Chapter One

The Creation of Food Worlds

Although the modern food system has come to appear almost normal, many of its fundamental features are in fact very recent. Only recently have people lived in a world in which most food has been consumed by a dominant urban-industrial population, heavily dependent on resources transported over great distances, from quite different environments and regions – the modern world in which "food miles" can add up to a worrying degree. Only in recent times have consumers in some countries come to think of food as a packaged good, to be obtained almost exclusively by purchase, and come to regard anything taken directly from the wild as potentially dangerous.

Only in the past ten thousand years have human beings moved decisively toward living in sedentary settlements, using agricultural, horticultural, and pastoral techniques to produce food from domesticated plants and animals. Over the great length of human history, beginning with the emergence of *Homo erectus* in Africa two million years ago, some 90 per cent of hominin[1] species have lived by hunting and gathering. The experience for anatomically modern humans (*Homo sapiens*) is strikingly different, though covering little more than 200 000 years. The greater part of this period belonged to hunter-gatherers, and as late as the time of Columbus fully one-quarter of the world remained hunter-gatherer, but the massive and accelerating growth in population over the past two hundred years placed the weight of numbers within an agricultural realm.

[1] *Hominin* is preferred to *hominid* in identifying modern humans and their immediate bipedal relatives and ancestors. In the light of recent genetic findings, the term used previously to describe human-like primates – *hominid* – is now used to include also gorillas, chimpanzees, and bonobos (Barham and Mitchell, 2008: 1 and 476).

How Food Made History, First Edition. B. W. Higman.

Settled, domesticated life associated with "civilization" comes late in the course of human history, marking a new relationship between people, plants, and animals. The transition became possible only with the end of the last Ice Age, which brought to a close the Pleistocene and ushered in the modern post-glacial epoch, the Holocene, an era of global warming. Sea levels were lower at the Last Glacial Maximum around 20 000 BP (before the present) than at any time over the previous 100 000 years, but then rose rapidly to the modern maximum with the melting of the northern glaciers and ice sheets. These changed environmental conditions enabled not only the transition to agriculture and urban life but also new modes of hunting and gathering. They created the conditions for the transition from a relatively uniform global food system to a world characterized by large-scale regional diversity and strongly contrasted modes of feeding a growing population.

Making the ancient world food map

The creation of unique and separate food worlds occurred in at least two ways. Most obviously, the rising sea levels associated with the melting of the massive glacial caps altered the balance between land and sea. Land which had long been dry and available as a pathway for human and other animals was inundated, creating formidable barriers. The most significant of these barriers was the Bering Sea, which cut off terrestrial movement between Asia and the Americas, thus establishing the basis for long-term independent development in the world's supercontinents, the so-called Old World of Eurasia and Africa and the New World of the Americas.

The result was two essentially separate food worlds, cut off from one another for millennia. This was something new in world history because, although there had been a series of transitions between glacial and interglacial conditions since the emergence of hominins, it was the first time human beings had been living in all the world's continents (except Antarctica) and the first time anatomically modern *Homo sapiens* had experienced such massive changes (Manning, 2006).

The rise in sea levels also created new island and archipelagic environments. In southeastern Asia, the Indonesian archipelago was brought into being and its islands cut off from New Guinea. The northern tip of Australia was separated from New Guinea and to the south Tasmania was similarly divided from the mainland. In the Caribbean, islands such as Cuba and Trinidad were separated from the Central and South American mainland. The possibilities of settlement and colonization by plants and animals became more difficult than they had been when land bridges existed. The animal life of islands, before the

coming of humans, exhibited high levels of diversity and endemism, but large mammals, including carnivores, that might have been used for food or motive power were generally rare.

A second, quite different, consequence of the end of the last Ice Age was the warming of the planet, which ultimately created the conditions for revolutionary change in the human exploitation of plants and animals for food, the transition to domestication and agriculture. Early hunter-gatherers typically depended on food resources within a limited territorial range. Their choices were constrained by what was available within that zone. They were food takers rather than food makers. If the resources became depleted, there were good reasons to move on, to look for fresh sites with similar plants and animals or to new places with a different mix of potential foods.

