Hence Polynesian history constitutes a natural experiment allowing us to study human adaptation, devoid of the usual complications of multiple waves of disparate colonists that often frustrate our attempts to understand adaptation elsewhere in the world.

Within that medium-sized test, the fate of the Moriori forms a smaller test. It is easy to trace how the differing environments of the Chatham Islands and of New Zealand molded the Moriori and the Maori differently. While those ancestral Maori who first colonized the Chathams may have been farmers, Maori tropical crops could not grow in the Chathams' cold climate, and the colonists had no alternative except to revert to being hunter-gatherers. Since as hunter-gatherers they did not produce crop surpluses available for redistribution or storage, they could not support and feed nonhunting craft specialists, armies, bureaucrats, and chiefs. Their prey were seals, shellfish, nesting seabirds, and fish that could be captured by hand or with clubs and required no more elaborate technology. In addition, the Chathams are relatively small and remote islands, capable of supporting a total population of only about 2,000 hunter-gatherers. With no other accessible islands to colonize, the Moriori had to remain in the Chathams, and to learn how to get along with each other. They did so by renouncing war, and they reduced potential conflicts from overpopulation by castrating some male infants. The result was a small, unwarlike population with simple technology and weapons, and without strong leadership or organization.

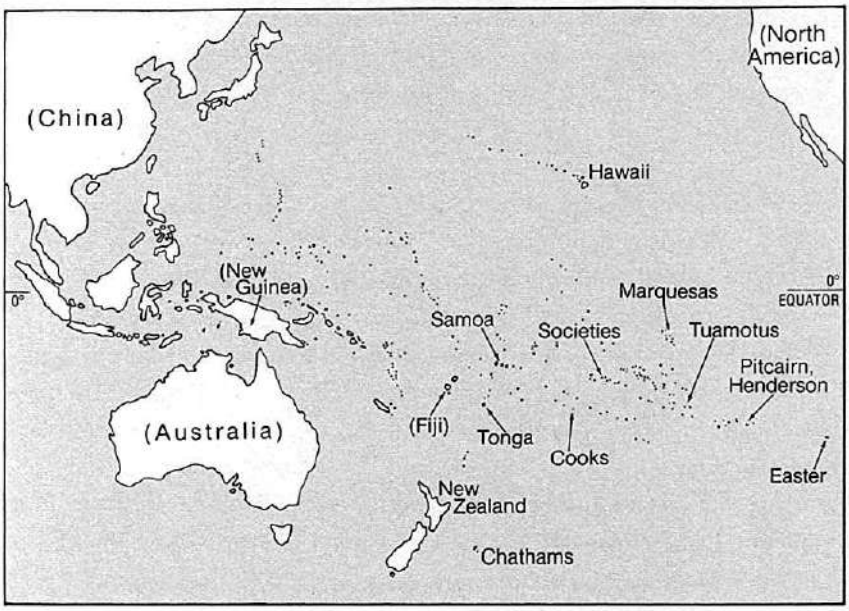

Figure 2.1. Polynesian islands. (Parentheses denote some non-Polynesian lands.)

In contrast, the northern (warmer) part of New Zealand, by far the largest island group in Polynesia, was suitable for Polynesian agriculture. Those Maori who remained in New Zealand increased in numbers until there were more than 100,000 of them. They developed locally dense populations chronically engaged in ferocious wars with neighboring populations. With the crop surpluses that they could grow and store, they fed craft specialists, chiefs, and part-time soldiers. They needed and developed varied tools for growing their crops, fighting, and making art. They erected elaborate ceremonial buildings and prodigious numbers of forts.

