

altering them to suit at least some of them, at least for a while. The greatest such alteration, centered initially in Southwest Asia, was the development of grain farming. With farming, radically new possibilities for human life opened up and an agrarian era of deliberate, laborious food production dawned. Neither human history nor the earth would ever be the same.

SHIFTING TO FOOD PRODUCTION, 11,000-3,000 YEARS AGO

A few hundred domesticated species of plants and animals established a new intimacy with humankind when small groups of people, located in at least seven different parts of the earth, began to produce most (and eventually almost all) of the food they consumed by resorting to agriculture and herding. An enormous increase in the number of people and in the number of domesticated plants and animals followed, because mutual dependence allowed domesticated plants, animals, and humans to capture far more energy from the face of the earth than they had done before. Humans and some, but not all, of their domesticated animals also had to work harder, and by changing the environment more radically than before, created greater risks for themselves from famine, disease, and warfare.

Humans managed all these new relationships. Their acts and choices altered the traits and behavior of the plants and animals that submitted to domestication so radically that archeologists can usually distinguish bones and seeds of domesticated species from those of their wild relatives. Humans also altered their own behavior radically when tending gardens, fields, and herds became a daily routine; and, for all we know, some of our hereditary traits deriving from the long era of hunting and gathering may have been altered through selection for those who best endured laborious routines of farming.

Recent improvements in radiocarbon analysis allow reliable dating of even a single grain of wheat; and statistical analysis of pollen deposited in ancient bogs and lake bottoms can reconstruct ancient plant assemblages with great precision. Such methods, and careful archeological digging, have gone far to clarify the beginnings of agriculture in Southwest Asia,

Central America, and the eastern woodlands of the United States, but comparable precision for China, Southeast Asia, South America, and sub-Saharan Africa is only beginning to emerge. Table 2.1 summarizes recent results:

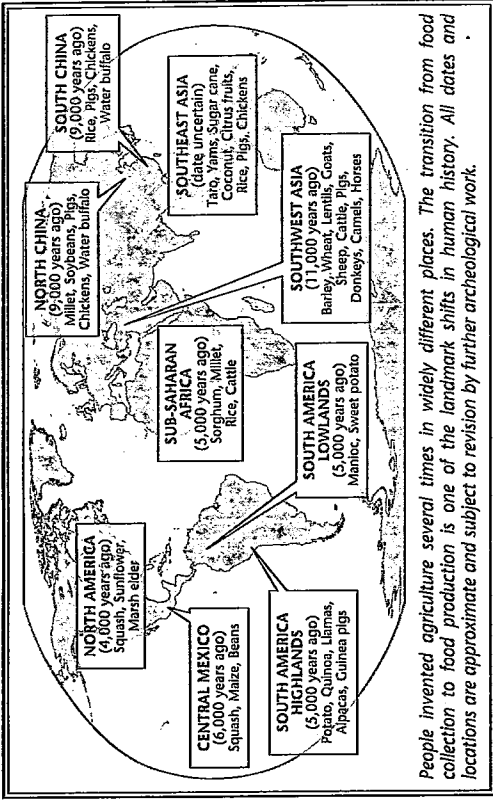
Table 2.1
Domestications of Plants and Animals

DATE	PLACE	MAIN CROPS	MAIN ANIMALS
Uncertain	Southeast Asia	taro, yams, sugar cane, coconut, citrus fruits, rice	pigs, chickens
11,000-4,000 years ago	Southwest Asia	barley, wheat, lentils	goats, sheep, cattle, pigs, donkeys, camels, horses
9,000-6,300 years ago	China	South China: rice North China: millet, soybeans	pigs, chickens, water buffalo
6,000-4,000 years ago	central Mexico	squash, maize, beans	none
5,000-4,000 years ago	South America	lowlands: manioc, sweet potato highlands: potato, quinoa	lowlands: none highlands: llamas, alpacas, guinea pigs
5,000-3,000 years ago	sub-Saharan Africa	sorghum, millet, rice	cattle

Why and how farming started has been much debated ever since studies of contemporary hunters and gatherers in the 1960s showed that they spent only a few hours each day getting food, and enjoyed a far better diet than hardworking peasant farmers who depended on a single staple for nearly all their nourishment. Who, then, would ever wish to become a farmer?