Over millennia, the process of seeking out fresh food resources contributed fundamentally to the migration of people and the first colonization of the world. This initial colonization consisted principally of people finding new sites, empty of people, where they could exploit the available resources, in a manner parallel to the spread of plants and animals into new niches. The entry of people, as well as of plants and animals, changed the ecological balance, and people learned how to manipulate aspects of the ecosystem in order to ensure their supplies of food. However, before domestication, people rarely carried seeds or animals with them in their migrations. Their objective was to exploit whatever existing stock they found in a new region, not to transform it.

Because the initial colonization of the world was achieved by hunter-gatherers, it took a long time to complete. Although human beings with all the skeletal characteristics of their modern descendants, *Homo sapiens*, inhabited Africa from about 200 000 BP, they did not leave the continent for many millennia. The great migration that spread human beings across the world commenced about 70 000 years ago and continued to 10 000 BP, during which long period resources were often limited by environmental conditions. As in much human migration, people were impelled to move on because they felt that they would starve if they stayed where they were and could only hope that where they went would be a better place. They were pushed rather than pulled. They possessed only limited knowledge about what lay ahead, but observed the movement of animals, much as sea-voyagers later took the flight paths of birds as an indication that land lay ahead unseen, beyond the horizon. These anatomically modern humans out of Africa also encountered populations of archaic *Homo* species in Eurasia – Neanderthals in Europe and the recently identified "Denisovans" of southern Siberia – with whom they sometimes mated, exchanging genetic material and, no doubt, knowledge (Reich *et al.*, 2010).

So long as the total human population remained small, there was little pressure to move on quickly. Probably, the desire to satisfy curiosity about what

lay across the next ridge or river accounted for a good deal of incremental migration, as much as any search for fresh food resources. In the Ice Age, however, the meager potential food resources in many regions meant that meat-eating humans often had little choice but to actively pursue their food when it moved ahead of them. Until the ice sheets and glaciers began to retreat, much of the arctic north was inhospitable and virtually uninhabitable because of the lack of food for animals as well as humans. Thus, the momentous movement of people across the Bering Sea land bridge, from Siberia to Alaska, that initiated the peopling of the Americas, commenced only toward the end of the Ice Age around 15 000 BP when the sea level was 300 ft (90 m) lower than it is today.

Most important in driving the pattern of migration was the fact that the people were hunter-gatherers, not looking for well-watered fertile sites where they could plant introduced crops and raise livestock, but always assessing the survivability of a place in terms of the observed stock of animals and plants that existed naturally in that environment. They devoted energy to digging for roots and tubers, and to the grinding or pounding of these materials using mortar and pestle, but for these omnivorous hunters what made a place attractive was above all the presence of animals which could be efficiently killed, cooked, and consumed. They were dedicated meat-eaters, obtaining more than half their calories from flesh and willing to tackle animals much larger than themselves. It was a dangerous business, with sabre-tooth tigers and other, now extinct, savage beasts competing for the same game.

It has long been claimed that it was the eating of meat that contributed most to the development of *Homo erectus*, separating human beings from the other primates, with a bigger brain and the capacity to construct language, itself arguably a product of the need for cooperation in early hunting and scavenging and meat distribution within groups (Bickerton, 2009: 121). Alternatively, because there were many hazards to depending on a meat diet, not only from the uncertainty of supply and the fierceness of prey and competitors but also from parasites, it may be that early humans used their new-found tools to dig up the roots and tubers that grew in secure abundance rather than to stalk wild animals or even to scavenge (Eisenstein, 2010). Tubers could have provided the brain boost needed for human development but only if they were first cooked, by roasting or boiling/steaming.

