World History
A Concise Thematic Analysis

SECOND EDITION

I

Steven Wallech • Touraj Daryaee • Craig Hendricks
Anne Lynne Negus • Peter P. Wan • Gordon Morris Bakken

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Volume I

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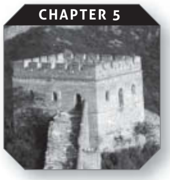

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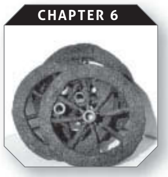

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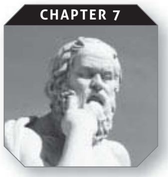

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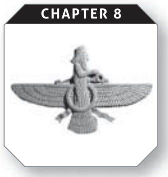

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Introduction

TEACHING WORLD HISTORY at the college level presents an instructor with an especially difficult challenge. Unlike most historians who conduct courses in the study of a particular culture, nation, or region, those who teach World History ostensibly must have familiarity with the history of all the earth's peoples. As daunting as such a proposition is, the matter is far more complicated. Because imparting the history of humanity within the confines of a college-level course is, of course, impossible, world historians must convey to their students an appreciation of the short- and long-term effects of human practices on local and regional environments, the interdependencies of humans, animals, plants, and pathogens, and the diffusion of ideas, technologies, and disease through trade, migration, war, empire building, and human resistance—phenomena that create cross-cultural, transnational, and transregional patterns over time.

To make things even more difficult, much of the historical literature on World History emphasizes the differences between regional cultures and local histories, leaving the instructor scrambling to find the similarities that might produce a lucid global narrative. In particular, the current generation of World History textbooks fails to succeed in conveying a unified, coherent account. Indeed, linear surveys lack a central storyline, with any potential core narrative submerged under a sea of details that simply overwhelms the student reader.

What probably explains this bleak state of affairs is the fact that as a distinct discipline, World History is only about six decades old. Begun in the 1960s as part of a slow shift from Western Civilization, World History gradually became a subdiscipline as increasing numbers of historians recognized the usefulness of a global perspective to understand humanity's past. Developing steadily despite the vast amount of material that had to be digested and the necessary development of new mental habits of synthesis, World History finally achieved recognition as a discipline in 1982 with the establishment of the World History Association. Since then, the WHA has grown to 1,500 members, World History has become a standard general education requirement at the college level, and several major universities now offer advanced degrees in the field.

With decades of combined experience teaching World History—in community colleges and four-year institutions—we have witnessed firsthand the frustration instructors and students of world history experience with current survey textbooks. Deeming a new approach necessary, even overdue, in 2007 we brought out the first edition of *World History: A Concise Thematic Analysis*, the first truly concise, accessible, and affordable World History survey. Now, in response to feedback from student readers and instructors alike, we present the revised and improved second edition

In this new, second, edition we have refined the themes used to synthesize the narrative as presented in the first edition. In addition, we have made corrections to the overall presentation based on new research developed in climate history and studies recently done on farm technology. The overall effect of these changes has added a far greater depth to the entire project, producing a better integration of the material and a more thorough analysis of regional developments. Finally, in this second edition we responded carefully to feedback and specific criticisms leveled against the first edition by filling in key gaps in the original narrative and more thoroughly tying the storyline to a comprehensive vision of the world.

It will be immediately apparent to anyone familiar with the full-length or even so-called concise world history surveys currently on the market that this book stands alone: its interesting and recurrent themes—conceptual bridges that span the many centuries—give it a unique voice. Its format helps the reader see the larger picture, to conceptualize patterns over time by importing concepts from one unit to another. And while this book might not offer flashy four-color maps and illustrations, its length and price speak for themselves. Too often students are required to pay a great deal of money for a book they have no hope of finishing, let alone comprehending or remembering long much longer than in the final exam.

To achieve the brief but coherent account of global events, the revised second edition of *World History: A Concise Thematic Analysis* comprises four complete units: the first is long, to lay a more thorough foundation for the entire narrative (eleven chapters); the second, short and concise (six chapters); the third is of medium length, with greater attention paid to consolidating and integrating the account of modernization (eight chapters); and the fourth and final unit is the same length as the third one (eight chapters), with new material to take the narrative of the contemporary world to the present.

Unit 1 employs three scientific themes to help explain the history of the ancient world. The first theme is a biological one used to explain the symbiosis of agriculture and the parasitism of disease. Coupled with this biological theme, a second one applies several geographic concepts to facilitate an understanding of the movement of plants, animals, tools, ideas, and germs from one major cultural hearth to another. Equally important is the condition of geographic isolation, which denied such movement. A new addition to the second edition is a third theme, climate history, which reveals clearly the impact of sharp changes in global weather conditions that dramatically altered the course of human events. Finally, Unit 1 introduces the concept of culture, explaining how human creativity responded to the scientific themes mentioned above as people everywhere adjusted to the changing circumstances of life in the ancient world.

Unit 2, the middle years of world history, develops further the concept of culture, elevating it to the central theme that governs the six chapters that consider the years 500 to 1500 CE. This section also responds to a constructive criticism of the first edition concerning the location of Persian history in the global narrative. The Parthian Empire has been moved to Unit 1 and linked through a more thorough analysis of the Hellenistic experience to the role that culture played in the middle years of world history. In Unit 2, culture serves to explain how the dominant human communities of the globe expanded to their limits, while only one of them developed the potential to change world events. Hence, a broad analysis of each major civilization reveals why most of them preferred stability to change, even as one of them broke the mold of tradition to set in motion a whirlwind of change that laid the foundation for globalism and the modern era.

Unit 3 addresses the modern era, 1492 to 1914. Its major themes are modernization, the differential of power, and globalization. Focusing on European culture as the one that proactively transformed the world, this analysis of modernization considers the key institutional changes that created the nation-state in the West. In this second edition we have reduced the total number of chapters dealing with modernization by consolidating the narrative, adding a more thorough study of the differential of power, and illustrating more explicitly the link between the themes and the historical narrative. Using a comparative cultural analysis of political, economic, and military institutions to demonstrate the growing material might of Europe in contrast with the waning power of non-European societies, Unit 3 outlines the material advantages that Western peoples and cultures enjoyed as they expanded outward—and were themselves transformed by the peoples, ideas, and resources they encountered in the Western Hemisphere, Africa, and Asia. Next, the theme of globalization helps explain how other cultures of the world imported many Western institutions, adapting them in an effort to survive, but ultimately sought to expel Europeans from their territories through the long and difficult process known as decolonization.

Unit 4 considers a new conceptualization of the postmodern world by revising its dates from 1914 to 2012. We chose 1914 rather than 1945 because 1914 marks the end of Europe's political and military advantages based on the theme, the differential of power. Most historians see World War II as the natural break in the modern narrative, but this text argues that the critical moment from a world history perspective is World War I. The Great War changed the balance of power in the world and started the era of decolonization that liberated what has since been called "the third world" nations from European colonial rule. While 1945 is appropriate for European history, the authors feel it is too Eurocentric for World History. This new set of dates, we contend, returns the narrative of history back to the world and diminishes the role played by Europe as a proactive culture. This also creates a more balanced storyline, and we have decided to preserve this approach.

The Post 1914 era begins by showing how global warfare, a harvest of violence set in motion by the empire building of Unit 3, destroyed Europe's hold over its colonies, protectorates, and spheres of influence and shifted dramatically the global differential of power. At the same time, we approached Unit 4 in a unique way. Given that 1914 to 2012 constitutes slightly less than one hundred years of world history, we strived to maintain an appropriate balance between its content and the remainder of the text. In other words, the last 99 years establishes the contemporary world but deserves no more space than does any other period of global history. Therefore, we kept the content of Unit 4 as concise as possible, even as we show that the tumultuous events leading all the way up to the state of the world today are the products of, and the conclusions to, the preceding three units.

The advantage of this long-, short-, medium-, medium-unit presentation is that it allows for a logical division of the text for use in either the semester or the quarter system. For those on the semester system, the completion of Units 1 and 2 bring the reader to the dawn of the modern age (1500 CE), the classic stopping point for the first half of world history. Units 3 and 4 complete the story in the second semester. For those on the quarter system, Unit 1 covers the ancient world, the standard stopping point in a ten-week class. Unit 2 and the first half of Unit 3 link the middle years to the early modern era (1000–1750 CE) and bring the narrative up to the formation of nation-states, the standard stopping point for the second ten-week period of study. Finally, the second half of Unit 3 and all of Unit 4 cover modernization and the postmodern age.

As mentioned, each unit features a dominant set of themes. Not only do these themes constitute the thesis for the unit under consideration, but they reappear throughout the text, providing cohesiveness and unity where none otherwise exists and making World History accessible and meaningful to student readers. On the other side of the desk, both experienced and inexperienced instructors, eager to find footholds as an otherwise unwieldy narrative unfolds, will find the use of overriding themes helpful. In short, the introduction of themes in a World History text eliminates the problem of presenting an isolated and seemingly endless list of facts, figures, and dates: the "one darn thing after another" phenomenon that gives World History a bad name.

Themes also help the reader build a comparative analysis of regional histories. Such comparisons help students grasp how human creativity produces a unique stamp on the development of distinct cultures, even as people everywhere struggle with a common set of problems. Finally, themes highlight contrasts between cultures, making the text relevant to an increasingly diverse student population, as well as useful in the new comparative World History courses.

Whether you are new to the field of World History or have taught the subject for years, it is our hope that, having tried our approach, you will agree that a concise thematic analysis goes a long way toward making a complicated compendium of human numbers, economies, and cultures meaningful to student readers.

Steven Wallech
Touraj Daryaee
Craig Hendricks
Anne Lynne Negus
Peter P. Wan
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THEMES FOR UNIT ONE

The Ancient World

- **The artificial existence of civilization**
- **The biology of civilization**
- **The geography of civilization**
- **The climate of civilization**
- **The relationship between belief and action**

UNIT 1 explains how the artificial existence of civilization emerged from the natural consequences of human interaction with geography, biology, and climate during the ancient era of world history. The **artificial existence of civilization** refers to the growing distance between human living conditions and nature as agriculture separated various peoples in different locations around the world from their passive reliance on the earth's bounty. The **natural consequences of human interaction with biology, geography, and climate** refers to the specific events surrounding the development of ancient cities as the people living in these urban centers developed the skills they needed to survive on the new food base generated by agriculture. Plant cultivation in turn imposed specific requirements on ancient human life—irrigation, field preparation, seed selection, food storage, rationing, the development of a calendar, the production of new tools, and an explanation of the local rhythms of nature—that elevated human consciousness to new levels of awareness in their new, but increasingly distant, relationship to the natural world around them. This new level of human consciousness launched world history once the people who dwelled in the oldest urban centers began to record their struggles to exist in the new, artificial setting agriculture had created. That record lies at the heart of ancient world history, the central narrative of Unit 1 of this text.

The **artificial existence of civilization** began when human foragers created a new biological relationship between their population and a select group of "omega" plants and animals to create agriculture. An omega organism is an individual plant or animal that, thanks to some natural trait, fails to reproduce often or at all. Ancient foragers that selected seeds for food preferred omega plants because they had certain highly desirable qualities. Omega seeds matured at the same time each growing season, their seeds grew to exceptional weight and size, and the parent plants trapped their seeds inside pods or on a cob. From nature's perspective, these omega plants could not reproduce well because any organism that traps its seeds inside a pod or on a cob denies those seeds access to the ground and the possibility of germination and, in time, reproduction. If a plant cannot reproduce, its genetic message is lost to the local plant population, and its genes soon disappear. If humans, however, select these plants and artificially cultivate their seeds, then these organisms do reproduce and a genetic code is artificially preserved, one that would otherwise disappear. Biologists call this creation of an omega gene pool *artificial selection* to distinguish it from natural selection. Once this gene pool was in place, the biology of civilization began.