What seems to have happened is that in unusually rich and diversified landscapes, communities of hunters and gatherers found it convenient to settle down for all or most of the year, whereupon already familiar methods for encouraging the growth of useful plants acquired wider scope than before. Hunters and gatherers had long been accustomed to using many different plants for different purposes. Plant fibers supplied clothing, nets, bow strings, and the like. Herbal medicines, poisons, and mood-altering drugs were highly valued, so was the nourishment that some plants

Map 2.1 Multiple Separate Inventions of Agriculture



provided. Whenever communities settled down, it was convenient to have especially useful plants growing close by. Wherever soil and climate allowed selected seeds and cuttings to flourish in new locations, such gardens could then be expanded until they provided most and eventually almost all of the food and other vegetable products people required.

Understanding how plants reproduced was surely age old. But as long as wandering human bands consumed food as it became available and shared it among all their members, the extra effort needed to cultivate gardens was unattractive and, above all, storing seed for next year's harvest was impractical. Only when familial units became independent consumers of food could farming take off. Very likely, sedentary living brought on this change. It is easy to imagine that whenever individual women began to create gardens of useful plants around their dwellings, they developed a sense of personal and familial ownership on the strength of the sweat they expended and the proximity of the garden to their home. Only when this principle replaced the sharing ethos of wandering bands could gardening and farming develop.

But gardening did not expand solely because of deliberate human choices. Other factors almost surely played a critical role. More particularly, a settled way of life in unusually rich environments allowed families to support more than a single small child, whereas among roving bands of hunters and gatherers population growth was restrained by the fact that mothers could usually carry only one infant when moving from

place to place, and toddlers easily got hungry, thirsty, tired, and lost. Settlement therefore permitted far faster population growth, and a growing population intensified local hunting and gathering, making wild food supplies scarcer and scarcer. This meant that settled groups were likely to find themselves trapped into an increasingly laborious routine of life, working first in small gardens, then in larger fields as returns from old-fashioned hunting and gathering diminished.

At the start, gardening was women's work. Raising plants before harvesting them was only a variation on gathering plants in the wild, as women and small children had always done. Tools for cultivation derived directly from the knives and digging sticks needed to cut wild-growing stems and dig wild-growing roots. But when gardens became fields, and yields from the hunt diminished so that each family's food supply for a whole year came to depend mainly on the harvest, men may have accepted new roles by helping to cut ripe grain and get it safely into storage. In Africa and pre-Columbian North America, cultivation remained mainly women's work. Perhaps it was only when domestic animals, under men's control, started to pull plows through the soil that men began to work in grainfields as a matter of course. No one knows.

In Southwest Asia, wheat and barley were the main crops while goats and sheep were the first herbivorous' domesticated animals. As we saw in the previous chapter, wild stands of wheat and barley were dense enough on some hillslopes of that region to invite year-round settlement, beginning about 15,000 years ago. Then drier climates set in and these settlements disappeared; but where soils were unusually moist, or where seasonal flooding occurred, a few communities began to sow wheat on land where grain did not grow naturally. Large springs in the Jordan Valley near Jericho began to sustain this sort of agriculture 9,800 years ago—the earliest well-attested example of settled farming yet discovered.

By then, wheat plants at Jericho had already adjusted to new conditions created by harvesting, storing, and sowing seed for the next year's crop. In particular, the stem attaching each seed to its stalk became tougher so fewer seeds fell to the ground when sickles cut the stalks. After all, when human hands began to sow the seed, only grains that reached storage bins safely could propagate themselves the following

Experts agree that dogs were domesticated among ancient hunters long before agriculture began. They assisted humans in the hunt by transferring wolfpack patterns of dominance and cooperation to a new, trans-species, human-canine society. The resulting range and precision of aural and gestural communication between dogs and humans is unique, as every dog owner knows.

As early as 15000 years ago
in a local
settlement
the first
domesticated
animals
were
wheat and
barley
It was
a period
of
the
earliest
well-attested
example
of settled
farming
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year. The further fact that plants with tough seed stems brought more food into humans' storage bins made the change mutually beneficial. Later on, several other mutations occurred spontaneously, and farmers deliberately selected mutants they recognized as advantageous. So more and larger seeds per plant, with thinner coats, and husks easier to remove, soon distinguished cultivated from wild varieties of wheat and barley.