This necessity led recently to the hypothesis advanced by the biological anthropologist Richard Wrangham that cooking, using fire as a tool, is at the center of these developments. Heat transforms meat (and other food) not only by making proteins and starches more digestible, and safer by warding off parasites, but also by increasing the amount of energy it delivers. The virtue of cooking is not a recent discovery. Rather, argues Wrangham (2009: 14), it occurred at the beginning of human evolution with the emergence of *Homo*

erectus and had anatomical consequences, so that we are creatures of our "adapted diet of cooked food, and the results pervade our lives, from our bodies to our minds." Raw-food diets can prove viable and have modern advocates but cooked food is the norm for almost all humans. It is cooked food that the starving dream of.

Fire was not only essential to cooking; it served as the most important tool of early transitions toward the manipulation of the environment and the behavior of wild animals within these ecosystems, practiced as early as 50 000 BP in southern Africa and Australia (Wrangham and Carmody, 2010). Down to about 10 000 BP, however, the essential cultures of hunting and gathering, fire and cooking, were effectively universal, and for this reason contributed little to the making of a diversified and regionalized ancient world food map. Until the end of the Ice Age, the pattern was essentially the same everywhere, though nuanced in terms of the specific plants and animals that were consumed in direct response to the biodiversity and environment of particular regions. This was not a closely interconnected world but one in which relatively isolated small communities existed within their particular ecological niches. It was the transition from hunting and gathering to agriculture, beginning around ten thousand years ago, and based on domestication and cultivation, that represented a true revolution in the global pattern of food systems.

The origins of domestication, agriculture, and urbanization

By 10 000 BP *Homo sapiens* had effectively settled in most regions of the world. Of the continental landmasses, the major exceptions were Antarctica, the coldest parts of the Arctic, and the icy northern two-thirds of mainland Eurasia. The peopling of these regions depended on the development of effective technologies for the hunting of large mammals, as well as more effective clothing and shelter. Antarctica never became attractive. Many islands also remained unsettled, particularly those of the Caribbean and the Pacific, because they were not stepping-stones to other places and lay beyond the accessible horizon. The islands of Remote Oceania, making up most of the Pacific, remained uninhabited even at 5000 BP, their peopling delayed by the need to develop ocean-crossing technologies and navigational skills. The food resources of such distant, isolated islands was impossible to predict and potentially hazardous.

Movement out of Africa into the tropical zones of Asia was relatively rapid once it began, with people settled all the way to Australia by 50 000 BP or earlier. The migration followed the water's edge around the tropical rim of the Indian Ocean and its often dense borderline of bamboo, subsisting on fish,

crustaceans, and plant food, and into the mainland and islands of eastern and southeastern Asia, as far as New Guinea. It was the warmer, southern regions of mainland Asia and the islands of southeastern Asia that were most densely peopled and it was there that the transformation of food production occurred first. Early migrations of *Homo sapiens* out of Africa to parts of eastern Europe proved fragile, and the establishment of a permanent population, interacting with other varieties of *Homo*, was not firmly established throughout Europe until about 30 000 BP. The human settlement of the Americas also moved rapidly once it was begun, around 15 000 BP, spreading speedily down the western spine before spilling out into the eastern vastness.

Hunter-gatherers moved conservatively, unwilling to risk more than necessary in a world still clothed in thick forest and grassland, in which lurked wild animals and unknown potentially deadly plants. Even where human beings had lived for millennia, the density of population remained sparse in 10 000 BP. The total for the world was not much more than five million. There seemed to be plenty of food for these few people. It had only to be collected or killed.

Five thousand years on, the world's population was ten times larger, reaching about 50 million by 5000 BP. The rapid acceleration that occurred in these millennia was not evenly spread across the world, however, but confined largely to those few regions where domestication provided the foundation for an agricultural revolution, in fewer than ten independent sites known across the globe. It was this revolution that made possible the new mode of sedentary living and the beginnings of an urban revolution and a completely new system of food supply. Even though the first farming technologies were crude and domestication limited, together these innovations were able to support as much as 100 times the population that hunting-gathering could efficiently feed. The origins of the agricultural revolution are disputed but generally attributed to the impact of changing combinations of complex interactions between overpopulation, overexploitation, settlement patterns, climate change, and temporary climate reversals (Dow, Reed and Olewiler, 2009; Barker, 2006; Bellwood, 2005; Cohen, 1977).