The **biology of civilization** involves the development of a positive reciprocal relationship between humans and their omega plants and animals, known as a *symbiosis*. This artificially created symbiosis saw humans clear the land for their omega plants, change the environment, and generate a food surplus. This food surplus supported growing human populations that continued to expand the number and size of the fields they cleared, thereby changing the environment and increasing the number of omega plants humans needed to continue to survive. Over extended periods of time this process completely changed the landscape from a natural to an artificial setting and demanded that people create and perpetuate a whole new set of skills to survive. These skills included water management, soil renewal, and organizing a complex division of labor to secure each year's food surpluses. Collectively called irrigation, these skills led to the appearance of clusters of agricultural villages, their inhabitants working in unison to dig canals, dredge channels, and build dams. In time, these clusters of villages fell under the authority of large cities that tapped the human labor of the outlying villages to exert control over vast areas under cultivation. For example, a huge amount of labor was required to control a river's water supply during its flood cycle so that the increased water, and the silt it carried, could reach the cleared fields and renew the land each year. These large cities were the hearths of civilization.

The biology of civilization has another aspect, as it also refers to the pathogens that took up residence with humans, omega plants, and omega animals, using them as hosts to sustain a local disease history. Thus a biological equilibrium developed whereby agriculture increased the numbers of humans, omega plants, and omega animals, with diseases periodically reducing the numbers of each through episodes of epidemics and pandemics: disease events that dramatically altered the course of human history. World history shows, however, that agriculture succeeded in preserving enough humans to sustain a continued growth of civilization and perpetuate an ever-increasing number of people, their omega plants, and their omega animals.

The **geography of civilization** refers to the specific events surrounding the development of the first cities, whose populations learned the skills needed to survive on the new food base generated by agriculture. Geography focuses attention on specific sites on the surface of the earth where humans took up cultivation. Geography also refers to one site's location relative to another, which affected the probability of the lessons of agriculture being transferred from one site to another.

The **climate of civilization** played the final role in the human drama of ancient world history. The ever-increasing number of humans, plants, and animals caused by the symbiosis of agriculture, despite the occasional reductions in populations due to parasites and epidemic disease, expanded the total number of organisms dependent on any one geographic site under cultivation. One of the most important new skills that humans living in such sites had to learn included the making of a calendar, forms of literacy, and ways to explain the local rhythms of nature—creating regional traditions and religions. Global fluctuations of wind patterns and sea currents periodically produced massive shifts in the volume and location of rain and snow that disrupted the rhythms of rivers and thereby undermined the survival of a given civilization. In sites accustomed to plentiful supplies of water, droughts undercut the artificial symbiosis of agriculture by disrupting the food supply, causing protracted famines and eroding the division of labor that sustained a civilization. In other, more arid, places, too much water from unexpected storms also disrupted food production, the excess precipitation overwhelming irrigation systems and ruining crops.

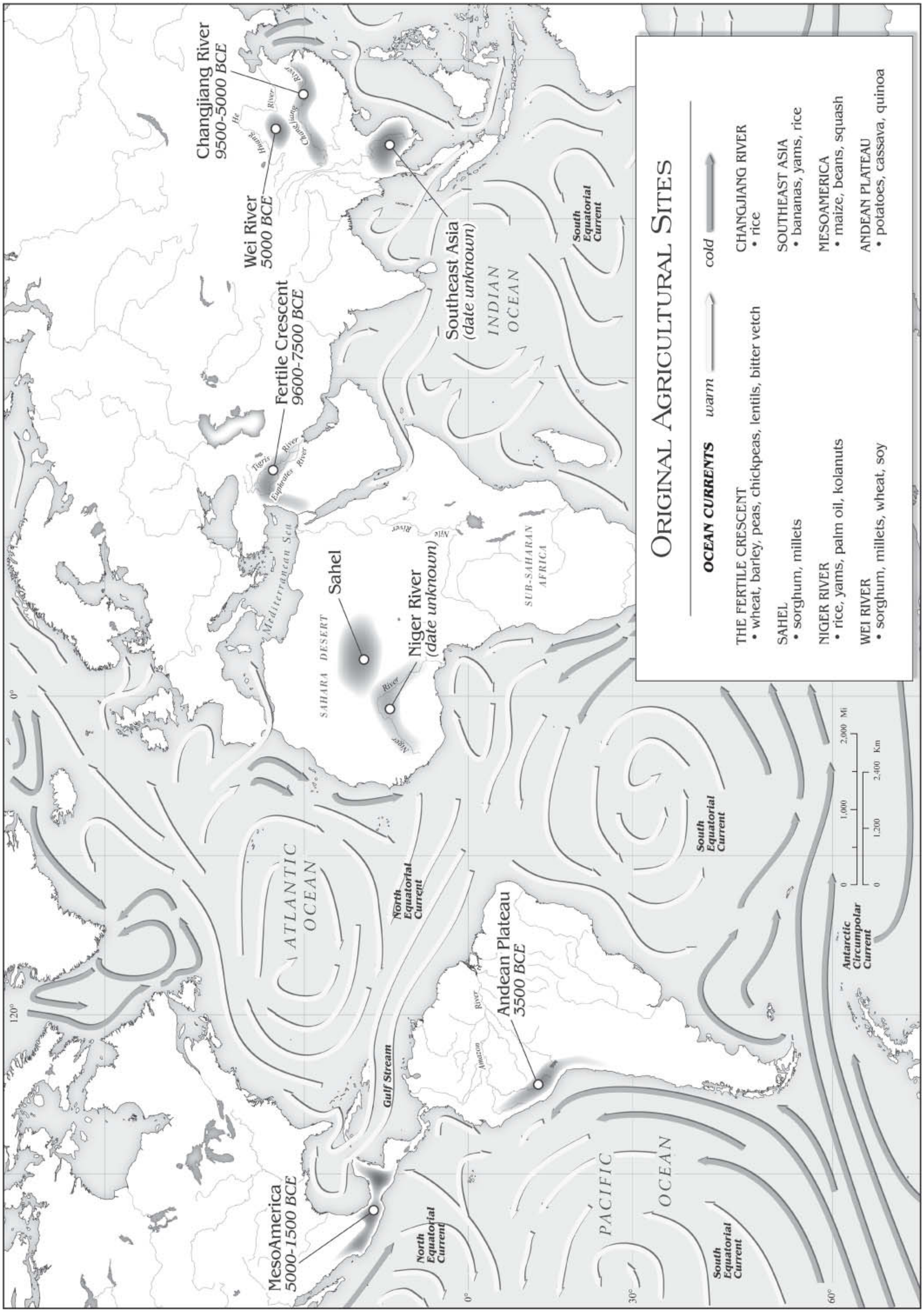
Climate also plays a key role in yet another facet of the artificial symbiosis known as agriculture. Humans cultivated omega animals the same way they controlled the reproductive cycle of omega plants. Omega animals are those individuals among social species that, because of their submissiveness or other such trait or quality, cannot compete well with the dominant members of the herd and therefore produce fewer or no offspring. The social hierarchy of the herd imposes the will of the "alphas," the individuals that natural selection rewards with numerous offspring. In effect, the course of nature partially "tamed" the omega animals before humans made contact with them. Humans selected the omegas because they were more easily controlled, the alphas having already preconditioned them, and their new human "masters" then offered the omega animals the opportunity to engage in sex and reproduce readily for the first time. These omega animals became the draft animals of farmers, or they developed into the domesticated herds that fed nomads. However, this artificial symbiosis created population pressures among nomads (people dependent upon herding animals) similar to those experienced by plant specialists. These pressures caused competition between nomadic tribes and led them to develop the art of war, which they waged to capture and protect the best grazing lands, or pastures. These wars periodically spilled over into the agricultural-based civilizations whenever the nomads unified and targeted the richest cities for conquest. In other words, climate exacerbated the hostile relations between nomads and cities. The droughts that destroyed the omega plants of a sedentary civilization also destroyed the grazing land of nomads. The loss of their grazing land set nomads in motion, these warlike people migrating toward whatever food sources were available. Such migrations caused massive, periodic invasions that civilizations sooner or later suffered.

Climate, then, combined with disease to weaken civilizations living off omega plants and exposing farmers to conquest. Any global shift in weather patterns, therefore, disrupted agriculture in all its forms: both the intensive cultivation of plants by sedentary people and the extensive use of large areas of land by nomadic societies. Short of major pattern changes, even prolonged droughts or storms could set in motion massive migrations that disrupted traditional patterns of life.

If sedentary cultures remained relatively free of disease and their climate conformed for a long period to the regular rhythms as forecasted on their civilization's calendar, urban societies spawned a new class of people, those with the free time to attain a new level of human consciousness. These people, in turn, were the first authors of world history. The people living in ancient cities that developed literacy described themselves through their art, literature, religion, science, and philosophy. They revealed how their beliefs complemented their actions to sustain the culture of their civilization. Thus was generated the raw material that historians use to this day to study and try to explain the events of the past.

The final element composing the central themes of Unit 1 is, therefore, the **relationship between belief and action**—that which explains why civilizations around the world generated the extraordinary artifacts, in all of their many forms, that continue to fascinate us. What, for instance, inspired the Egyptians to build pyramids? Why did Chinese philosophy generate such continuity in Chinese history as to produce a pattern of life that lasted longer than any other civilization in world history? Why did the Greeks create a philosophy that did not include any of their gods or goddesses, the so-called Greek miracle, which laid a foundation for science? What is it about Indian civilization that made the people of the subcontinent reject experience as a valid form of information to explain the rhythms of nature?

Remarkably, you can find the answers to all of these questions, and gain a cohesive and coherent picture of the history of the ancient world, by keeping the Themes of Unit 1 in mind as you read. At this point, learning World History probably—and probably should—strike you as a daunting, even impossible, task. Using the themes of Unit 1, however, reminds us of the humanity of our ancient ancestors and makes studying world history manageable. Their struggles in their daily lives and with their environments were very much like our own. Their view of the universe, which complements these struggles, makes perfectly good sense in the context in which they were forged. This type of history, then, is always and immediately relevant to anyone curious about the past. It is this type of history that makes studying past events both useful and enjoyable.


Original Agricultural Sites
OCEAN CURRENTS
warm
cold
THE FERTILE CRESCENT
• wheat, barley, peas, chickpeas, lentils, bitter vetch
SAHEL
• sorghum, millets
NIGER RIVER
• rice, yams, palm oil, kolanuts
WEI RIVER
• sorghum, millets, wheat, soy
CHANGJIANG RIVER
• rice
SOUTHEAST ASIA
• bananas, yams, rice
MESOAMERICA
• maize, beans, squash
ANDEAN PLATEAU
• potatoes, cassava, quinoa
Changjiang River
9500-5000 BCE
Wei River
5000 BCE
Fertile Crescent
9600-7500 BCE
Southeast Asia
(date unknown)
Sahel
Niger River
(date unknown)
Andean Plateau
3500 BCE
MesoAmerica
5000-1500 BCE
INDIAN OCEAN
ATLANTIC OCEAN
PACIFIC OCEAN
SAHARA DESERT
SUB-SAHARAN AFRICA
Mediterranean Sea
Tigris River
Euphrates River
Nile River
Niger River
Huang He River
Changjiang River
Amazon River
Gulf Stream
North Equatorial Current
South Equatorial Current
Antarctic Circumpolar Current
0
1,000
2,000 Mi
0
1200
2,400 Km
120°
0°
30°
60°

CHAPTER 1

Biology and World History

Civilization and Nomads

The origins of agriculture mark the boundary between prehistory and history. Before the domestication of plants and animals, humans lived a nomadic existence of hunting and gathering. Since hunting and gathering involves following migratory animals, early humans continuously moved from place to place, which denied them the idle time necessary to develop the skills to produce a written history of their past. Instead, all the earliest humans left behind were fragments of their existence in the form of discarded or lost tools, broken or abandoned artifacts, deserted campsites, some cave paintings, and heaps of bones and debris that bear witness to their diet. With the development of agriculture, however, humans finally had the chance to settle down, develop cities, and in time refine an urban division of labor that included scholars able to leave an organized record of their people's past. Thus, world civilization began about the time people opted for plant cultivation over hunting.

Yet the question remains: Why would different groups of people at various times and in various places choose to abandon millions of years of living in harmony with the rhythms of nature in order to take up a new style of life based on agriculture? What forced different human populations to forsake a pattern of existence that met all of their (and our) ancestors' needs and substitute for it the artificial mechanisms that eventually created ever more impenetrable buffers between humankind and nature?