Wherever alluvial fans and springs provided the necessary moisture, similar experiments with wheat farming occurred along the inland side of the coastal hills of the Levant as far north as Damascus. Further north in Syria and Iraq, barley was domesticated at about the same time by an exactly parallel process. Simultaneously, the breeding of goats by farmers in the foothills of the Zagros Mountains (western Iran) and of sheep by farmers in the foothills of the Taurus Mountains (southern Turkey) also came under human control.

Penning the herd at night and protecting it against other predators as the animals grazed by day was essential to the new relationship between humans and animals. As with the grains, radical adjustment on both sides ensued. Human herdsmen, safeguarding the animals and leading them to pasture by day and into corrals at night, took over the role of the dominant male in the social structure of domesticated flocks. From the animals' point of view, human weapons were no doubt better protectors than horns. But herdsmen could only make their leadership effective by killing off defiant animals, thus inadvertently breeding selectively for submissive behavior. This altered genetic traits very quickly, as the thinner bones of domesticated flocks and herds plainly show. At the same time hunters had to learn to safeguard the animals they once had preyed upon, killing selected individuals only occasionally.

The development of settled farming injected new kinds of information into the human web. Apprentice farmers constantly exchanged skills, knowledge, seed, and breeding stock with neighboring communities. Within a few centuries a core assemblage of improved varieties of wheat, barley, sheep, and goats came together in an ever-growing number of agricultural villages scattered throughout the fertile crescent that extended through the better-watered plains and foothills of Iraq, Syria, and Israel. Many other plants were soon brought under cultivation as well. Lentils supplemented grains from the start. Olives, grapes, figs, and dates also became valued crops in suitable locations beginning about 8,000 years ago. Various green vegetables and spices added variety and vitamins to the diet as well. Flax was raised for its linen fibers.

From its initial cradleland, the Southwest Asian style of mixed farm-

From
genetic
founder
to
social
stability

ing and animal domestication proceeded to expand in every direction. With suitably enlarged irrigation works, such farming proved feasible, for example, even in desert lands along the lower reaches of the Tigris and Euphrates rivers. This specialized environment, in fact, became the initial seat of urban living and complex, stratified society—that is, civilization—as we will see in the next chapter.

Of equal importance, however, was the adaptation of grain farming to higher elevations and more northerly latitudes where sufficient rain fell to sustain forests. Cutting the bank of deciduous trees killed them and allowed sunlight to reach the ground so that grain scattered beneath needed only naturally occurring rainfall to mature successfully. Fertility could be renewed subsequently by spreading ashes produced by burning the dead trees; and when early farmers occupied rich soils, especially windblown loess, permanent settlement was feasible. But when pioneers cleared poorer soils, yields soon declined, so forest farmers often found it best to move to a new location and begin the slash and burn cycle again. By doing so repeatedly in a single lifetime, they therefore created a moving frontier of settlement in suitably forested regions by about 4,000 years ago.

When agricultural expansion into the forested zone of Eurasia was still in its early stages, however, new domestications and new ways of exploiting flocks and herds greatly enhanced the productivity of this Southwest Asian style of farming. The list of additional animal domestications is long:

Table 2.2
Southwest Asian Domesticated Animals

ANIMAL	DATE	PROBABLE SITE OF FIRST DOMESTICATION
sheep	10,000 years ago	Taurus Mountains
goats	10,000 years ago	Zagros Mountains
pigs	8,700 years ago	Southwest Asia and China
cattle	8,000 years ago	unknown
donkeys	7,000 years ago	Egypt
horses	6,000 years ago	Ukraine
two-humped camels	before 4,700 years ago	Central Asia
one-humped camels	before 3,000 years ago	southern Arabia

Wheat
barley
millet
oats

6000
3000

Wheat
barley
millet
oats
rice
cotton
silk
iron
steel
gunpowder
paper
printing
compass
magnetism
algebra
calculus
astronomy
navigation
medicine
art
architecture
engineering
mathematics
philosophy
religion
literature
music
drama
poetry
history
geography
botany
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botany
zoology
mineralogy
metallurgy
chemistry
physics