Whatever the causes of the agricultural and urban revolutions, a key feature of the transformation was that they occurred independently at a widely separated series of sites spread across the world rather than diffusing from a single cultural hearth. This strongly suggests that the transformation was rooted in fundamental changes in the relationship between human beings and the natural world, associated with the transition from the Pleistocene to the Holocene. It is equally clear that the new ways of obtaining food did not quickly dominate everywhere and that not all peoples embraced the new ways, even when they became aware of these practices. This is an historical understanding not always shared by earlier interpretations of the transition.

Indeed, the scholar who invented the central terms of the debate, the Australian archeologist V. G. Childe, thought of the Neolithic Revolution and the Urban Revolution as confined largely to Southwest Asia and the Nile valley.

Childe's achievement, first set out in his book *Man Makes Himself* (1936), was to shift the study of prehistory away from the previously dominant three-age system with its emphasis on inorganic materials and tools – the Stone, Bronze, and Iron Ages – to a way of thinking about the past that introduced organic materials, particularly people and their food, as central drivers of change. The Neolithic Revolution – literally the New Stone Age, contrasted to the Old Stone Age of the Pleistocene – did not completely escape the traditional model but Childe used the term to distinguish its peoples from the "food gatherers" who had come before. He argued that this revolution transformed human economy by giving people control over their food supply. The Urban Revolution depended on the availability of surpluses and a diversified agriculture that could cope with seasonal variations in cropping patterns.

These changes were closely connected with innovations in knowledge and technology – from the plow to irrigation, writing and numeric notation, magic and religion – which Childe considered more significant than anything that had come before or was to come after. His revolutions were effectively complete by 5000 BP. Scholars have come to call Childe's Neolithic Revolution an Agricultural Revolution, which better identifies the core of his concept and points to its organic and biological underpinnings, but the fundamentals of his ideas remain secure and ensure a central role for food in long-term human development. The transition is undoubtedly one of the great turning points in history.

Research over the past half-century, particularly the use of new techniques for establishing ancient chronologies and tracing genetic heritages, has enabled a richer, more nuanced and more diverse view of the past than Childe's model was capable of capturing. Not only is it accepted that there were multiple, independent Agricultural and Urban Revolutions scattered around the world but it is also now recognized that the very meaning of "agriculture" and of "farming" need to be freshly conceptualized. Similarly, the notion that hunter-gatherers can be defined in simple opposition, by their merely not being farmers, has been challenged.

Most definitions of hunter-gatherer or forager societies refer to the distinctiveness of their patterns of subsistence, notably their hunting of wild animals, their collecting of wild plants, and their fishing, all without control over the reproduction of these food resources and without recourse to domestication. However, between the hunter-gatherer peoples who depended exclusively on wild plants and animals, at one extreme, and those farmers who relied heavily on the managed production of domesticated species at the other, there existed a vast and varied population that picked and chose from resource and technology options in ways that are not neatly classified and are