Although not all historians agree on exactly why and how this change occurred, most of them believe that the primary factor common to people everywhere was population pressure. Among those who study population pressure, the most frequent explanation they provide is global climate change. These scholars propose a scenario that starts with global warming and resulted in what became known as the "Broad Spectrum Revolution." This Broad Spectrum Revolution linked climate to ecological conditions, human diet, and human adaptability to mark the boundary between prehistoric and historic times.

This scenario began when the last ice age ended and the world's ecology changed. About twenty thousand years ago global warming ushered in a new era called the Long Summer that continues into the present. During this Long Summer, the carrying capacity of the Earth increased to support growing human numbers, plant varieties, and animal populations, which encouraged different bands of human hunters to adjust to a new abundance. The way these hunters adjusted ultimately trapped them in a new lifestyle called agriculture.

How this transition from hunting-and-gathering occurred began innocently. When the Long Summer began, scholars estimate that the world's total number of humans fell within the range of 3 to 8.5 million; this means that there was about one human for every 31 square miles. Such small numbers, as well as low concentrations of people, reflected both millions of years of hunting-and-gathering and the way a nomadic lifestyle limited the birthrate of each human generation. Since hunters relied on following, tracking, trapping, and killing game animals during the last ice age, this nomadic economy played a key role in defining the density and distribution of humans.

> People's life expectancy did not exceed thirty years, with middle age occurring at about fifteen and puberty around the age of twelve.

Generally, people who lived by hunting and gathering organized their societies in similar ways. Usually there was a sexual division of labor in which men hunted and women gathered. People's life expectancy did not exceed thirty years, with middle age occurring at about fifteen and puberty around the age of twelve. Hunting bands traveled great distances to exploit seasonal variation in their food supply. When women became physically mature and capable of bearing children, they could no longer engage in hunting. Hunting required long-distance jogging to trap and kill large game animals, and once the kill occurred, hunters had to dress the meat and carry it back to camp. Jogging, trapping, killing, and carrying heavy loads endangered the survival of a baby during pregnancy.

Furthermore, pregnancy handicapped women who lived a nomadic lifestyle because they were compelled to march from camp to camp carrying everything they owned. Such long treks both increased the miscarriage rate among pregnant women and imposed extended nursing upon these same women once the birth occurred. Women extended their nursing because they had to carry infants and toddlers as they marched, since these children could not keep up on their own. While carrying their newborns, these mothers also found that nursing pacified their infants, and since no substitute for mother's milk existed, they did not wean their babies until these kids could walk alongside the hunting band on their own.

Also, scholars estimate that a nomadic woman suffered a 50-percent miscarriage rate during her fertile years, and she nursed her baby for up to three to four years after a successful delivery. Nursing limits a woman's fertility because the process releases an enzyme called prolactin that interferes with ovulation in women who have just delivered their babies. Later, prolactin obstructs the hormonal balance needed for fertilization or the implantation of a fertile egg. Finally, prolactin prevents a female from sustaining a pregnancy to full term. Both miscarriages and extended nursing, therefore, reduced the total number of children a woman could have after puberty.

Accordingly, women living in a hunting-and-gathering band could expect to give birth to no more than two to four children. Of these potential four offspring, two had to reach adulthood in order to replace the parents that sired them, but many children died before maturing. Such a low fertility rate maintained human numbers but did not add very many additional people to the world's population. These circumstances explain why scholars estimate that the average growth rate among nomadic hunters was only .15 percent per year.

But the warming trend of the Long Summer changed the way Ice Age hunters-and-gatherers survived. The warmer climate created a new bounty for these hunters to exploit. The new conditions offered more game animals, increased numbers of fish, and generated an abundance of cereals, grasses, and pulses for extended foraging. This new bounty radically changed female fertility.

Hunting changed because the abundant new plant life, responding to warmer and wetter springs and summers, fed increased wild animal populations that reduced people's need to travel as far to maintain meat supplies. Fishing increased as sea levels rose and rivers swelled with the growing volume of rainwater; furthermore, fishing is a semi-sedentary occupation because humans camped near the spawning grounds to exploit a new resource. Finally, the new abundance of plant life itself allowed humans to forage with greater success without having to travel. Greater food supplies encouraged people to remain in one locale to exploit the new resources.

Staying in one place year around, whether fishing, hunting, or foraging, or even all three, reduced miscarriages among females, which generated more children. The increase in human offspring forced women to wean their children earlier. Reduced nursing time prevented prolactin from inhibiting pregnancy, fertilization, or full-term pregnancies. Thus, women gave birth to more and more babies, which further increased population pressure.

The worldwide increase in human numbers drove foragers to discover the secrets of seed germination and establish the biological relationships between themselves and domesticated plants and animals. These new biological relationships, however, took time because humans had to learn the lifecycles of these desirable organisms, gain control over their reproduction, and replace the wild varieties with newly domesticated ones. Happily, wild grasses provided the biological resources necessary for this transition. Wild grasses are hermaphrodites; they have both male and female sex organs that can preserve an individual plant's DNA. Wild grasses are also annuals that invest 60 percent of their energy in producing seeds within a four- to six-month growing cycle, die quickly, and scatter these seeds to generate a new crop next year. Wild grasses, therefore, made up an ideal plant population for humans to learn the secrets of cultivating their own food supply.

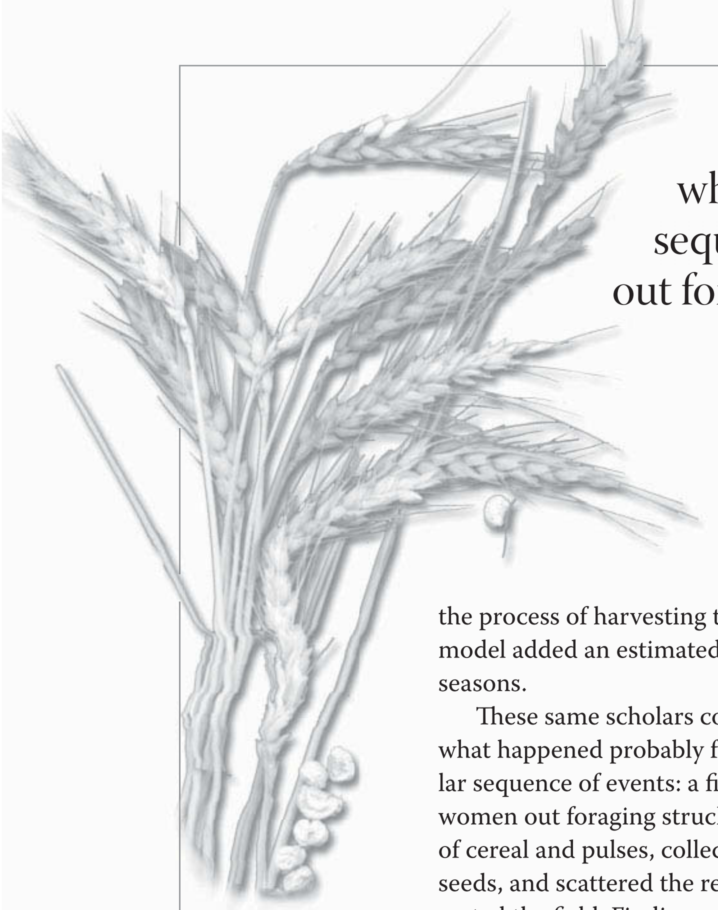
Wild grasses, such as wheat and barley, or the pulses like peas, chickpeas, lentils, and bitter vetch, made up the first domesticated plants of world history. All seven of these grasses, and their wild ancestors, are found in the region where agriculture first began: the Fertile Crescent. Because the Fertile Crescent is the best-known example of how humans started to plant their food, and this region is the most studied and best documented, it will serve this text well as a case study.

The wild varieties of the Fertile Crescent's original seven grasses produced brittle ears and pods that spontaneously fell apart or exploded to scatter their seeds. The seven grasses these foragers collected included: Two types of wheat, barley, peas, chickpeas, lentils, and bitter vetch. These foragers found collecting these seven plants rewarding but extremely difficult and time consuming. The reason why these foragers invested so much time is because wild grasses matured in different months of the spring and summer. These wild grasses did so in order to increase their chances of reproductive success over as long a period as possible. Another difficulty in harvesting these seeds was that a forager must strike the ear or pod at the right time to catch the falling seeds. However frustrating for humans, these characteristics made wild grasses the alphas of their species, i.e., the individuals most likely to succeed in reproduction and define the gene pool from generation to generation.

Occasionally, however, a mutant plant appeared among these wild grasses or pulses. These mutant strains were the exceptions to the wild variety, and they were very rare. Their frequency was no more than one individual per two million wild plants. They produced an ear or pod that did not scatter its seeds, and they matured at the same time each year. Since their seeds remained on the ear or in the pod, they could not reproduce on their own. These qualities of trapping the seeds and maturing at the same time made the rare mutant plant the omega of its species, i.e., the individual that did not reproduce and soon disappeared from the gene pool.

However, from the human's point of view, such mutants were much more useful than the typical grasses or pulses. Replacing a population of seed-scattering wild grasses, the alphas, with a mutant, domesticated strain, the omegas, required that foragers understand the value of such a change and then act to promote it by ensuring that the omegas' seeds reached the soil. To calculate the period needed to complete this transition from alphas to omegas, several scholars created a computer simulation. They demonstrated that if the human foragers understood what they were doing, they would need as many as twenty growing cycles to complete this process. However, if foragers who did not act deliberately but occasionally scattered omega seeds in

> The new abundance of plant life itself allowed humans to forage with greater success without having to travel. Greater food supplies encouraged people to remain in one locale to exploit the new resources.



These same scholars concluded that what happened probably followed a particular sequence of events: a first generation of women out foraging struck the wild varieties of cereal and pulses, collected most of the seeds, and scattered the rest that then regenerated the field.

the process of harvesting them, the computer model added an estimated 180 to 230 growing seasons.

These same scholars concluded that what happened probably followed a particular sequence of events: a first generation of women out foraging struck the wild varieties of cereal and pulses, collected most of the seeds, and scattered the rest that then regenerated the field. Finding a few mutants, these same women picked them, capturing all the seeds, and later planted them. Over the course of three or four generations, this style of foraging allowed the great-granddaughters of these original gatherers to convert wild, alpha clusters of wheat into a domesticated, omega field. Having done this once, future generations of foragers grasped the value of this process and became more deliberate.

Scholars estimate that from 9600 BCE to 5000 BCE, as plant selection led to cultivation, this new style of producing food took root in a variety sites throughout the Fertile Crescent. Furthermore, human numbers increased from an estimated 8.5 million to 100 million. In the oldest agricultural sites found in the regions where wild wheat, barley, peas, chickpeas, lentils, bitter vetch, and flax first fell under human control, human numbers increased from one person for every 31 square miles to 500 in the same area. In other words, population pressure accelerated, reinforcing a gradual commitment to cultivation.

Accordingly, as human numbers grew, people could no longer supply their needs through hunting-and-gathering or fishing. At that time, select communities of people turned to cultivation to meet their growing demand for food. Each of these independent developments responded to the local conjuncture of climate, geographic location, and human numbers by domesticating plants and animals. When and where these events actually took place and how rich a supply of food they generated depended on the local circumstances.

Only recently, scholars have partially decoded the process of transition from wild alphas to domesticated omegas in the Fertile Crescent. During the eight millennia before the warming trend became steady, people who belonged to a foraging culture called the Natufin lived in villages throughout the Fertile Crescent. They refined a complex, semi-sedentary lifestyle that reflected the bounty of the longer springs and summers, the milder winters, and the rainfall that had replaced snow. Collecting the brittle varieties of wild cereal grasses and pulses common to the Fertile Crescent, they learned about plant germination from the seeds that fell from the parent plants during gathering. The Natufin also collected the rare but easy to gather mutant omegas that retained all their seeds because their ears and pods did not break open. Given the general abundance of wild cereals and pulses, the Natufin deliberately planted the alphas, but occasionally found an omega and planted it as well.

Then from 10800 to 9600 BCE a sharp cooling trend called the "Younger Dryas" set in. This thousand-year period of cold began when the melting of massive glaciers flooded the North Atlantic with freezing water (see the section on climate below). The effect of this cold water shut down the warm currents of that ocean that supported the Long Summer and returned temperatures to near Ice Age levels. The impact on Eurasia was that a major drought set in; cold and dry once again replaced wet and warm.