These domesticated animals provided much of the impetus for the subsequent spread of the Southwest Asian style of agriculture into Europe, across much of the rest of Asia, and into parts of Africa, and, much later, into America and Australia as well. What made that world-girdling expansion so irresistible was an amazing elaboration of human relationships with their domesticated flocks and herds. For example, between 6,000 and 5,000 years ago a mutant wool-bearing variety of sheep appeared somewhere in Southwest Asia and soon spread widely, since wool plucked (later sheared) from sheep's backs proved to be an extremely useful fiber for making textiles.² About the same time, first goats, then sheep were also persuaded to allow human hands to milk them. Herdsmen, in effect, substituted themselves for kids and lambs as consumers of milk—an extraordinary perversion of natural biological relationships. Cattle and even mares and camels were subsequently induced to provide milk for human consumption as well, but only some human populations of Western Asia and Europe evolved the capacity to digest fresh milk. These populations retain an infant trait into adulthood, enabling them to exploit the possibilities of milking to the full. This is the clearest known case of a genetic modification among humans provoked by agriculture and herding.

From a human point of view, milking had the enormous advantage of increasing caloric yields from the fodder a lactating animal consumed by something like four times over what slaughter for meat could provide. From the animals' point of view, it meant that humans began to maintain far larger herds than before; and on the grasslands of Eurasia and Africa, where full-blown pastoralism came to prevail, domesticated herds eventually far outnumbered their human attendants. This constituted a wry sort of reward for the diversion of food resources from lambs, kids, calves, and foals that made milk, cheese, butter, and yogurt available to humans.

A second, and almost equally important, use of domestic animals was as beasts of burden, and for pulling plows and wagons. Donkeys were the first pack animals; but horses, mules, and camels later superseded them for most long-distance transport because of their greater carrying capacity. Cattle were the primary traction animals at first, since hitching a plow or wagon to their horns was comparatively easy, and oxen—that is, castrated males—were placid and strong.

In most fertile environments soft ground and watercourses

² Wild sheep were hairy, with a short woolly undercoat. Wool-bearing sheep exaggerated the undercoat, perhaps due to selection by humans who already knew how to clothe themselves by spinning and weaving flax and other vegetable fibers into cloth.

obstructed transport, so wheeled vehicles³ could only be used for short hauls at first. And long after imperial governments built roads suitable for carts, plowing remained by far the most important use of animal muscle power since it multiplied the amount of ground that a family could cultivate manifold. Above all, this meant that in most years, on many different sorts of soil and in various climates, humans and oxen could produce more grain than they needed for their own consumption. This created an ecological opening for the emergence of cities and civilization that soon proved readily adaptable to diverse regions of the world. That fact, together with the priority in time that Southwest Asian civilizations enjoyed over all others, helps to explain why their heirs in Western Asia, India, and Europe became so dominant in subsequent millennia.

The beginning of agriculture in China is less well known. Firm evidence that rice was cultivated in the Yangzi Valley about 8,500 years ago on seasonally flooded banks of lakes and streams was only discovered in the 1980s, and new sites continue to turn up. Exactly how and where such practices began remains unclear. Rice has the enormous advantage of yielding far more abundantly than the grains of Southwest Asia. Modern harvest to seed ratios for rice are as much as 100:1 even when using traditional methods, whereas in medieval Europe a yield of 6:1 for wheat was exceptionally high.

On the other hand, rice cultivation was (or became) more laborious than Southwest Asian grain agriculture. Rice farmers start their plants in special seedbeds and then transplant them one by one and by hand into the standing water of paddy fields.⁴ They subsequently weed and harvest by hand as well. Water buffalo sometimes plow the soil to prepare it for planting, but in general animal power played a much lesser role in rice paddy cultivation than in Southwest Asian cereal farming. Human labor was critical, especially after farmers started to grow water-loving rice on higher, uneven ground. They then faced the enormous task of creating artificially leveled fields, diking each one separately, and then diverting streams from their natural course to create shallow ponds, only a few inches deep, in each paddy field. The necessary water engineering had

³ Wheeled vehicles were known in Mesopotamia about 5,500 years ago, as proven by a pictograph from Erech scratched onto a clay tablet. Actual wooden remains have been discovered only from much later times.