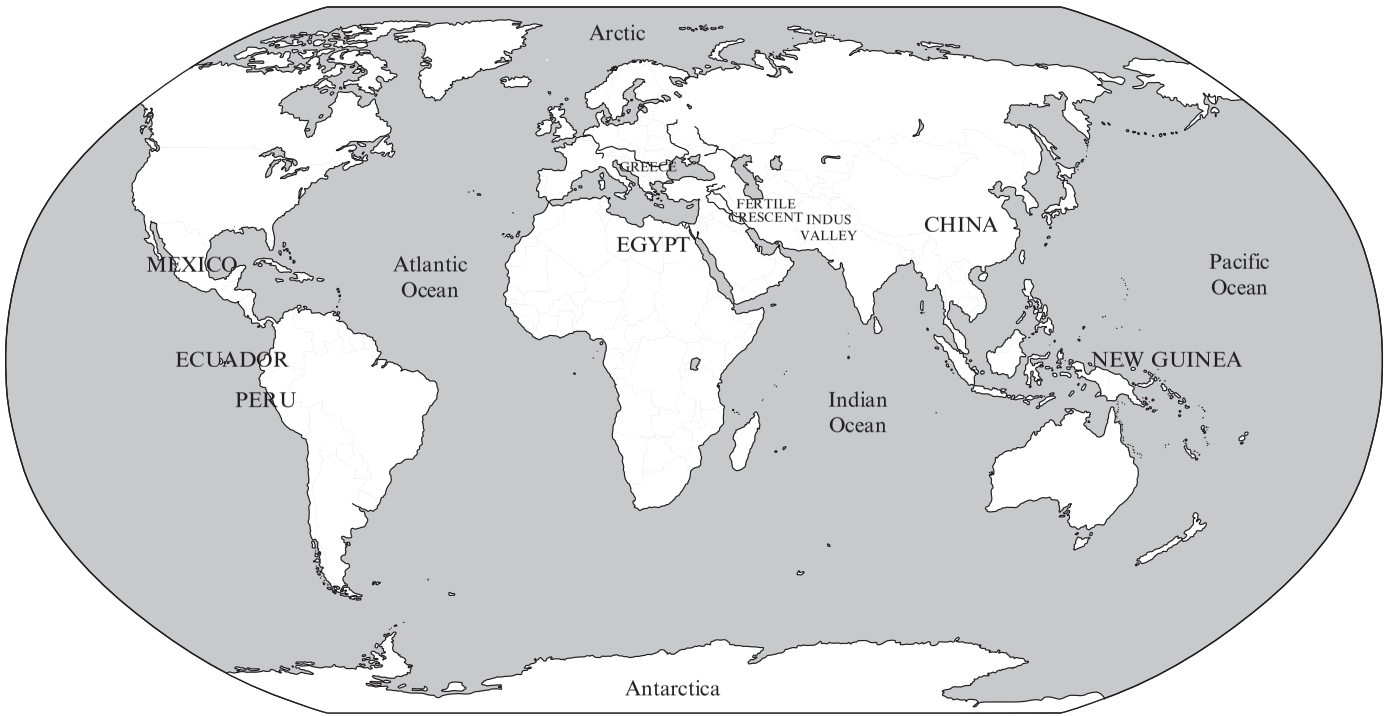

Figure 1.1 Sites of early agriculture, circa 5000 BP.

hard to map. The existence of this middle group demonstrates that there is nothing fundamentally incompatible about foraging and farming, and that the transition from one to the other need not be swift and sure. Low-level food production can exist with or without domesticated plants and animals, and with or without the application of land management technologies such as fire (Smith, 2001).

Thus, rather than seeing a sharp break between hunting/gathering and agriculture, it is possible to conceive a continuum, stretching from strict forms of hunting and collecting from nature all the way to the mechanized industrial agriculture of domesticated plants and animals. Along this continuum, the manipulation of soil, water, and microclimate is gradually intensified but the nature of the choices made about what to eat and what to grow remain essentially the same. Change might be extended over generations or even millennia. Thus, it can be argued that the behavior of those hunters and gatherers who did not invent or adopt agriculture was not unaffected by the transition from the Pleistocene to the Holocene but simply took different forms. In some cases they went only part of the way toward domestication. Some embraced the agrarian way of life only to reject it. But every choice, every selection, of what to consume from nature and what to avoid had its genetic consequences and its impact on the dispersion of plants and animals.

The outcome of these changes was a world of contrasting regions of food production and consumption, setting up the potential in the long term for exchange as well as competition and conflict for territory and resources. Previously, there had been significant contrasts between regions in terms of the particular foods that were consumed, since they all depended on what was available locally, but modes of exploitation had been more uniform. Now, there were contrasts not only in what was consumed as food but also in how it was produced, distributed, and prepared. It was a revolutionary and long-lasting difference but one observed only by those who lived in a few widely scattered sites. Those who looked on from the perspective of hunting and gathering were not always impressed by what they saw, thinking the life of the farmer much inferior to their own in terms of the amount of time and effort required to produce foods which were no better than third-rate. Vast regions of the world remained dominated by peoples more or less happy to depend on hunting, fishing, and gathering.