After so many years of bounty because of the Long Summer, the sudden onset of a cold millennium drove some people back to a migratory hunting-and-gathering existence and others in the opposite direction toward selecting the rare omega plants for cultivation. Seeking refuge in the valleys lining the Zagros Mountains, the slopes of the hills of Judea, and the sheltered valleys of Galilee or still further along the waterways of the Euphrates River, some of these foraging Natufin communities managed to maintain their semi-sedentary lifestyle. One site in particular left evidence of deliberate cultivation and plant selection.

At this site, which is called Abu Hureyra, foragers isolated and planted a mutant strain of rye. Sometime between 11000 and 10400 BCE, the people of Abu Hureyra converted the alpha variety of rye into an omega population. By doing so, they transformed the genetics of this rye so that it could not reproduce without direct human intervention: it had been domesticated. At that moment, farming truly began.

As long as the wild alpha varieties made up the majority of the seeds eaten by foraging communities, the plants the Natufin selected could reproduce on their own. Once the mutant variety dominated the plant gene pool, however, these omegas became dependent on humans to the same degree as the Natufin of Abu Hureyra depended on rye as a food source. The farmers of Abu Hureyra, therefore, created a biological symbiosis between themselves and rye, but they did so by replacing natural selection with artificial selection.

Scholars argue that the lessons learned at Abu Hureyra suggest that there were other communities that developed the same techniques, but these villages have yet to be found. Although Abu Hureyra disappeared during the great drought of Younger Dryas, the lessons that people learned there did not. Domesticated cereals and pulses appeared everywhere after 9600 BCE, when the warming trend resumed. These newly domesticated strains included the "founder plants" common to the Fertile Crescent that were named earlier: wheat, barley, peas, chickpeas, lentils, bitter vetch, and flax.

The selection and cultivation of these seven founder plants and the later addition of the four major animal species locked the new farmers of the Fertile Crescent into a specific lifestyle that ultimately resulted in the creation of cities some four and a half millennia later. These urban centers emerged as continued population pressures forced farmers to seek an ever more complex division of labor and specialization of skills. Once these cities appeared, prehistory ceased and world history began.

In the process of making the selection of omegas over alphas, the ancient farmers of the Fertile Crescent were the first to impose artificial selection on natural selection. They thereby substituted human decisions for natural occurrences and forged a link between biology and culture. This link meant that as human numbers grew, and became ever more dependent on the omega varieties they planted, they deliberately increased the number of omega plants. Hence, a symbiosis developed: The humans needed the omegas for food, and the omegas needed the humans to reproduce.

A deeper look at this first case study reveals some of the consequences of artificial selection. By consistently choosing the mutant seeds over wild varieties, humans also unwittingly created a greater distance between themselves and nature. Although the cultivation of omega plants that met immediate human needs produced an increasingly reliable food supply and therefore offered greater food security, human numbers continued to grow, generating a population ever more dependent on farming. As the numbers of people increased, the combinations of labor needed to cultivate mutant plants also grew more complex. Such combinations of labor relied on the habits of cooperation learned during the hunting, fishing, and foraging phase of the early Long Summer. These new organizational systems, in turn, led to deliberate soil, water, and land management that closed the trap of symbiosis between humans, cereals, and pulses. Humans who lived off agriculture could no longer rely on access to wild sources of food. Still regarding themselves as hunters, fishers, and foragers, these humans slipped ever so slowly into farming without recognizing it. Living off nature simply became increasingly more remote as grain dependency grew.

The selection and cultivation of these seven founder plants and the later addition of the four major animal species locked the new farmers of the Fertile Crescent into a specific lifestyle that ultimately resulted in the creation of cities some four and a half millennia later.

Each animal species that humans chose had to have several key characteristics:

- Growing food for an animal should not compete with land dedicated to human food production too much.
- Animals selected also had to mature into useful adults quickly;
- they had to breed under the supervision of humans;
- they had to have a docile disposition;
- they would have to be calm and thrive in captivity;
- they had to form social hierarchies that humans could exploit; and
- they had to graze peaceably with other, alien species.

Of all the animal species in the world, only a few met human needs.

The symbiosis between humans and animals followed a scenario similar to that of domesticated plants. To domesticate members of any wild species of animal, a human first had to tame the individual animal and then successfully breed it in captivity. In the case of the first domesticated plants, farmers' deliberate selection and planting of mutant seeds incapable of flying far away on the wind combined both the taming and reproductive steps in the domestication process. In the case of animals, these two steps occurred as separate but complementary operations. What humans had to do was find animals with some key qualities that would support domestication.

Each species that humans chose had to have several key characteristics: Growing food for an animal should not compete with land dedicated to human food production too much. Animals selected also had to mature into useful adults quickly; they had to breed under the supervision of humans; they had to have a docile disposition; they would have to be calm and thrive in captivity; they had to form social hierarchies that humans could exploit; and they had to graze peaceably with other, alien species. Of all the animal species in the world, only a few met human needs.

Once humans had selected members of the few species that met these criteria, ancient farmers then had to eliminate or replace the alpha males and females of the local herd. The alphas were those animals least likely to be tamed because they had won sexual dominance in the wild; they comprised the most aggressive members of the social hierarchy, and they resisted domestication with a passion. The omega individuals, on the other hand, tended to be excluded by the alphas from access to sex and reproduction. Thus, the omegas were least likely to reproduce in the wild. Hence, if a human were to intervene and release the omega from the alpha's control, then reproduction in captivity could replace reproduction in the wild. Like the domestication of plants, this process of selection and breeding substituted artificial selection for natural selection and changed the gene pool of

Llamas, known to be even-tempered, were easily domesticated, useful not only as pack animals but also as a source for wool and meat, providing goods for trade with neighboring, nonnomadic communities. Sacsayhuamán, Incan site near Cuzco, Peru.

domesticated animals by enabling the tamer animals to reproduce. Accordingly, those herds of animals that served humanity as domesticated species began to vary substantially from their wild ancestors.

Many species changed in size. Cows, pigs, and sheep became smaller because humans bred more stunted animals that ate less than did their wild ancestors. Also, because sheep produced wool, humans bred varieties of these animals that did not shed their fleece. Furthermore, since cows and goats produced milk, humans selected individuals that provided the highest yields. And as oxen and horses provided either strength or served in the military, humans bred them to increase in size in order to maximize their power. This latter example, however, required that humans also develop an easy-to-grow plant fodder to feed larger animals, since most of the land had already been dedicated to producing food to sustain the human population.

In any event, once a band of humans had successfully domesticated a species of animal, its role in the new agricultural community depended on what type of agriculture the humans had decided to practice. If most of the land went to plant production, animals became a source of labor, provided fiber, or served as a luxury food. This proved true because to produce 10,000 calories of animal flesh required 100,000 calories of plant life. If these 10,000 calories of animal flesh made up the bodies of humans, most of the plants produced in an area fed people; if these 10,000 calories were animals, most of the plants had to be used to feed herds. Hence, land dedicated to plant cultivation could not be used to raise livestock. Furthermore, once the number of people dependent on plant food grew too large for them to rely on animals for meat, then the land could no longer be dedicated to raising livestock. As a result, two types of symbioses marked the beginning of world history: *intensive* and *extensive* agriculture.

Intensive agriculture specialized in plant cultivation and derived its name from the labor required to produce each year's crops. Intensive agriculture yielded ten times more calories than did herding and generated a human population ten times as large, but it confined the bulk of these people to a specific location (close to their fields) under the control of a network of towns and cities. Consequently, as this style of agriculture grew, so did the demand for management skills. The result was the development of an urban division of labor, the specialization of tasks, concepts of status and authority, calendars, religious explanation of the seasons and forces of nature, and writing. Some or all of these features of urban life eventually emerged wherever such a culture had enough time to grow and mature.

In contrast, extensive agriculture specialized in animals and derived its name from the amount of land it required to keep large herds alive. Extensive agriculture involved moving a herd from pasture to pasture in order to supply its needed plant calories. This method generated far fewer humans per square mile than did intensive cultivation, and it denied them permanent residence in any one locale, eliminating the possibility of developing urban skills. The result was that extensive agriculture did not produce the types of occupations that required an urban division of labor or a written history.

Thus the domestication of plants and animals set the stage for the dawn of world history. Once agriculture, especially intensive agriculture, began, urbanization became possible. When urbanization occurred, writing became a distinct possibility as well. As writing emerged, an explicit record of the past could be developed and maintained. Hence, without agriculture, humanity would still live in a manner consistent with prehistoric times (i.e., the time before written records). For better or worse, the line between prehistory and history was drawn by the domestication of plants and animals. Once that line was drawn and the supply of food produced by agriculture created the symbioses that brought specific human, plant, and animal populations into a reciprocal relationship that substituted artificial selection for natural selection, then

Thus the domestication of plants and animals set the stage for the dawn of world history. Once agriculture, especially intensive agriculture, began, urbanization became possible.

a natural lifestyle like hunting-and-gathering had to give way permanently to an urban existence. Accordingly, the domestication of plants and animals defined the conditions of possibility that humans later exploited to produce the great civilizations of world history.

The new warm era that began after 20,000 years ago set in motion an epoch of unusual duration that provided warmer temperatures, melted continental glaciers, and exposed new lands in equatorial and mid-latitude locations to an abundance of plant life. These changes made more foodstuffs available and encouraged foraging, fishing, and seed selection.

Climate

As mentioned above, 18,000 years ago a warming trend began that continued into the present. Historical climatologists have confirmed this trend by measurements taken from ice cores drilled into the glaciers of Greenland. The ratio of oxygen isotopes in these ice cores indirectly proved that the rise in temperature began 20,000 years ago. When ^{18}O is in a higher ratio to ^{16}O, the planet is relatively warm and wet; the opposite is true when ^{16}O rises higher than ^{18}O. The reason why is because ^{18}O is heavier than ^{16}O.

Water comprises two hydrogen atoms and one oxygen atom. ^{18}O is an oxygen isotope that is two neutrons heavier than ^{16}O and both are found in water molecules. Because of this weight difference, ^{18}O requires more energy to evaporate than ^{16}O when rain clouds form. This means that ^{18}O is more likely to fall as rain than ^{16}O when air cools and condensation occurs. As air moves from a warm zone, where rain clouds form, to a cold one, where rain tends to fall, water vapor condenses and the heavier oxygen isotope falls before the lighter one. This means that if a warming trend is occurring, more ^{18}O atoms will be found in rain and snow than during an Ice Age. This creates the ratio between ^{18}O and ^{16}O and tells if the period is a warm one or a cold one.

The new warm era that began after 20,000 years ago set in motion an epoch of unusual duration that provided warmer temperatures, melted continental glaciers, and exposed new lands in equatorial and mid-latitude locations to an abundance of plant life. These changes made more foodstuffs available and encouraged foraging, fishing, and seed selection. What caused these changes in climate and what sustained them raises fundamental questions about climate itself, how it forms, how it changes, and how it affects human behavior. Hence, a brief explanation about the weather complements the origins of agriculture reported above.

Ocean currents and winds shape climate around the world, creating the circumstances that make living easier for humans today than during the last Ice Age. Ocean currents move heat from the equator toward the northern and southern latitudes, raising temperatures in these locations and converting them from cold to warm zones. These warm temperatures then generate high and low pressure pockets that whip up the winds, which in turn propel the ocean's surface waters in a common direction. The winds push the Earth's warm currents away from the equator until they reach sinking points, where the now-cold water drops deep beneath the surface and returns to its point of origin. The quantity of salt in the water determines where the currents sink. Together, the winds and salt content combine to create what is called thermohaline circulation: *thermo* refers to the temperature of the water and *haline* to the water's salinity.