Thus, Moriori and Maori societies developed from the same ancestral society, but along very different lines. The resulting two societies lost awareness even of each other's existence and did not come into contact again for many centuries, perhaps for as long as 500 years. Finally, an Australian seal-hunting ship visiting the Chathams en route to New Zealand brought the news to New Zealand of islands where "there is an abundance of sea and shellfish; the lakes swarm with eels; and it is a land of the karaka berry. . . . The inhabitants are very numerous, but they do not understand how to fight, and have no weap-

ons." That news was enough to induce 900 Maori to sail to the Chathams. The outcome clearly illustrates how environments can affect economy, technology, political organization, and fighting skills within a short time.

As I ALREADY mentioned, the Maori-Moriori collision represents a small test within a medium-sized test. What can we learn from all of Polynesia about environmental influences on human societies? What differences among societies on different Polynesian islands need to be explained?

Polynesia as a whole presented a much wider range of environmental conditions than did just New Zealand and the Chathams, although the latter define one extreme (the simple end) of Polynesian organization. In their subsistence modes, Polynesians ranged from the hunter-gatherers of the Chathams, through slash-and-burn farmers, to practitioners of intensive food production living at some of the highest population densities of any human societies. Polynesian food producers variously intensified production of pigs, dogs, and chickens. They organized work forces to construct large irrigation systems for agriculture and to enclose large ponds for fish production. The economic basis of Polynesian societies consisted of more or less self-sufficient households, but some islands also supported guilds of hereditary part-time craft specialists. In social organization, Polynesian societies ran the gamut from fairly egalitarian village societies to some of the most stratified societies in the world, with many hierarchically ranked lineages and with chief and commoner classes whose members married within their own class. In political organization, Polynesian islands ranged from landscapes divided into independent tribal or village units, up to multi-island proto-empires that devoted standing military establishments to invasions of other islands and wars of conquest. Finally, Polynesian material culture varied from the production of no more than personal utensils to the construction of monumental stone architecture. How can all that variation be explained?

Contributing to these differences among Polynesian societies were at least six sets of environmental variables among Polynesian islands: island climate, geological type, marine resources, area, terrain fragmentation, and isolation. Let's examine the ranges of these factors, before considering their specific consequences for Polynesian societies.

The climate in Polynesia varies from warm tropical or subtropical on most islands, which lie near the equator, to temperate on most of New Zealand, and cold subantarctic on the Chathams and the southern part of New Zea-

land's South Island. Hawaii's Big Island, though lying well within the Tropic of Cancer, has mountains high enough to support alpine habitats and receive occasional snowfalls. Rainfall varies from the highest recorded on Earth (in New Zealand's Fjordland and Hawaii's Alakai Swamp on Kauai) to only one-tenth as much on islands so dry that they are marginal for agriculture.

Island geological types include coral atolls, raised limestone, volcanic islands, pieces of continents, and mixtures of those types. At one extreme, innumerable islets, such as those of the Tuamotu Archipelago, are flat, low atolls barely rising above sea level. Other former atolls, such as Henderson and Rennell, have been lifted far above sea level to constitute raised limestone islands. Both of those atoll types present problems to human settlers, because they consist entirely of limestone without other stones, have only very thin soil, and lack permanent fresh water. At the opposite extreme, the largest Polynesian island, New Zealand, is an old, geologically diverse, continental fragment of Gondwanaland, offering a range of mineral resources, including commercially exploitable iron, coal, gold, and jade. Most other large Polynesian islands are volcanoes that rose from the sea, have never formed parts of a continent, and may or may not include areas of raised limestone. While lacking New Zealand's geological richness, the oceanic volcanic islands at least are an improvement over atolls (from the Polynesians' perspective) in that they offer diverse types of volcanic stones, some of which are highly suitable for making stone tools.

The volcanic islands differ among themselves. The elevations of the higher ones generate rain in the mountains, so the islands are heavily weathered and have deep soils and permanent streams. That is true, for instance, of the Societies, Samoa, the Marquesas, and especially Hawaii, the Polynesian archipelago with the highest mountains. Among the lower islands, Tonga and (to a lesser extent) Easter also have rich soil because of volcanic ashfalls, but they lack Hawaii's large streams.