Food worlds at 5000 BP

The map of global food systems in about 5000 BP was more complex than any that had gone before but displayed no more than scattered suggestions of what it might become (Figure 1.1). It was characterized by "islands" of

agriculture, either beacons lighting the way or alternatively vulnerable experiments that might falter and fade, in the midst of a still overwhelming world of hunter-gatherer economies. The domestication of the most important crop plants, including rice, wheat, and maize, was already almost at an end, completed within the years between 10 000 BP and 4000 BP. However, the proportion of the world's population living in urban places at 5000 BP was small and none of these settlements was individually substantial in modern terms. Not all of them would survive. What would happen next was far from a foregone conclusion.

Although in 5000 BP vast regions of North and South America still waited for their transitions, as did much of mainland and island Asia, and most of sub-Saharan Africa, Australasia, and the Pacific, the world food map was much more diverse than it had been five thousand years before. The transition to agriculture probably occurred first in Southwest Asia by 10 000 BP and from there diffused to the Indus valley of what is now Pakistan by 9000 BP, Greece by 8500 BP, and to the lower Nile by 7000 BP. The initial spread of agriculture into eastern and central Europe, around 8000 BP, followed the migration of people from Southwest Asia. Widely separated, but strikingly contemporaneous, independent examples of the shift occurred in New Guinea (10 000–7000 BP), Central Mexico (by 9000 BP), China (8500 BP), and northern South America (7000 BP). Almost all of Europe made the transition by 5000 BP, as did several additional regions in mainland eastern and southeastern Asia (Putterman, 2008: 745–6; Denham, 2007: 16).

Beyond the boundaries of those few scattered cultures that embraced the Agricultural and Urban Revolutions in the fullest degree, hunter-gatherers experimented with new ways of finding their food and at least implicitly faced hard decisions about whether to continue in the old paths or to adopt elements of sedentism and the hard labor of cultivation. Generally, people could make these decisions on their own terms. With the exception of some special cases, this was not a time of great empires or military conquest. Nor was it a time of powerful state systems or organized religion. People found their gods among the plants and animals with whom they shared the world. Although in some places, for example Central Europe, the first farmers were not descended from local hunter-gatherer populations but rather from people who had immigrated in the early Holocene, it is not clear how far this may have involved invasive colonization (Bramanti *et al.*, 2009).

In some cases, there is evidence that first farmers expanded their populations and spread into nearby regions, imposing their genes, languages and cultures on hunter-gatherer communities, but cultural diffusion and a process of gradual absorption of farming and food systems seems to have been more important in the long term. Rather than being forced to adopt or participate in any particular system of resource exploitation, in ways that would dominate much of the

history of the world in the millennia to come, most people had to base these decisions on their perceptions of the environments in which they lived and their relationship to other living things. They were relatively free to make their choices on the basis of their local knowledge, including the observation of farmers and town-dwellers if such communities existed within their range.

Hunter-gatherer peoples occupied the widest range of environments. Their food sources and their technologies varied in direct response to differences in the environments in which they found themselves or chose to inhabit by migration and colonization. For individual groups and communities, choice was effectively bounded by their immediate environmental sites and by the biodiversity of those sites. The world beyond those boundaries was typically hostile and its resources potentially hazardous. Thus, the hunter-gatherer peoples of 5000 BP could do no better than choose to eat from what lived around them, whatever those resources might be. In doing so, human beings proved themselves highly adaptable omnivores, selecting from widely different ranges of foods in different places. However, in spite of these strong contrasts, hunter-gatherers lived according to a relatively uniform set of principles, in a pact with nature which was both respectful and fearful. A central feature of hunter-gatherer societies in 5000 BP was the eating of meat. In some regions, where plants could not prosper, meat-eating was a necessity. This was most obviously the case where climatic extremes of heat and cold, and wet and dry, created deserts and ice fields, which were parsimonious in their supply of edible plant life suited to the human digestive system but supported a relative bounty of land and sea animals.