Scientists have not been able to measure the thermohaline circulation directly, but they did discover that the wind-driven surface currents are horizontal and the haline sinking points are vertical. The wind-driven circulation occurs in the upper few hundred meters of the ocean. Broadly speaking, these surface currents form five great anti-cyclonic spirals north and south of the equator in both the Pacific and Atlantic and south of the equator in the Indian Ocean. Fast-moving, warm western currents such as the Gulf Stream transport heat from the tropics to mid-latitudes on the western side of the Atlantic, while cold water flows back toward the equator from Iceland and the Labrador Sea of Greenland or the Canary Islands (this is the location for the Canary Current—see below). The northern Indian Ocean circulation follows the monsoon winds southwest during the summer but weakens during winter and reverses itself (the term monsoon itself comes from the Arabic *mausen*, which means "season").

In the southern hemisphere, westerly winds drive the Antarctic Circumpolar Current. This powerful stream of water flows west from just north of Antarctica and travels all the way around the world. In the northern hemisphere, the presence of land breaks up the movement of the wind, makes the warm surface currents more complex, and carries water in a variety of directions.

The Atlantic presents a good example of how an oceanic conveyor belt works. The Gulf Stream warms the North American shores, crosses the Atlantic going eastward, becomes the North Atlantic Drift Current, and transfers heat to Europe and the Mediterranean. One branch of the North Atlantic Drift Current turns southward off the coast of Africa, becomes the Canary Current (as noted above), cools, sinks, and swings back toward the Americas. A second branch continues to flow northward along the west coast of Ireland and Scotland, where it becomes the Norwegian Current. This warm water continues north into the Barents Sea and the Arctic Ocean.

All along this complex route, the Gulf Stream releases heat and moisture into the atmosphere. This increases the saline content of the water while heating up the land that the current encounters. Having given away its warmth, the current is cool by the time it reaches the Arctic Circle, and it has a high salt content because of the moisture it has released. Now the cold, dense, and salty water sinks beneath the surface just east of Iceland and southwest of Greenland, forms a deep-water current, and becomes part of the conveyor belt that swings south to resurface near the equator, where it joins the Gulf Stream again.

The density of the seawater near the sinking points is the result of both temperature and salinity. Salty water is denser than fresh water; also, cold water is denser than warm water. Although the Gulf Stream holds more salt than the surrounding seas, it is much warmer so that its density remains less. On its journey north, as the Gulf Stream becomes the North Atlantic Drift, it cools, which joins with its salt content to increase its density, causing it to sink in specific locations. Once it sinks, the cold salty flow beneath the surface regenerates the surface current.

The heat released by the flow of the Gulf Stream and other currents sets up high and low pressures zones over the ocean that determine the westerly winds that warm Europe. When these winds blow, mild winters follow, with long growing seasons and bountiful food production. When these currents falter, the westerly winds weaken, Europe's winters grow harsh, and torrential rains hammer crops during summer. The stability of these currents and their accompanying winds, sets the tone for agriculture in Europe as the mini–ice age of the Late Middle Ages demonstrated (see chapter 15, vol. 1).

In the Pacific, the story is quite different. The Pacific Ocean is in perpetual motion; west-blowing trade winds push warm surface water toward Asia. These waters form a pool of moisture thousands of miles across. As warm surface water moves west, cold water from the depths flows to the surface and takes its place near South America. The eastern Pacific is cold, even close inshore. Little moisture evaporates from these cold waters, and as a result the Peruvian coast receives almost no rain. Mexico's Baja California and the U.S. state of California have long dry seasons in summer, while on the other side of the Pacific, warm water generates clouds. Heat and humidity climb to unbearable levels, and monsoon rains fall over Southeast Asia and Indonesia.

For some unknown reason, every few years this process reverses itself. Usually during the Southern Hemisphere's spring, this machine hesitates and the interaction of air and water shifts. The northeast trade winds slacken and sometimes die completely, while an El Niño–Southern Oscillation event begins. When an El Niño occurs, a brief global climate shift also occurs: centuries of rain fall on Peru within a matter of days, drowning crops; Mexico's Baja California and the U.S. state of California experience wet summers; the Great Plains states enjoy mild winters; and the monsoons fail to occur throughout Asia and Africa, crops there die from lack of water, and famine becomes common.

Winds and currents in both great oceans, therefore, influence the agriculture everywhere. When contemplating the origins of cultivation, we should recognize that winds and currents were the forces that created the Long Summer. Furthermore, winds and currents played a critical role in maintaining the weather that sustained each yearly growing season once civilization began. Finally, scholars are beginning to see that climate itself is the determining factor in feeding the world today. Without a fundamental shift in the winds and currents, the end of the last ice age would not have occurred; given the dependency we have developed on cultivation, paying attention to winds and currents today seems like a wise thing to do. The more we know about climate, the better off we will be in the future.

The Geography of Cultivation

In any given place or time, once human numbers grew beyond what nature's bounty could support through a hunting-and-gathering lifestyle, people turned to cultivation to meet their growing demand for food. Each of these independent developments of cultivation around the world evolved in synchronization with the local climate, geographic location, and the numbers of humans, animals, and plants. When and where these events occurred, and how rich a supply of food each one generated, depended on specific local conditions. In addition, the longer this process endured, the greater abundance and variety of foods it produced. Also, the geographic position of each original site for plant and animal domestication in relation to other human communities created great contrasts in the effect of agriculture on local human behavior. As a result, the oldest, richest, most fertile, and most strategically located cultivation sites played the largest role in the way agriculture shaped world history.

Those regions where agriculture started earliest produced the greatest supply and variety of foods and developed the first cities, therefore dominating the first chapters in the story of humanity. And those regions with the best ecological circumstances had a better chance of developing at a faster rate than those with fewer natural resources. The contrast between these sites, the consequences of these differences, and the diverse cultures they produced all help to explain why there is such wide variation in the way early civilizations developed throughout the ancient world. The wealth or dearth of food produced, the strategic location or the relative isolation of one human group compared with another, and the creative potential fed by local conditions, all played a key role in the development of local culture. Finally, the study of all the local cultures taken together constitutes the material for early world history.

To lay a foundation for understanding the part geography played in the origins of world history, one must begin with a broad assessment of local conditions. Two key concepts play a central role in this assessment: *site*, which refers to the actual place where agriculture began, and *situation*, which refers to the location of this place in relation to other human communities. The more generous the natural resources of a site and the more strategic its situation, the greater the geographic impact local agriculture would have in world history.

Another crucial factor in the development of civilizations is a concept known as *land axis*. Given the general topography of the continents, land axis determined whether large sections of the Earth fell roughly within the same agriculturally productive climatic zones. A quick contrast of the three largest landmasses will illustrate this point. Eurasia has a broad land axis that runs east and west. Because of this orientation and the shared temperate zone stretching from Spain in the west to China in the east, much of Eurasia falls within what geographers call the *sunbelt*. If agriculture began in a strategic location on the Eurasian continent, say the Fertile Crescent, then domesticated plants and animals easily could spread from their point of origin to other zones of cultivation that shared common seasons, temperatures, and moisture levels. The fact, therefore, that many of the earliest civilizations on the Eurasian continent developed a common crop-base using plants and animals whose original ancestors came from the Middle East should not come as a surprise.

In sharp contrast, the Americas have a broad land axis that runs north and south. Most of the land in North America, Mesoamerica, and South America lies in such a way as to make a north-south axis dominant, as opposed to the east-west axis of Eurasia. But since the climate zones tend to run east-west, a north-south land axis naturally created a wide variety of agricultural conditions moving from north to south. Many of these climatic zones were inhospitable to the plants and animals originally domesticated by other Native Americans in different sites. Consequently, when humans did develop a successful relationship with local plants and animals in the Americas, they found it much more difficult to migrate with these resources to other locations. Hence, the spread of agriculture took much longer in the Americas than it did in Eurasia.

The continent of Africa is roughly 5,000 miles wide and 5,000 miles long. Thus, its land axis should have played a significant role in the development of agriculture. Yet the fact that the Sahara Desert—in which rainfall amounts to less than an inch per year—begins just south of the Atlas Mountains in North Africa eliminated many of the advantages promised by the continent's east-west axis. In addition, the Sahara is the largest desert on Earth, with approximately 3 million square miles of sand dunes and wastelands, a barrier that precluded the possibility of plants and animals to the south having shared a common ancestry with those in the north. Hence, the lands cultivated in sub-Saharan Africa had plants of different origin than those native to Eurasia and North Africa. This made the African story unique when compared to the rest of the Eastern Hemisphere. And this placed sub-Saharan Africa in a state of isolation similar to that of the Americas.

Having made these broad statements about land axis, we move to an analysis of the sites where agriculture actually began. The point here is to determine why some sites were better suited to agriculture than others. This analysis also includes the location of these sites relative to other potential zones of cultivation once humans learned to live with certain plants and animals.

The original sites for the development of agriculture include the Fertile Crescent, mentioned above, the Wei, the Yellow, and the Changjiang (Yangtze) River valleys of China, the central valley of Mexico, the Andean highlands, and the Sudanese Belt and Niger River valley of sub-Saharan Africa. One other possible site is in Southeast Asia. Each site served as the setting for a unique story and supplied a different array of plants and animals that were potential foods for humans. Of these various sites, one is the oldest, has the best location, and enjoys the best situation. This site comprises the Anatolian highlands of Turkey, the Zagros Mountains of western Iran, and the Levant coast of Syria, Lebanon, and Palestine, or the Fertile Crescent.

As already mentioned, the geographic range of the Fertile Crescent's plants is well known, and the genetic changes these plants underwent in the process of domestication have been thoroughly documented. As a site, the Fertile Crescent enjoys a Mediterranean climate that offers mild, wet winters and long, dry summers. Such a climate encourages plants that grow rapidly, produce large seeds, and then lie dormant until the next growing season. Known as annuals, these plants not only produce the edible cereals and pulses mentioned above, but also put more energy into seed production rather than stems, stocks, and plant fibers. Thus these plants generate some of the most nutrient-rich foods in the

Cave painting by the Cochimi Indians circa 3500 BCE depicting hunters with fish, deer, and frogs. Near Mulegé, Baja California.

world. And because their seeds are so large and lie dormant for so long, annuals are easy to store from one growing season to the next. Because of these qualities, the seven founder plants that fed the early farmers in the Fertile Crescent later became a foundation for feeding an urban population.

A second advantage the Fertile Crescent offered its residents was its strategic location in the world. Situated on a land bridge between North Africa, Europe, and Asia, the Fertile Crescent allowed the seven founder plants common to this region to spread far and wide. Given the basic east-west land axis of Eurasia, the wheat, barley, peas, chickpeas, lentils, bitter vetch, and flax of the Fertile Crescent made their way across the North African coast, throughout Europe as far as Great Britain, across North Africa to Morocco, and from Iraq to Iran, India, and as far north as Tibet.

In contrast, China, Mexico, the Andes, and the Sudanese Belt and Niger River of Africa offer far fewer advantages. China's size, relative isolation, and ecological diversity when compared to the Fertile Crescent produced a wide variety of human responses to local circumstances. Each of these responses represented how early farmers dealt with the specific climate, soil, and wildlife available for cultivation. One of the first occurred in the Wei River valley around 5000 BCE due to an abundance of loess. Loess, an unusually deep and fertile topsoil rich in decayed organic materials, especially the lime produced from the decomposed shells of small creatures, is yellow in color. Because the Wei flows into the Yellow River, loess stains the water of both rivers and gives the latter its name.

Deposited by the wind and spread by the flooding of local rivers, loess provides an excellent medium in which to cultivate plants. Spread along the floodplains of both the Wei and Yellow rivers, loess supplied the soil needed to cultivate plants in North China. The plants first domesticated in North China included soybeans, millet, and sorghum. The Chinese later added wheat to this list of foods, but the DNA (genetic code) of Chinese wheat varied from that of the variety domesticated in the Fertile Crescent. In any event, although the combination of soybeans, millet, sorghum, and wheat provided the original food base for North China, these four crops could not match the immense nutritional output of the seven founder plants native to the Fertile Crescent.

While North China produced the four founder crops named above, South China experienced an independent agricultural revolution. Separated from the North by interior mountain ranges and distinctly different climates, South Chinese farmers could not grow wheat, millet, sorghum, or soybeans. Given an abundance of water due to both the monsoons and the Changjiang River, Southern Chinese farmers had to grow plants that had a high water tolerance. Accordingly, they managed to domesticate rice around 9000 BCE–an even earlier event than the Wei River. As a result, two separate agricultural societies evolved in China as if they were continents apart.