⁴ Varieties of rice will also grow on dry land, but wet rice cultivation became basic to the East Asian style of farming. Marginal communities in mountain districts of Southeast Asia still raise rice on rain-watered land, but their yields are far below those of paddy fields.

to be perpetually maintained. It also required complex local agreements to regulate access to, and delivery of, the running water needed to keep the growing rice in each paddy field suitably inundated until the time came to drain the field and harvest the ripened crop.

Consequently, when rice farming became basic to Chinese and other East Asian societies, incessant work in the fields shaped family relations and larger social structures along different lines from what prevailed elsewhere. But rice did not become China's main staple until after about 200 C.E. Before then, the core of historic China was situated in the valleys of the Huang He (Yellow River) and some of its tributaries where an entirely different style of agriculture, featuring millet, soybeans, and pigs (with up to two dozen lesser crops) began about 7,500 years ago. In this part of China, early farmers hoed soft, fertile loess (i.e., windblown) soils, and depended on fluctuating monsoon rainfall to assure the harvest.

Beginning about 4,000 years ago villages practicing this sort of agriculture supported the earliest Chinese dynasties, whereas rice farmers of the south lived in simpler societies that proved incapable of resisting Chinese expansion. Why this was the case, even though rice cultivation was (or became) so much more productive and reliable than raising millet, is well worth asking. But an answer must await extensive archaeological investigation throughout the vast expanse of Southeast Asia and its offshore islands. Scattered discoveries suggest that settled communities (often living along the shore or beside inland lakes and streams where fish and other aquatic foods were available) may be very ancient in that part of the world, and a tropical style of garden cultivation, featuring starchy roots like taro and yams, and a variety of tree crops together with sugar cane and sometimes also rice, may have arisen at a very early date.

Gardens located in secluded highland valleys of New Guinea, discovered by the outside world as recently as the 1930s, show what human societies could do by cultivating a large number of different kinds of plants in the tropics where year-round growth permitted continual harvesting of just enough for immediate consumption. Though quite populous, these communities remained small, mutually hostile, and isolated from the outer world both by choice and by an unusually hostile lowland environment.⁵

⁵ The coastal plains of New Guinea are intensely malarial and were thinly populated. Even the most eager imperialists found little to attract them to the mangrove swamps that lined the coast, which is why the upland farmers of New Guinea were able to preserve their isolated, independent ways of life until very recently.

Similar farming and fishing communities in tropical Southeast Asia may well be very old indeed, for many tropical roots can be propagated simply by cutting off the top of the tuber and putting it back in the ground. That simple way of maintaining a valued food source was probably familiar to hunters and gatherers from time immemorial. After all, such plants produced another tuber in a period of a few months ready to greet and reward migratory humans when they returned to the spot. But even when communities settled down and began to depend on food from enlarged gardens, as upland New Guinea peoples did, archeological traces remain very slender. As a result, no one can yet reconstruct the history of this kind of tropical cultivation.

It is nevertheless worth noting that settled communities of fisherfolk may have arisen very early. And the monsoon seas of the Indian Ocean, the Indonesian archipelago, and the South China Sea are especially conducive to long-distance sailing. The prevailing winds blow equably from one direction for half of the year and in an opposite direction for the other half, making return voyages comparatively easy. The dispersal of Austronesian and Polynesian languages, to Madagascar off the African coast and throughout the Pacific, attests to the eventual range of such voyaging. And the initial human occupation of Australia 60,000-40,000 years ago shows how early humans learned to cross open water—at least 170 kilometers or 105 miles—by some sort of flotation.

It therefore seems likely that the use of rafts and boats was very old among inhabitants of the islands and coastlands of Southeast Asia. On the strength of such devices, settled communities of fisherfolk may have supplemented what they gathered from the sea by creating tropical gardens long before agricultural villages arose in Southwest Asia or anywhere else. But rising sea levels due to the most recent retreat of glaciers means that any and all ancient coastal settlements are deep underwater today. Settled fishing communities located inland along lakeshores or riverbanks are therefore the most likely places for finding traces of this sort of early tropical gardening.