As for marine resources, most Polynesian islands are surrounded by shallow water and reefs, and many also encompass lagoons. Those environments teem with fish and shellfish. However, the rocky coasts of Easter, Pitcairn, and the Marquesas, and the steeply dropping ocean bottom and absence of coral reefs around those islands, are much less productive of seafood.

Area is another obvious variable, ranging from the 100 acres of Anuta, the smallest permanently inhabited isolated Polynesian island, up to the 103,000 square miles of the minicontinent of New Zealand. The habitable terrain of some islands, notably the Marquesas, is fragmented into steep-walled valleys

by ridges, while other islands, such as Tonga and Easter, consist of gently rolling terrain presenting no obstacles to travel and communication.

The last environmental variable to consider is isolation. Easter Island and the Chathams are small and so remote from other islands that, once they were initially colonized, the societies thus founded developed in total isolation from the rest of the world. New Zealand, Hawaii, and the Marquesas are also very remote, but at least the latter two apparently did have some further contact with other archipelagoes after the first colonization, and all three consist of many islands close enough to each other for regular contact between islands of the same archipelago. Most other Polynesian islands were in more or less regular contact with other islands. In particular, the Tongan Archipelago lies close enough to the Fijian, Samoan, and Wallis Archipelagoes to have permitted regular voyaging between archipelagoes, and eventually to permit Tongans to undertake the conquest of Fiji.

AFTER THAT BRIEF look at Polynesia's varying environments, let's now see how that variation influenced Polynesian societies. Subsistence is a convenient facet of society with which to start, since it in turn affected other facets.

Polynesian subsistence depended on varying mixes of fishing, gathering wild plants and marine shellfish and Crustacea, hunting terrestrial birds and breeding seabirds, and food production. Most Polynesian islands originally supported big flightless birds that had evolved in the absence of predators, New Zealand's moas and Hawaii's flightless geese being the best-known examples. While those birds were important food sources for the initial colonists, especially on New Zealand's South Island, most of them were soon exterminated on all islands, because they were easy to hunt down. Breeding seabirds were also quickly reduced in number but continued to be important food sources on some islands. Marine resources were significant on most islands but least so on Easter, Pitcairn, and the Marquesas, where people as a result were especially dependent on food that they themselves produced.

Ancestral Polynesians brought with them three domesticated animals (the pig, chicken, and dog) and domesticated no other animals within Polynesia. Many islands retained all three of those species, but the more isolated Polynesian islands lacked one or more of them, either because livestock brought in canoes failed to survive the colonists' long overwater journey or because livestock that died out could not be readily obtained again from the outside. For instance, isolated New Zealand ended up with only dogs; Easter and Tikopia,

with only chickens. Without access to coral reefs or productive shallow waters, and with their terrestrial birds quickly exterminated, Easter Islanders turned to constructing chicken houses for intensive poultry farming.

At best, however, these three domesticated animal species provided only occasional meals. Polynesian food production depended mainly on agriculture, which was impossible at subantarctic latitudes because all Polynesian crops were tropical ones initially domesticated outside Polynesia and brought in by colonists. The settlers of the Chathams and the cold southern part of New Zealand's South Island were thus forced to abandon the farming legacy developed by their ancestors over the previous thousands of years, and to become hunter-gatherers again.

People on the remaining Polynesian islands did practice agriculture based on dryland crops (especially taro, yams, and sweet potatoes), irrigated crops (mainly taro), and tree crops (such as breadfruit, bananas, and coconuts). The productivity and relative importance of those crop types varied considerably on different islands, depending on their environments. Human population densities were lowest on Henderson, Rennell, and the atolls because of their poor soil and limited fresh water. Densities were also low on temperate New Zealand, which was too cool for some Polynesian crops. Polynesians on these and some other islands practiced a nonintensive type of shifting, slash-and-burn agriculture.