While the internal circumstances of China isolated agricultural communities and prevented the internal diffusion of plant species to create a common food base, the Americas developed cultivation under far more secluded geographic conditions. Large deserts transected the northern regions of Mexico and restricted cultivation to central and southern Mesoamerica. Also, the land bridge between Mesoamerica and South America proved to be virtually impassible because it is a very narrow isthmus covered with a dense jungle. Furthermore, the Andes Mountains along the west coast of South America rise sharply out of the Pacific Ocean to create a very narrow coastal plain with isolated mountains and valleys. Finally, both the Atlantic and the Pacific oceans virtually quarantined the Americas from both Eurasia and Africa.

Beginning with Mesoamerica (the present-day Southwestern United States and all of Mexico, Central America, and the Caribbean Islands) the story of the domestication of plants in the Americas remains a long and confusing one. The key founder plant of Mexican agriculture, the wild ancestor of corn, still has not been identified with certainty to this day. Most experts argue, however, that a grass called *teosinte* (*Zea mexicana*), and not wild corn, provided the genetic material that led to domesticated maize (corn) from 5000 to 1500 BCE. Teosinte grows all over Central America and has been successfully crossbred with wild corn. This proves that both plants share compatible DNA, which suggests a common ancestry. And like maize, teosinte produces an edible dry seed one can grind into flour or soften with water. Finally, teosinte, like corn, pops when heated. According to the argument for teosinte, the development of ancient domesticated corn required constant human intervention to select individual plants that eventually evolved into maize. Once they selected these plants, ancient gatherers then preserved the most desirable traits by deliberately planting those varieties of teosinte with the largest cobs.

Arguing against the teosinte theory are some who believe that the original DNA for corn evolved from an ancient variety of pod corn (*Zea maystunicata*), a type of wild maize found not in Mexico but South America. Pod corn gets its name from the fact that a husk covers each kernel. This argument states that wild pod corn is far more generous as a food than teosinte and would more likely have been selected for consumption. In order to render maize from teosinte, the counterargument continues, humans would have had to conduct centuries of very complicated selective breeding. Finally, the ancient farmers who cultivated teosinte would have had to have prior knowledge of what they were doing in order to produce the maize eaten today.

Amid the ongoing dispute over whether teosinte or pod corn is the original ancestor of corn, the most recent scenario for the domestication of maize is that an accidental cross-fertilization created a new grain. This most recent argument states that teosinte serendipitously fertilized a wild grass called gamagrass or *Tripsacum* to create an unusually hardy plant that also generated a better grain than its parent plants. Furthermore, desperation for food, rather than flavor, encouraged the cultivation of these robust teosinte-gamagrass offspring in a high-risk environment. The constant threat of drought common to the Oaxaca Valley of southwestern Mexico, where the domestication of Mexican corn occurred, would have motivated Mesoamerica's earliest farmers to cultivate any hardy plant capable of dealing with a quixotic climate. Over the course of several centuries, rather than thousands of years, as this new theory argues, the teosinte-gamagrass hybrid went from a low-yielding cob into what we now call corn and would have led to the acquisition of the food production knowledge necessary to create modern maize.

Separate from the current dispute over the ancestry of domesticated corn is another major flaw in this plant that must have further delayed the acceptance of maize as a reliable source of food. Each kernel of corn contains an indigestible supply of the vitamin niacin. If one consumes mostly corn without having prepared it properly, one will feel satisfied but can develop a dangerous niacin deficiency that leads to a disease called pellagra, which, unless the victim ingests niacin, can be lethal. To make the niacin within the corn digestible, the kernels have to be boiled in a lime-rich water to produce either hominy or dough that can be baked into tortillas.

Despite all the problems associated with the domestication of corn, it became one of the founder crops of civilization in the Western Hemisphere. And to this founder crop, Mexican farmers added squash and beans. All three of these plants, combined with the chili pepper, compose "the Mexican trinity"—the three key plants—of Mesoamerica. The protein and carbohydrates from corn, beans, and squash supplied a sufficiently balanced diet to sustain human life, but their nutritional yield did not come close to the abundance offered by the seven plants found in the Fertile Crescent. Furthermore, the north-south land axis of Mesoamerica discouraged diffusion of these foods to other locations. Only after centuries of climatic adjustment did corn eventually

Teosinte on the left, maize on the right, and a hybrid at center.

make its way north; it did not arrive in the northeastern forests of North America until 200 CE.

Like the farmers of Mesoamerica, the first cultivators of the Andes had a very difficult time domesticating their staple plants, potatoes and beans. Just as the hunters and gatherers of Mexico lived in a harsh environment, the first farmers of the Andes selected beans and potatoes to supplement a scarce food supply. They began this process around 5000 BCE. Living at 8,500 feet, the Guitarrero people gathered fruits, potatoes, beans, lima beans, and chili peppers to supplement a diet of deer and rabbit. In the process of selecting their foods, the Guitarrero gained control over the reproductive cycle of plants capable of living at high altitudes. Grown on small plots of land near rivers and streams, potatoes and beans soon became the most common foods in the Andean diet.

Eventually ancient farmers in the Andes developed different strains of potatoes that could grow at various altitudes and in all kinds of soil and weather. Some of the potatoes they chose evolved into a rich, starchy food highly preferred by humans. Others grew well at low altitudes and were selected because they stored water. Some grew fast enough so that they could adjust to the very short growing season found at the highest elevations of the Andes. Still others were chosen because they could be easily stored after they had been pressed and frozen in the cold mountain air. In fact, experts believe that some 3,000 varieties of potatoes exist today because of the careful selection process begun by the ancient South American farmers.

Given the many isolated valleys and mountains of the Andes, a diverse population of farmers slowly evolved in a difficult environment. With the addition of a South American founder plant called quinoa (a protein-rich grain the British today call corn), and a tuber called cassava, the total supply of cultivated food in the Andes eventually matched that found in Mesoamerica. Caught in the same kind of isolation that maize experienced in Mexico, however, the potato did not make its way north into Mesoamerica until the Spanish conquest. As a result, both Mesoamerica and South America developed independently of one another (5000 BCE–1492 CE), and neither possessed anything like the site and situation advantages of human groups in the Fertile Crescent when it came to plant migration.

The last region known to have domesticated its own founder crops is sub-Saharan Africa. Although sub-Saharan Africa exists in close proximity to the Fertile Crescent, none of the plants selected in this portion of Africa were related to wheat, barley, peas, lentils, chickpeas, or bitter vetch. As already mentioned, the east-west land axis of Eurasia permitted the founder crops of the Fertile Crescent to spread southwest into North Africa, northwest into Europe, and east into India, and Tibet. At the same time, these same crops diffused up the Nile as far as Ethiopia, where they stopped. The reason these plants were able to travel as far as they did was that much of North Africa, Europe, and Southwest Asia, and the long valley of the Nile as far south as Ethiopia experienced mild, wet winters and long, dry summers, which happened to be the ideal climatic conditions for Fertile Crescent crops.

Just below the Sahara, however, in a region called the Sahel, the rainy season is exactly the opposite of the Mediterranean climate to the north. Rain falls mostly in the summer, while the winters are dry. The founder crops of the Fertile Crescent therefore fared poorly in the Sahel; indeed, they drowned there during their growing phase. But even if these plants could have adapted to this change in the rainfall pattern, there were already annual grasses in the Sahel that could provide the needed food—sorghum and millet. Since both are founder plants, they provided the necessary calories for the beginning of urban life. The date of their domestication was 2000 to 1800 BCE.

Meanwhile, just south of the Sahel lies a wet zone that would not support either sorghum or millet. Thus, like China, a second, independent process of domestication occurred in Africa, this one along the Niger River. These crops include African rice, yams, oil palms, and kola nuts. Although both yams and rice were founder crops, the yam proved to be the best at traveling with its farmers. African rice, therefore, remained confined to West Africa and did not accompany yams during the great human trek called the Bantu migration between 3000 BCE and 500 CE.

The last batch of founder plants grown in Africa was not native to this continent; rather, they came from Southeast Asia. These include bananas, Asian yams, Asian rice, and taro, all of which traveled with Asian and

Indonesian farmers across the India Ocean at an unknown date. Because the DNA of both Asian yams and rice are different from that of their African counterparts, these plants appear to have been domesticated independently in Southeast Asia at some unknown date. Of these two plants, Asian rice proved far more mobile than the African variety and spread throughout East Africa.

The contrasts among the various geographic sites where the original domestication of plants took place, along with the number of founder crops involved in each process, determined the earliest date for the origin of cities and the availability of a food surplus to feed people living in an urban setting. Just as important is the capacity of these plants to travel from one potential cultural hearth to another. Three factors all combined to determine how large the potential food surpluses might be during each harvest: 1) the earlier a plant fell under human control; 2) the greater the predictability of that plant's life cycle as a food source when compared to hunting-and-gathering; and 3) the total number of plants domesticated as dietary resources. Since a food surplus is defined as the number of seeds not needed by farmers either as the means to generate the next crop or as food itself, then the greater the size of the surplus, the more people it might release from agricultural work to engage in urban occupations and refine alternative skills. Hence, a large food surplus ensures a greater chance that writing, metallurgy, armies, recorded religious speculation, philosophy, art, literature, and proto-science, the bases for the term *civilization*, would appear. Therefore, historians in general agree that the beginning of agriculture marked the beginning of cities and the beginning of cities marked the beginning of world history.

Given the list of cultural possibilities made available by the domestication of plants, the earlier a group of people began cultivation and the farther they could travel, the greater their impact on a geographic region. Accordingly, the peoples of the Fertile Crescent had extraordinary advantages over those in China, the Americas, sub-Saharan Africa, and Southeast Asia. The Fertile Crescent, as mentioned, had seven founder crops; occupied the land bridge between Eurasia and Africa; diffused its food supply to India, Iraq, Iran, North Africa, and Europe; and gathered up many useful

TABLE 1.1 DOMESTICATION OF PLANTS

PLANT	LOCATION	WHEN
Einkorn, Emmer, & Barley	Fertile Crescent	9600–8000 BCE
Peas, Lentils, & Chickpeas	Fertile Crescent	9600–8000 BCE
Bitter Vetch & Flax	Fertile Crescent	9600–8000 BCE
Rice	Changjiang River	9000 BCE
Fig Trees	Fertile Crescent	9000 BCE
Bottle Gourd	Asia	8000 BCE
Broomcorn Millet	East Asia	6000 BCE
Bread Wheat	Fertile Crescent	6000 BCE
Manioc/Cassava	Andean Plateau	6000 BCE
Maize/Corn	Oaxaca Mexico	5500 BCE
Potato	Andean Plateau	5000 BCE
Avocado	Central America	5000 BCE
Chili Peppers	South America	4000 BCE
Watermelon	Fertile Crescent	4000 BCE
Pomegranate	Iran	3500 BCE
Hemp	East Asia	3500 BCE
Sunflower	Central America	2600 BCE
Sorghum	Sub-Saharan Africa	2000 BCE
Pearl Millet	Sub-Saharan Africa	1800 BCE
Chocolate	Mexico	1600 BCE

artifacts through trade with strangers on the fringes of sedentary agriculture. And once cities came into existence, trade joined the list of crucial urban activities and stimulated enormous growth in civilization. As a result, then, one cannot stress enough the advantages acquired by those cultures that founded the first cities in the Fertile Crescent.

The Domestication of Animals

Equally important as this history of the domestication of plants, yet subordinate in terms of food value, is the role played by the domestication of animals. The number of domesticated animals found in a region determined the availability of an alternative energy source to do labor for humans in the process of producing food. Also, the types of animals available for domestication determined the number of different uses humans could find for such a powerful resource. Yet to maintain an animal required use of land in such a way that barred plant cultivation for humans on that parcel. Furthermore, as mentioned above, the ratio of the number of calories of plant matter needed to keep an animal alive, versus the number of calories this same animal offered in terms of meat protein, is 10 to 1; in other words it took 100,000 plant calories to produce 10,000 meat calories. Clearly, it was better to work an animal in the production of plants than to eat it. Hence, the domestication of animals is a subordinate story in the development of cities when compared to the domestication of plants.