Yet even if tropical gardening antedated grainfields by thousands of years, as seems likely, it remained comparatively insignificant for human history as a whole. That is because tropical gardeners leave roots and fruits where they grow until ready for consumption. Grains that ripen all at once must be harvested and stored; and the consequent availability of concentrated supplies of food in farmers' storage bins and jars made the rise of states and cities possible. Priests and soldiers could demand and

Must, soldiers protect be must food store

get part of the grain harvest from those who had raised it as a price for protection from supernatural and human harm. But without storage, massive and regular transfer of food from farmers to city folk was impracticable, inhibiting social and occupational differentiation. Consequently, the specialized skills of urban life could not arise on the basis of tropical gardening, however productive it might be.

It is therefore plausible to believe that when grain farmers of North China started to sustain powerful states and armies about 4,000 years ago, the rulers of these states found that armed expansion southward at the expense of tropical gardeners was comparatively easy. Thereupon, farmers from the north enlarged the material basis of the Chinese state system by moving south and making harvested rice—which must be stored and is easily transported—their principal crop; this in turn compelled tropical subsistence gardeners, among whom rice was only a subordinate crop, to withdraw to marginal, mountainous terrain.

In sub-Saharan Africa, another center of plant domestication arose about 5,000 years ago. The Sahara Desert began to expand when a drier climate set in about 6,000 years ago. This made human life more difficult in West Africa. But some groups were able to expand their food supply many times over by planting seeds of sorghum and two different kinds of millet on soft, moist soils that were exposed in the dry season when water levels receded in several now-vanished lakes on the southern fringe of the Sahara.

Cattle herding was another successful response to climate change on Africa's wide savanna grasslands. Cattle keeping, perhaps introduced from Southwest Asia, spread further and faster than farming in West Africa, and eventually prevailed throughout most of the continent's many grasslands. But where tsetse flies abounded, lethal sleeping sickness (transmitted to humans by these flies) kept some African grasslands safe for wild animals, where they survive into the twenty-first century. By comparison, the southward spread of agriculture in Africa proceeded more slowly than herding because early farming specialized in exploiting lakeshore environments, and these diminished as lakes dried up.

In the Americas, agriculture began in three distinct places. In Mexico, maize, beans, and squash became the dominant cluster, beginning more than 5,000 years ago. Along riverbanks in the eastern woodlands of the United States a less productive group of plants, of which sunflowers and gourds are familiar to us, came under cultivation about 4,500 years ago. And in South America, root crops, including manioc and sweet

South east Asian part of the grain harvest

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South west Africa

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potato, were domesticated in the tropical lowlands at least 5,000 years ago, while in the Andean altiplano—the high plains in today's Bolivia and Peru—another very productive crop cluster, featuring potatoes and quinoa, came under cultivation between 5,000 and 4,000 years ago. Peoples of the high Andes also domesticated llamas, alpacas, and guinea pigs. Llamas worked as pack animals, but none of the animals were milked or used for plowing or traction. Instead, human muscles performed all the labor of cultivation in the Americas, and except in the high Andes, transport was by human portage, supplemented by watercraft.

Of these agricultural complexes, the Mexican proved the most capable of penetrating new environments. Maize, squash, and beans spread northward into the southwestern United States about 3,200 years ago and began to displace older crops in the eastern woodlands about 1,000 years ago. Similarly, maize, squash, and beans arrived in South America perhaps as much as 5,000 years ago, but did not thrive in the harsh environment of the altiplano, where potatoes and quinoa remained securely dominant.

Even though the caloric yield per acre of both maize and potatoes almost matches paddy rice and far exceeds what wheat and barley can provide, America, like sub-Saharan Africa, lagged behind Eurasia in developing new sources of power over nature and new ways of coordinating human effort. Eurasia had the advantages of greater size, far more numerous domesticable species, and, above all, a more capacious communications web embracing its much larger population.⁶ All of these contributed to an accelerating rate of invention and change in that part of the world. As a result, beginning about 5,500 years ago, different styles of village agriculture in Southwest Asia and in China supported different styles of complex, specialized, and socially stratified (i.e., civilized) society and polity that became protagonists of this innovative process. But before pursuing that story, a few general remarks about the rural underpinning that sustained early civilizations in Eurasia, Africa, and the Americas seem in order.