Other islands had rich soils but were not high enough to have large permanent streams and hence irrigation. Inhabitants of those islands developed intensive dryland agriculture requiring a heavy input of labor to build terraces, carry out mulching, rotate crops, reduce or eliminate fallow periods, and maintain tree plantations. Dryland agriculture became especially productive on Easter, tiny Anuta, and flat and low Tonga, where Polynesians devoted most of the land area to the growing of food.

The most productive Polynesian agriculture was taro cultivation in irrigated fields. Among the more populous tropical islands, that option was ruled out for Tonga by its low elevation and hence its lack of rivers. Irrigation agriculture reached its peak on the westernmost Hawaiian islands of Kauai, Oahu, and Molokai, which were big and wet enough to support not only large permanent streams but also large human populations available for construction projects. Hawaiian labor corvées built elaborate irrigation systems for taro fields yielding up to 24 tons per acre, the highest crop yields in all of Polynesia. Those yields in turn supported intensive pig production. Hawaii was also unique within Polynesia in using mass labor for aquaculture, by constructing large fishponds in which milkfish and mullet were grown.

As a result of all this environmentally related variation in subsistence, human population densities (measured in people per square mile of arable land) varied greatly over Polynesia. At the lower end were the hunter-gatherers of the Chathams (only 5 people per square mile) and of New Zealand's South Island, and the farmers of the rest of New Zealand (28 people per square mile). In contrast, many islands with intensive agriculture attained population densities exceeding 120 per square mile. Tonga, Samoa, and the Societies achieved 210–250 people per square mile and Hawaii 300. The upper extreme of 1,100 people per square mile was reached on the high island of Anuta, whose population converted essentially all the land to intensive food production, thereby crammed 160 people into the island's 100 acres, and joined the ranks of the densest self-sufficient populations in the world. Anuta's population density exceeded that of modern Holland and even rivaled that of Bangladesh.

Population size is the product of population density (people per square mile) and area (square miles). The relevant area is not the area of an island but that of a political unit, which could be either larger or smaller than a single island. On the one hand, islands near one another might become combined into a single political unit. On the other hand, single large rugged islands were divided into many independent political units. Hence the area of the political unit varied not only with an island's area but also with its fragmentation and isolation.

For small isolated islands without strong barriers to internal communication, the entire island constituted the political unit—as in the case of Anuta, with its 160 people. Many larger islands never did become unified politically, whether because the population consisted of dispersed bands of only a few dozen hunter-gatherers each (the Chathams and New Zealand's southern South Island), or of farmers scattered over large distances (the rest of New Zealand), or of farmers living in dense populations but in rugged terrain precluding political unification. For example, people in neighboring steep-sided valleys of the Marquesas communicated with each other mainly by sea; each valley formed an independent political entity of a few thousand inhabitants, and most individual large Marquesan islands remained divided into many such entities.

The terrains of the Tongan, Samoan, Society, and Hawaiian islands did permit political unification within islands, yielding political units of 10,000 people or more (over 30,000 on the large Hawaiian islands). The distances between islands of the Tongan archipelago, as well as the distances between Tonga and

neighboring archipelagoes, were sufficiently modest that a multi-island empire encompassing 40,000 people was eventually established. Thus, Polynesian political units ranged in size from a few dozen to 40,000 people.

A political unit's population size interacted with its population density to influence Polynesian technology and economic, social, and political organization. In general, the larger the size and the higher the density, the more complex and specialized were the technology and organization, for reasons that we shall examine in detail in later chapters. Briefly, at high population densities only a portion of the people came to be farmers, but they were mobilized to devote themselves to intensive food production, thereby yielding surpluses to feed nonproducers. The nonproducers mobilizing them included chiefs, priests, bureaucrats, and warriors. The biggest political units could assemble large labor forces to construct irrigation systems and fishponds that intensified food production even further. These developments were especially apparent on Tonga, Samoa, and the Societies, all of which were fertile, densely populated, and moderately large by Polynesian standards. The trends reached their zenith on the Hawaiian Archipelago, consisting of the largest tropical Polynesian islands, where high population densities and large land areas meant that very large labor forces were potentially available to individual chiefs.