The successful domestication of animals, like that of plants, depended on the species of animals available in a particular geographic site and the situation of that site. Yet even where there was an abundance and a variety of animals that might be domesticated, three questions still begged answers: What kind of temperament did these animals have? How social were they? And would they submit to human domination?

Once again, when compared to the rest of the world, the Fertile Crescent proved to have extraordinary advantages in its natural supply of domesticable animals. The superb site and situation of the Fertile Crescent allowed for the easy transfer of any animal species the people living there managed to domesticate. The Fertile Crescent therefore introduced to human use the greatest number of domesticated animals, which included sheep, goats, and pigs, between 8500 and 7000 BCE. Although three species does not seem to be a whopping number, it is when compared to the total number of large domesticated mammals found in the world today, a mere fourteen. Happily, the close proximity of the Fertile Crescent to the eastern Sahara allowed humans to add cattle to the list of domesticated animals around 7000 BCE. Here land axis and the common Mediterranean climate permitted cattle to travel to the Fertile Crescent and sheep, goats, and pigs to cross into Egypt.

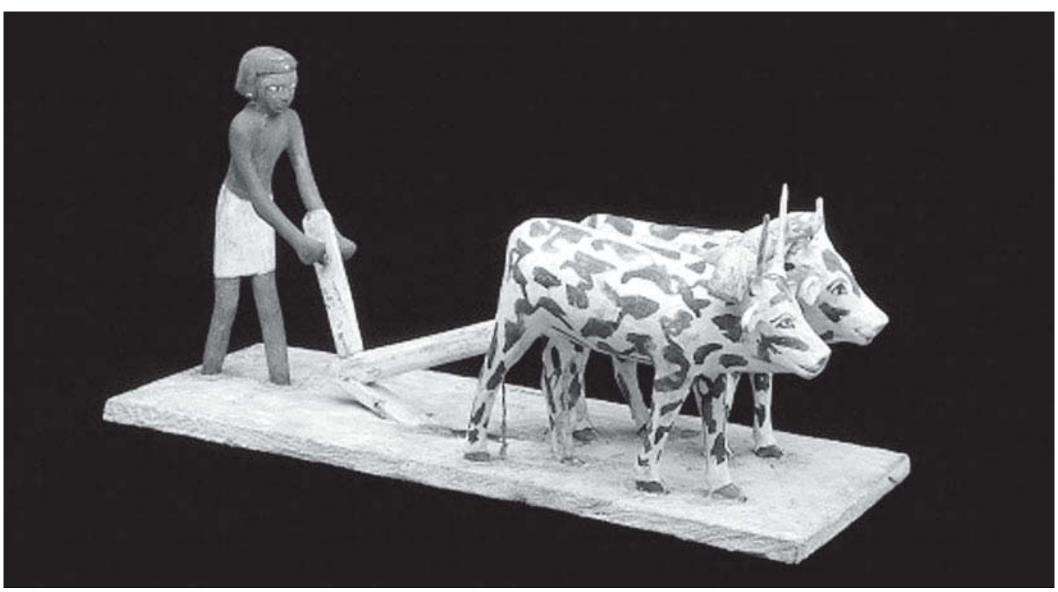
Indeed, cows or oxen, sheep, goats, and pigs represent four of the five major animal species that people use throughout the world today. The fifth major species is the horse, which was domesticated in Kazakhstan, near southern Russia, around 3500 BCE. Besides these five, there are only nine other minor species of domesticated animals; these nine, however, did not travel as well as the original five. The minor nine include the Arabian camel (one hump), the Bactrian camel (two humps) from Central Asia, the Andes camelids (the llama and the alpaca), the North African and Southeast Asian donkey, the north Eurasian reindeer, and the Himalayan and Southeast Asian water buffalo. Two local variations of cattle are distinct enough from those found in the Middle East to be listed separately: the Bali cow from Southeast Asia, and the mithan from India and Burma. In total, this combination of the major five and minor nine constitutes only fourteen animal species selected from a list of 148 potentially domesticable large herbivorous mammals. Native to Eurasia alone, twelve of these fourteen species did not reside below the Sahara Desert or live in the Americas. (Keep in mind that North Africa belonged culturally to the Middle East and is therefore considered part of Eurasia rather than Africa proper.) The remaining 134 potential candidates for domestication did not have the correct qualities that would make them useful to humans.

As mentioned above, the correct qualities that large herbivorous mammals need to serve as domesticated animals involve their diet, growth rate, breeding habits, disposition, and temperament, or tendency to panic. *Diet* refers to the amount of plant calories humans are willing to dedicate to an animal rather than to themselves. *Growth rate* defines how long it takes an unproductive offspring to reach useful adult maturity. *Breeding habits* are important because many species of mammals are too shy to allow humans to intervene in their reproductive cycle; *disposition*, then, refers to how aggressive a species of mammal might be, whether it will submit to human domination or instead try to injure its captors. Finally, *temperament*, or the tendency to panic, refers to those species of large herbivorous mammals that damage or destroy themselves in captivity. These animals might be useful as game on the open plains but will not tolerate being confined in pens.

To these qualities must be added *sociability*: Does the species in question live in herds? Do individual animals within a local population of the species have a social hierarchy? And do these same individuals live in an overlapping range with other species of animals, or are they solitary? If a particular species of mammal lives in herds, it suggests that this species has established a social hierarchy; if this species lives in ranges that overlap those of other species, it suggests that this species will tolerate strangers. Hence, humans tend to select individual animals from a species that will accept people as a substitute for the dominant member of a herd. At the same time, if these animals live in overlapping ranges with other species, they seem to be tolerant of strangers who seek to be their leader. Accordingly, all fourteen of both the major and minor species found on the list of most useful domesticated mammals in the world today possess the right qualities and social disposition. And of these fourteen species, the ancient ancestors of three of the major five lived within the Fertile Crescent. The fourth had to migrate from Egypt.

Because the Fertile Crescent ultimately included four of the five major species of large herbivorous domesticated mammals, it was twice blessed with exceptional biological resources. Of these four, one was an excellent draft animal, two provided wool, two supplied milk and milk products, and all four provided meat. Also, the early date of the domestication of plants (9600 to 7500 BCE) and animals (9000 to 7000 BCE) in the same region led to the possibility of improved farm tools. Oxen (*Bos taurus*), usually castrated male cattle, proved to be very powerful, docile, and obedient creatures. Using oxen to pull up the stumps of felled trees, early farmers observed that dragging the roots along the freshly exposed soil prepared the land for cultivation. Hence, the idea of the plow came into existence. Yet the effective use of such a heavy and cumbersome tool would not have been practical without the muscle power of the ox.

The plow itself, once discovered, was thoroughly refined and then spread to wherever Fertile Crescent plants came under cultivation. Since the Mediterranean grasses of the



Wooden model of an ancient Egyptian plow. Its use enhanced food production by fifty-fold and differentiated horticulture from agriculture. Middle Kingdom, about 2040–1750 BCE.

Fertile Crescent traveled as far west as Spain, as far north as Great Britain, and as far east as Tibet, all the farm tools developed for planting arrived in these places soon afterward. Also, since most plows required a draft animal to drag it through the soil, oxen as well as the other three useful species spread to all of the above places as well. Combined with flax (which produced linen as a fiber for clothing), the wool supplied by sheep and goats completed a list of materials useful both to people living at high altitudes and those engaged in river valley cultivation. Finally, the availability of milk from cows and goats and meat from all four species of domesticated mammals provided luxury food sources that complemented an overwhelmingly carbohydrate diet in all of the Mediterranean world.

As for China, the original domesticated animals there included the pig, the dog, and the chicken. Bones of these local animals appear in the earliest agricultural sites of northern China. Still later, the Chinese domesticated ducks and geese as sources of meat and added the silkworm to create a unique fiber, silk, that remained a Chinese secret for centuries. At the same time, because of the east-west land axis of Eurasia, the Chinese ultimately acquired knowledge of the twelve species of large domesticated animals found in Eurasia today. From the major five and seven of the minor nine (Eurasia did not import the alpaca or llama), the Chinese picked whatever they needed according to regional variations in local climate and the domesticated plants under cultivation. At the same time, the Chinese eventually had access to all of the Eurasian farm tools. To illustrate the power of the plow, in particular, one merely needs to look at the dramatic impact that the relatively late arrival of this tool had on Chinese history.

Chinese cultivation began as an independent discovery and did not lead to the development of the plow because of the absence of any large draft animals early in Chinese agricultural history. Eventually, the Chinese acquired cattle between 2500–2000 BCE some four and a half millennia after the Fertile Crescent, and the early wooden plow soon followed. This early wooden plow, called the ard or scratch plow, prepared the soil by cutting a symmetrical groove in the land. This type of wooden plow worked well in thin or soft soils but not in rich, thick earth. In contrast, the tool we call "plows" actually cut the soil, which developed early in the Fertile Crescent. This type of plow, however, did not arrive in China until iron technology crossed the Himalayas and Gobi from the Middle East. This new iron plow changed Chinese cultivation dramatically after 500 BCE to create an agricultural revolution that fuelled a major conflict called the Era of the Warring States (430–221 BCE). Accordingly, while the iron plow revolutionized Chinese agriculture, it also launched an era of intense conflict.

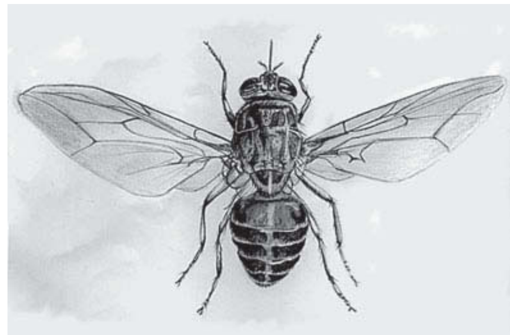
The combination of iron, the plow, and large draft animals dramatically transformed food production in China. And the sudden abundance of new food surpluses in conjunction with the decline of the Zhou Dynasty (1050 to 256 BCE) released a large number of people from agricultural pursuits. Because the Era of the Warring States (403 to 221 BCE) began within a century of the iron plow's arrival, one can conclude that local Chinese rulers chose to use their newfound surpluses of food to feed vast armies. At the end of this era of warfare, the victorious ruler, Qin Shih Huangdi (reigned 221–210 BCE), had the means to create the Chinese Empire. This suggests the extraordinary new urban division of labor at his disposal. Therefore, the arrival of the iron plow in Chinese history played a silent but fundamental role—it released enough people to fuel a new political order that converted China from a system of competing kingdoms into a united, fully integrated state.

Although the plow thoroughly changed Chinese history, it did not arrive in the Americas or sub-Saharan Africa until very recent times. In both places, the development of agriculture before 1492 had to take place without the use of domesticated draft animals or valuable farm tools like the plow. When comparing both regions, however, the Americas represented the most dramatic example of geographic isolation. Therefore, we will consider the Americas first.

Quarantined by two great oceans, the Western Hemisphere experienced the arrival of human migrants very late in world history, near the end of the Pleistocene Era (the last ice age). Although the route they took is currently disputed by contemporary archaeologists, these migrants probably walked across the frozen Bering Straits (once the ice age ended, this ice bridge melted, separating the tips of present-day Russia and Alaska by seawater), while their arrival occurred sometime between 15,000 and 30,000 years ago. The migrating hunters who crossed the ice sheets covering the Bering Straits found a rich supply of large herbivorous mammals that had never seen humans and did not recognize these newly arrived hunters as a threat. As a result, a mass extinction of indigenous American animal species began and ultimately eliminated nearly all the potential candidates for domestication. Accordingly, Mesoamerica had only three species of animals that people found useful—a hairless dog (later called the Chihuahua), the guinea pig, and the turkey. Clearly, these three animal species could not supply a significant amount of meat, labor, or potential clothing fibers in comparison to cattle, sheep, goats, and pigs. Just as clearly, none of these three could pull a plow or a wheel-based cart. Consequently, human muscle had to supply all the labor necessary for food production and the construction of cities in both Mexico and Central America.