First of all, living in the same place all year round allowed rapid elaboration of useful artifacts that were too heavy to carry about. In temperate climates, weatherproof housing and clothing made from vegetable and animal fibers brought real advances in comfort. New ways of prepar-

⁶ At least 70 percent of humankind lived in Eurasia for the last several thousand years, making it more crowded, competitive, and interactive than anywhere else.

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ing food by boiling, baking, and brewing added both to human welfare and to women's work. Spindles and looms were needed for weaving; grinding stones and ovens were needed for baking; and, eventually, cunningly designed flues and chimneys raised oven heat high enough to allow the manufacture of pottery for use as plates, cups, storage jars, water pots, and other purposes. Stone axes to fell trees, hoes to till the soil, and sickles to cut the grain were additional novelties in the farmer's toolkit, which, together with human—and livestock—population growth, allowed these communities to transform natural environments far more radically than before.

Farmers, after all, displaced variegated natural vegetation with more or less uniform stands of a few chosen plants, along with some weeds that defied human efforts to eliminate them. Domesticated animals also transformed landscapes by their intensified grazing, and both agriculture and grazing accelerated erosion. In addition, human impact on the environment was further enhanced by population growth that resulted from resorting to food production.

In temperate climates, where diseases were less burdensome than in tropical lands, farming village populations clearly grew much faster than hunting bands had previously done. We know this because, in a given locality when suitable soils had all been occupied, or lost their initial fertility, farmers regularly looked around for new places to settle. As a result, the Southwest Asian style of agriculture spread across all of Europe between 8,000 and 6,700 years ago. Intrusive colonists seem to have pioneered the exploitation of windblown loess and other specially favored soils in Eastern and Central Europe. Older inhabitants subsequently borrowed ideas and techniques from the newcomers to develop various combinations of hunting and gathering with pastoral and agricultural ways of life. Eastward expansion of the Southwest Asian style of farming has been much less carefully studied. Yet archeologists know that wheat and barley farmers penetrated to the borders of northwest India about 8,000 years ago, and these same crops reached northern China about 3,500 years later, where they supplemented but did not replace the older staple of millet. Archeology also shows how Mexican corn, squash, and beans spread to North and South America, but the dispersal was slowed by the fact that maize had to adjust genetically to different day lengths in different latitudes before it could ripen with the seasons.

Such population growth and territorial expansion constituted an extraordinary biological success for farmers and their domesticated

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plants and animals. Indeed, the way domestication altered older ecological niches for wild as well as for domesticated forms of life is as exceptional in biological history as the initial spread of humankind around the entire earth had been. Human adaptability and conscious choices lay behind both. Webs of communication and concerted human behavior once again demonstrated their power to transform earth's ecosystems, and this time more drastically than before.

Yet success generated new risks and dangers. For example, settled communities were more vulnerable to infections, since they remained in close contact with their own wastes and garbage instead of moving on as hunters and gatherers did. As a result, the disease burden that human bands had radically reduced when they left tropical African infections behind and learned to endure freezing temperatures began to rise again. Moreover, humans were liable to contract viral herd diseases from their domesticated animals so that such historically significant diseases as smallpox, measles, and influenza could begin to bedevil them.⁷ Stands of grain also became vulnerable to viral and insect attack, as well as to drought, hail, and flood. Crop failure meant famine, and throughout ensuing millennia famine combined with epidemic disease, and with another new scourge—organized warfare—to limit human numbers.

There is no clear archeological evidence of warfare among early farming villagers. Arrowheads do not usually tell whether they were aimed against people or against animals; and, as was the case among the farmers of the New Guinea highlands until very recently, fighting among early village communities in Africa and Eurasia was probably mainly a matter of exchanging missiles with enemies from a suitable distance. Yet we can be sure that herdsmen routinely used weapons to defend their flocks from animal and human predators, and farmers had to protect their stores of grain from human robbers as well as from insects, rats, and mice. A few ancient rock carvings in Spain and North Africa portray battle scenes, and walled and stockaded villages also appear both in Europe and China. Moreover, as we will see in the next chapter, finding ways of coping with organized violence became one of the principal reasons village farmers submitted to the heavy cost of supporting cities and states.