The variations among Polynesian societies associated with different population densities and sizes were as follows. Economies remained simplest on islands with low population densities (such as the hunter-gatherers of the Chathams), low population numbers (small atolls), or both low densities and low numbers. In those societies each household made what it needed; there was little or no economic specialization. Specialization increased on larger, more densely populated islands, reaching a peak on Samoa, the Societies, and especially Tonga and Hawaii. The latter two islands supported hereditary part-time craft specialists, including canoe builders, navigators, stone masons, bird catchers, and tattooers.

Social complexity was similarly varied. Again, the Chathams and the atolls had the simplest, most egalitarian societies. While those islands retained the original Polynesian tradition of having chiefs, their chiefs wore little or no visible signs of distinction, lived in ordinary huts like those of commoners, and grew or caught their food like everyone else. Social distinctions and chiefly powers increased on high-density islands with large political units, being especially marked on Tonga and the Societies.

Social complexity again reached its peak in the Hawaiian Archipelago, where people of chiefly descent were divided into eight hierarchically ranked

lineages. Members of those chiefly lineages did not intermarry with commoners but only with each other, sometimes even with siblings or half-siblings. Commoners had to prostrate themselves before high-ranking chiefs. All the members of chiefly lineages, bureaucrats, and some craft specialists were freed from the work of food production.

Political organization followed the same trends. On the Chathams and atolls, the chiefs had few resources to command, decisions were reached by general discussion, and landownership rested with the community as a whole rather than with the chiefs. Larger, more densely populated political units concentrated more authority with the chiefs. Political complexity was greatest on Tonga and Hawaii, where the powers of hereditary chiefs approximated those of kings elsewhere in the world, and where land was controlled by the chiefs, not by the commoners. Using appointed bureaucrats as agents, chiefs requisitioned food from the commoners and also conscripted them to work on large construction projects, whose form varied from island to island: irrigation projects and fishponds on Hawaii, dance and feast centers on the Marquesas, chiefs' tombs on Tonga, and temples on Hawaii, the Societies, and Easter.

At the time of Europeans' arrival in the 18th century, the Tongan chiefdom or state had already become an inter-archipelagal empire. Because the Tongan Archipelago itself was geographically close-knit and included several large islands with unfragmented terrain, each island became unified under a single chief; then the hereditary chiefs of the largest Tongan island (Tongatapu) united the whole archipelago, and eventually they conquered islands outside the archipelago up to 500 miles distant. They engaged in regular long-distance trade with Fiji and Samoa, established Tongan settlements in Fiji, and began to raid and conquer parts of Fiji. The conquest and administration of this maritime proto-empire were achieved by navies of large canoes, each holding up to 150 men.

Like Tonga, Hawaii became a political entity encompassing several populous islands, but one confined to a single archipelago because of its extreme isolation. At the time of Hawaii's "discovery" by Europeans in 1778, political unification had already taken place within each Hawaiian island, and some political fusion between islands had begun. The four largest islands—Big Island (Hawaii in the narrow sense), Maui, Oahu, and Kauai—remained independent, controlling (or jockeying with each other for control of) the smaller islands (Lanai, Molokai, Kahoolawe, and Niihau). After the arrival of Europeans, the Big Island's King Kamehameha I rapidly proceeded with the consolidation of the largest islands by purchasing European guns and ships to invade and conquer first Maui and

then Oahu. Kamehameha thereupon prepared invasions of the last independent Hawaiian island, Kauai, whose chief finally reached a negotiated settlement with him, completing the archipelago's unification.