In contrast, the natives of South America managed to domesticate both the llama and the alpaca—two high-altitude camelids. Probably because they lived higher than 16,000 feet above sea level, these two camelids escaped the mass extinction that had swept away other useful mammals. Like their Eurasian relatives, the Arabian and Bactrian camels, neither the llama nor the alpaca had a suitable body frame or disposition for pulling plows or carts, so neither could be used to enhance plant cultivation. Furthermore, neither the llama nor the alpaca were large enough to match the muscle-power of an ox, nor could either species carry as much weight as their larger Eurasian relatives. Still, the llama and alpaca gave South Americans advantages that Mesoamericans did not enjoy; people in the Andes had access to these small pack animals that could carry up to a hundred pounds of weight apiece, while supplying an excellent wool fiber useful for high-altitude lifestyles.

In contrast to the Americas, sub-Saharan Africa provided a more complex history of animal domestication, yet it still produced the same results. Given the abundance of large herbivorous mammals living in Africa today, one would expect that several of the major domesticated species available to the world might have come from a sub-Saharan source. In fact, however, sub-Saharan Africa did not produce any major variety of domesticated animals known to the world today. All of the species native to sub-Saharan Africa were either too aggressive, combative, antisocial, or shy to allow humans to manage their lives. To complicate further the history of domesticated animals in sub-Saharan Africa, the tsetse fly precluded the survival of foreign livestock. This lethal insect feeds off the blood of quadrupeds and causes a disease called



The tsetse fly (Glossina morsitans) compounded the problems of Africa's food production by carrying disease that killed valuable draft animals needed for heavy agricultural labor.

trypanosomiasis (sleeping sickness). Like the mosquitoes that feed off humans, the female tsetse fly requires blood to ovulate. Thus, each bite stimulated reproduction, so the more animals a farmer brought into an area, the more flies soon confronted his herds. As a result, the tsetse fly created a disease barrier against the migration of the major five Eurasian species below the Sahara.

Fortunately, the tsetse fly did not live everywhere in sub-Saharan Africa; rather, it was confined to the equatorial forests of the continent and spread only where there was enough animal blood, shade, and moisture to sustain its life cycle. This deadly pest did not live in the grasslands of the Sahel and the Nile Valley of Egypt and the Sudan. Hence, Eurasia's domesticated animals could penetrate into sub-Saharan Africa, but only in the limited range mentioned above. Accordingly, cattle, camels, and donkeys lived on the Sahel, while pigs, cattle, sheep, and goats ventured into Egypt. Furthermore, a major movement of people, called the Bantu migration (3000 BCE to 500 CE), from a region near modern Nigeria and Cameroon took cattle, sheep, and goats to South Africa during a 3,500-year trek. This trek took so long because those domesticated animals traveling with the Bantu required 2,000 years to acquire the immunities needed by all mammal species that crossed into tsetse fly country. The tsetse fly therefore delayed, but did not prevent absolutely, the entry of domesticated animals into its range. Yet wherever humans took their animals, the tsetse fly followed. Thus, the insect spread with the Bantu migrants.

Given these restrictions on animal migration, the plow and the wheel did not penetrate into sub-Saharan Africa—just as they failed to reach the Americas. Yet the absence of both tools for most of African history was not caused solely by the absence of suitable draft animals, as in the case of the Americas. Instead, in sub-Saharan Africa there were several good reasons why the plow could not be used. Although cattle migrated into regions of cultivation below the Sahara, camels and donkeys were far more common as draft animals. Neither was suitable to pull a plow. Furthermore, the soils of the African grasslands, the region where cities appeared first on the continent, were poor and thin and did not respond well to cultivation with a plow. Indeed, if plowed, these soils suffered from severe wind and water erosion due to the erratic rainfall in the area. Finally, anyone attempting to bring the plow into sub-Saharan Africa would have had to cross as many geographic barriers as confronted those trying to bring it to China. So just as the plow required the Iron Age before entering China, sub-Saharan Africans also acquired knowledge of this tool late in their history, but, for the reasons cited above, still did not put it to use.

Urban Development

In food production, meanwhile, the value of large domesticated animals, especially draft animals capable of pulling a plow, was immeasurable. In combination with the development of irrigation, the role of the plow in accelerating efficient agriculture created such happy circumstances that they actually spurred the erection of the first cities in world history. On the eastern arc of the Fertile Crescent, where so many founder plants and domesticated animals met, two sections of land combined irrigation with the use of the plow to create the first cities. One of these regions was the Shot-al-Arab district of Iraq, and the other was the Susiana Plain of Iran. Each represented a tiny strip of land representing about 1 percent of the total land space in the Fertile Crescent, but on these relatively tiny patches of arable earth were the resources needed to support urban development.

Both the Shot-al-Arab and the Susiana Plain had a high water table and marshy features where the plow functioned with supreme efficiency. In both locations, the plow increased crop yields fiftyfold when compared to cultivation using hoes and pointed sticks. The result was a dramatic increase in food production in a severely restricted area. Such environmentally attractive regions, with an abundance of surplus food, led to an extraordinary concentration of people. At the same time, this concentration of people resulted in the formation of the first urban hierarchies (the organization of cities, towns, and villages according to their function in the economy) between the years 6500 and 3000 BCE.

Beginning around 6500 BCE, on the Susiana Plain in the semi-arid southeast of Iran, a number of residential agricultural villages formed on very small pieces of land. Covering a mere two to three acres, each village housed six or seven families and exploited the floodplains of local streams. Each flood season, fresh water and soil renewed the fertility of the fields, and the villages generated rich crop yields using the plow. As population began to grow in response to the abundance of food, more of these villages began to pop up across this same region. Within five hundred years, irrigation began as teams of farmers dug little ditches to feed fields farther and farther away from their water source. Crop yields continued to increase, as well as human numbers, and soon some thirty villages clustered near all the available streams and rivers on the Susiana Plain.

Between the years 5500 and 4600 BCE, the demand for water regulation increased dramatically as still more villages appeared in response to the continual growth in human numbers. Irrigation channels now required an organized division of labor, and an urban hierarchy replaced the original haphazard cluster of agricultural hamlets. One town on the site later occupied by Susa became the principal city; it covered some 18 to 20 acres while administering the region under cultivation. Ten larger villages of 7.5 to 10 acres in size provided for the local management of resources. And the remaining twenty-nine villages cultivated the soil to supply this system with food. During this same period, large residences and local ceremonial centers appeared in the original Susa, forming the primary religious center of this new urban hierarchy.

TABLE 1.2 DOMESTICATION OF ANIMALS

ANIMAL	LOCATION	WHEN
Dog	Undetermined	30000–14000 BCE
Sheep	Fertile Crescent	8500 BCE
Goats	Fertile Crescent	8000 BCE
Pigs	Fertile Crescent	7000 BCE
Cattle	Eastern Sahara	7000 BCE
Chicken	Asia	6000 BCE
Guinea pig	Andean Plateau	5000 BCE
Donkey	Northeast Africa	4000 BCE
Horse	Kazakhstan	3600 BCE
Silkworm	China	3500 BCE
Llama	Andean Plateau	3500 BCE
Bactrian Camel	Southern Russia	3000 BCE
Dromedary Camel	Saudi Arabia	3000 BCE
Banteng (Asian Cattle)	Thailand	3000 BCE
Water Buffalo	Pakistan	2500 BCE
Duck	Western Asia	2500 BCE
Yak	Tibet	2500 BCE
Alpaca	Andean Plateau	1500 BCE
Reindeer	Siberia	1000 BCE
Turkey	Mexico	100 BCE–100 CE

By 4600 BCE, however, the number of settlements had decreased suddenly. Perhaps the population declined as well. Then, a new level of complexity emerged in the area as three large administrative centers took the place of one. Each new center comprised impressive monumental buildings, elaborate official residences, storage facilities, marketplaces, and large workshops. A system of administrative specialists and bureaucrats seems to have taken up residence in each of these centers, while the urban hierarchy that supported these three cities became more complex as well. No longer organized merely to exploit irrigation and food production, these three cities served as manufacturing centers or engaged in commercial exchanges. Large and small cities and towns within the region reflected the availability of native resources and the demand for local services. Finally, by the year 3000 BCE, one city again dominated the Susiana Plain, occupied 1/2 square mile of land, and administered all the large towns, villages, and agricultural hamlets in the area.

As this Iranian urban hierarchy emerged on the Susiana Plain, another appeared on the far more famous site of the Shot-al-Arab. The reason for the Shot-al-Arab's fame derived from the fact that it laid a foundation for the rise of Mesopotamian civilization. Mesopotamia, also known as the "Land between the Rivers," produced several enduring cultures that made good use of the Tigris and Euphrates rivers. Like the Susiana Plain, the Shot-al-Arab district of Mesopotamia supported an early village, then town, and finally city development. Unlike, the Susiana Plain, the Shot-al-Arab went onto create a pattern of life that spread far and wide.

The set of original settlements on the Shot-al-Arab belonged to the Ubaid Culture. The farmers of this culture were non-Semitic people who organized the drainage and irrigation that turned the marshes of the Shot-al-Arab into a productive zone. They were an extension of the Natufin peoples and represented the first flowering of sedentary settlements mentioned above. They preceded the arrival of the Sumerians, and prepared the soil for this far more urbanized culture.

The Sumerians were a people who migrated into Shot-al-Arab from the Caspian Sea and transformed the region into the "mother-culture" of Mesopotamia. By the time the Sumerians arrived irrigation was complete, the plow was in use, and a patchwork of ancient towns and villages worked the land. The Sumerians began what is called the Uruk period (4000–3000 BCE) and transformed Mesopotamia into a rich urban zone. Uruk was the first principal city to dominate this emerging region; it appeared near the Euphrates River and grew far greater in size than any urban center located on the Susiana Plain. Indeed, Uruk soon developed into a major urban center that housed 30,000 people, covered 1,000 acres of land (approximately 1.55 square miles), featured a major temple, and administered an urban hierarchy that controlled ten times the number of farming villages as found on the Susiana Plain. Uruk continued to grow, becoming a veritable human magnet, as numerous people began to migrate into the region. From this center, Sumerian history began (see chapter 2).

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The farmers of Sumer during the Uruk period are also famous for developing of the first true plow. This tool appeared around 3000 BCE and took the name: "seeder plow." A funnel above the plow's blade placed seeds in the furrow carved into the soil and gave this plow its name. The blade itself did not scratch the earth as did the ard, but rather turned the soil. Because of the force needed to pull this plow, Sumerian farmers harnessed two oxen to overcome the added friction. Nonetheless, the seeder plow prepared the land far more efficiently than any other tool before it. Hence, as city size increased, so did the demand for food, and as the demand for food increased, so did the quality of agricultural technology. This made Sumer the most efficient food producer in the world at that time.

The point of this brief urban history is to illustrate that the earlier people combined the productivity of the plow with a manageable system of irrigation, the sooner they would concentrate in a specific site to form a city, and the sooner that city would realize the correct circumstances to propel a human community to form an urban hierarchy. At the same time, the development of an urban hierarchy is a human response to growing population pressures that results in an ever-increasing demand for administrative skills. These skills, in turn, encourage occupational specialization, the development of an urban division of labor, regional exploitation of resources, critical thinking skills, and an impulse to literacy. Nonetheless, the absence of the plow or irrigation does not prevent the development of an urban hierarchy; rather, it delays the process and explains, in part, why the people of the Fertile Crescent had such an enormous temporal advantage in the formation of cities.

Similar human concentrations appeared elsewhere in the world, but they did so later because either the food base did not include as many founder plants or domesticated animals or the irrigation and the plow were not both present. Thus, the cities of China followed the developmental pattern of Susiana cities and Uruk but did so later because they lacked as rich a food base and the plow. The Valley of Oaxaca, Mexico, had to wait even longer than China because the original farmers in that area lacked domesticated animals, the plow, and irrigation. And even though the people of Cahokia (near present St. Louis, Missouri) enjoyed easy access to the seemingly limitless supply of fresh water from the Mississippi River, they had to wait the longest because they imported their knowledge of corn from Mexico and did not have draft animals or the plow. In each case, the appearance of cities required a concentration of people that depended on the availability of domesticated plants and animals as well as the proper farm technology.

The Nomads

As mentioned above, the domestication of plants and animals led to two different symbioses that marked the beginning of world history: intensive and extensive agriculture. Intensive agriculture required that people settle down permanently, generate food