Life in settled communities also seems to have weakened the ties of extended-kinship and encouraged solidarity with neighbors instead.

⁷ DNA analysis suggests that smallpox, perhaps humanity's greatest scourge over the centuries, was derived from camel pox carried by Arabian camels.

we're not talking about smallpox
it's more of a
disease that was
spread by camels
on a large scale
more to the west

Exactly how this happened is obscure. Village populations were usually larger than hunting bands, and fields were probably tended by separate families in most cases. When it became necessary to safeguard stored grain against raiders, farmers gathered together into comparatively large settlements and sometimes erected walls or stockades for defense. In proportion as local defense became vital, neighborhood perhaps took over from kinship as the primary basis of solidarity. Or so one may suppose.

Finally, in temperate climes, knowing when to plant was of critical importance. This focused attention on the seasonal movements of sun, moon, and planets. Calendrical astronomy became the province of experts whose special knowledge established a new kind of social leadership. Professional guides to the world of spirits had certainly existed among hunters and gatherers. Cave art alone is sufficient evidence of that. But accurate measurement of the seasons required a different sort of knowledge and skill, and in due course became another critical ingredient for the rise of cities and civilization.

(b) agriculture
seasons
of the year

Village life and culture are the social structure the early agricultural villages had

By about two millennia after their emergence, agricultural villages had spread like a rash across Eurasia, Africa, and the Americas and became the frame within which the majority of humankind lived and died. The overwhelming majority of our predecessors continued to reside in such villages until very recently. Once initial adjustments to local conditions had been worked out, customary rural routines transmitted all necessary knowledge and skills from generation to generation across millennia, with only occasional and usually modest alterations. In short, biological and cultural continuities among our predecessors depended on village custom. Even when compelled to pay rents and taxes to outsiders, village autonomy prevailed in daily affairs; and sporadic disruption by famine, epidemic, and war rarely prevented survivors from resuming familiar routines as soon as local conditions permitted.

In effect, sedentary villages replaced roving bands of hunters and gatherers as the basic cells of human society. Within each village the web of face-to-face communication was intense and assured continuity of custom. But such villages were also embedded in a far-flung web, denser than before, yet still very slender in comparison with what was to follow when cities and civilizations, traders and missionaries, professional fighting men and specially skilled artisans began to operate across

Village life
Village stockades were only occasional and seldom brought anything new to local attention that required or invited changes in existing habits. p. 42

wider and wider regions of the earth. Long after cities first arose they remained exceptional and unstable. But of course it was the instability of urban life, together with its tensions and challenges, that provoked city folk to undertake most of the technological, religious, intellectual, political, economic, and institutional changes of subsequent history. We turn to their emergence next.

III

WEBS AND CIVILIZATIONS IN THE OLD WORLD, 3500 B. C. E. - 200 C. E.

The rise of civilizations established connections among scores of thousands, and then among millions of persons, who necessarily remained strangers to one another. For the first time, key relationships and important everyday transactions routinely transcended the primary communities within which human beings had previously lived. With greater and greater frequency, city dwellers, villagers, migratory pastoralists, as well as increasingly marginalized hunters and gatherers, all had to deal with strangers—somehow. For everyone within reach of civilization a variable mix of voluntary exchange of goods and services with involuntary submission to plunder, rent, and taxes became inescapable entanglements of ordinary life.

Moreover, once started, civilizations tended to expand just as agricultural villages continued to spread across fertile landscapes, and as bands of skilled hunters and gatherers had previously occupied almost the entire habitable earth. The reason for expansion was the same. Civilized forms of human society could wring more food and energy from the environment than before, thereby generating superior wealth and power. Nor did the process stop with the rise of separate civilizations and separate metropolitan webs. Instead, evolving skills, habits, and ideas sustained conflict and cooperation among larger and larger numbers of people, until what had begun as separate civilizations came to impinge on one another so as to create an ever-thickening web throughout most of Eurasia and much of Africa by 200 C.E. This we will call the Old World Web.

The rise of civilizations altered the shape and expanded the impor-