The remaining type of variation among Polynesian societies to be considered involves tools and other aspects of material culture. The differing availability of raw materials imposed an obvious constraint on material culture. At the one extreme was Henderson Island, an old coral reef raised above sea level and devoid of stone other than limestone. Its inhabitants were reduced to fabricating adzes out of giant clamshells. At the opposite extreme, the Maori on the minicontinent of New Zealand had access to a wide range of raw materials and became especially noted for their use of jade. Between those two extremes fell Polynesia's oceanic volcanic islands, which lacked granite, flint, and other continental rocks but did at least have volcanic rocks, which Polynesians worked into ground or polished stone adzes used to clear land for farming.

As for the types of artifacts made, the Chatham Islanders required little more than hand-held clubs and sticks to kill seals, birds, and lobsters. Most other islanders produced a diverse array of fishhooks, adzes, jewelry, and other objects. On the atolls, as on the Chathams, those artifacts were small, relatively simple, and individually produced and owned, while architecture consisted of nothing more than simple huts. Large and densely populated islands supported craft specialists who produced a wide range of prestige goods for chiefs—such as the feather capes reserved for Hawaiian chiefs and made of tens of thousands of bird feathers.

The largest products of Polynesia were the immense stone structures of a few islands—the famous giant statues of Easter Island, the tombs of Tongan chiefs, the ceremonial platforms of the Marquesas, and the temples of Hawaii and the Societies. This monumental Polynesian architecture was obviously evolving in the same direction as the pyramids of Egypt, Mesopotamia, Mexico, and Peru. Naturally, Polynesia's structures are not on the scale of those pyramids, but that merely reflects the fact that Egyptian pharaohs could draw conscript labor from a much larger human population than could the chief of any Polynesian island. Even so, the Easter Islanders managed to erect 30-ton stone statues—no mean feat for an island with only 7,000 people, who had no power source other than their own muscles.

THUS POLYNESIAN ISLAND societies differed greatly in their economic specialization, social complexity, political organization, and material

products, related to differences in population size and density, related in turn to differences in island area, fragmentation, and isolation and in opportunities for subsistence and for intensifying food production. All those differences among Polynesian societies developed, within a relatively short time and modest fraction of the Earth's surface, as environmentally related variations on a single ancestral society. Those categories of cultural differences within Polynesia are essentially the same categories that emerged everywhere else in the world.

Of course, the range of variation over the rest of the globe is much greater than that within Polynesia. While modern continental peoples included ones dependent on stone tools, as were Polynesians, South America also spawned societies expert in using precious metals, and Eurasians and Africans went on to utilize iron. Those developments were precluded in Polynesia, because no Polynesian island except New Zealand had significant metal deposits. Eurasia had full-fledged empires before Polynesia was even settled, and South America and Mesoamerica developed empires later, whereas Polynesia produced just two proto-empires, one of which (Hawaii) coalesced only after the arrival of Europeans. Eurasia and Mesoamerica developed indigenous writing, which failed to emerge in Polynesia, except perhaps on Easter Island, whose mysterious script may however have postdated the islanders' contact with Europeans.

That is, Polynesia offers us a small slice, not the full spectrum, of the world's human social diversity. That shouldn't surprise us, since Polynesia provides only a small slice of the world's geographic diversity. In addition, since Polynesia was colonized so late in human history, even the oldest Polynesian societies had only 3,200 years in which to develop, as opposed to at least 13,000 years for societies on even the last-colonized continents (the Americas). Given a few more millennia, perhaps Tonga and Hawaii would have reached the level of full-fledged empires battling each other for control of the Pacific, with indigenously developed writing to administer those empires, while New Zealand's Maori might have added copper and iron tools to their repertoire of jade and other materials.

In short, Polynesia furnishes us with a convincing example of environmentally related diversification of human societies in operation. But we thereby learn only that it can happen, because it happened in Polynesia. Did it also happen on the continents? If so, what were the environmental differences responsible for diversification on the continents, and what were their consequences?