What exactly did people choose to eat around 5000 BP? In part, the contrasts around the world reflected differences in a population's location along the tangled continuum that stretched from strict foraging to strict agriculture, but they also had to do with geographical location, rooted in local differences in biodiversity and topography, climate and soil. There were limits to the range of environments in which *Homo sapiens* could survive, but beyond the extremes people seemed able to find food almost everywhere on earth. The species proved highly adaptable. The plants and animals which made up the food of human beings were significantly less adaptable, flourishing in some environmental niches but not in others. Further, their dispersal by diffusion was less universal than that of humans.

Africa

Within Africa, the birthplace of *Homo sapiens*, people diffused first from their original home in the continent's eastern and southern grassland ecosystems to occupy the great zone of savanna stretching from Ethiopia to Senegal (Figure 1.2). The region was, however, subject to some of the most extreme

Figure 1.2 Africa.

fluctuations in climate experienced anywhere during the Holocene. Hunter-gatherers prospered on the grassy savannas from about 9000 BP, until severe aridification drove the early pastoral peoples from most parts of the Saharan desert around 6000 BP, often for as long as a thousand years. New groups of humans began to enter the region around 5000 BP, taking advantage of lakeside sites that offered fish, clams, and crocodiles that could be used to supplement the now scarce land animals.

Away from the lakes, there was intensified herding of domesticated cattle, and of domesticated sheep and goats introduced from the Levant which did better under drought by more efficiently exploiting the diminished vegetation, for a more diversified diet. The rapid desertification of the Sahara around 5000 BP made livestock increasingly important, by providing a relatively

dependable supply of milk and meat, and perhaps blood. At the same time, the expanding mobile pastoralist peoples pushed into moister grassland regions to the south and east, and continued to practice hunting and gathering, including the collection of fruits, tubers, and wild grains (Barham and Mitchell, 2008: 359–62; Shaw *et al.*, 1993; Phillipson, 1985: 113–47). Here then was a perfect example of the continuum from foraging to farming, of the long-term coexistence of pastoralists and foragers, and of the potential for exchange between food producers.

These forces of change led to an expansion of food production systems into sub-Saharan Africa, which eventually saw the combination of herding with cultivated crops come to occupy almost the entire continent. This system was not derived from the experience of Egypt, which had the advantage of unusual ecological conditions. The domestication and cultivation of grain crops to the south exploited different plants, all of them indigenous, such as pearl millet and sorghum. Much of this process did not begin until about 4000 BP, and active cultivation rather than the occasional collecting of seed took even longer. Dating of the transition to farming throughout the rainforest remains poorly understood. The range of combinations of systems of food production and acquisition were complex, with the potential for repeated independent invention. It is most likely that sub-Saharan Africa, throughout the equatorial rainforest and beyond, remained the domain of hunters and gatherers.

At 5000 BP, the sole example of settled, agricultural society in Africa was that found on the lower Nile. Small villages of farming people had appeared first in the delta two thousand year before, cultivating barley and emmer wheat, with granaries for storage, and keeping domesticated cattle, sheep, goats, and pigs, but still practicing fishing and hunting, and foraging wild plant food. These settlements expanded substantially during the long period down to the unification of the Egyptian state and the establishment of the first of the numbered Egyptian dynasties, with their pharaohs and deities, in about 5000 BP. It was at this time that a new crop complex was introduced to Egypt, combining wheat, barley, and legumes. Oxen were harnessed for the first time, to pull plows through the wet, heavy soil, but much of the tillage continued to be the work of hand-hoes. This crop-combination was successful in the conditions of the lower Nile, where the annual flood washed away excess salts and fertilized the fields, but it failed to spread much further, even where irrigation was attempted, as for example at oases in the Sahara and in the uplands of Ethiopia and Eritrea (Wenke, 2009: 56–65).

In ancient Egypt, wheat and barley were used to bake bread and brew a thick, dark beer, but sometimes the grains were boiled whole or made into a kind of porridge, or roughly ground and baked as flat pancakes. These cereal

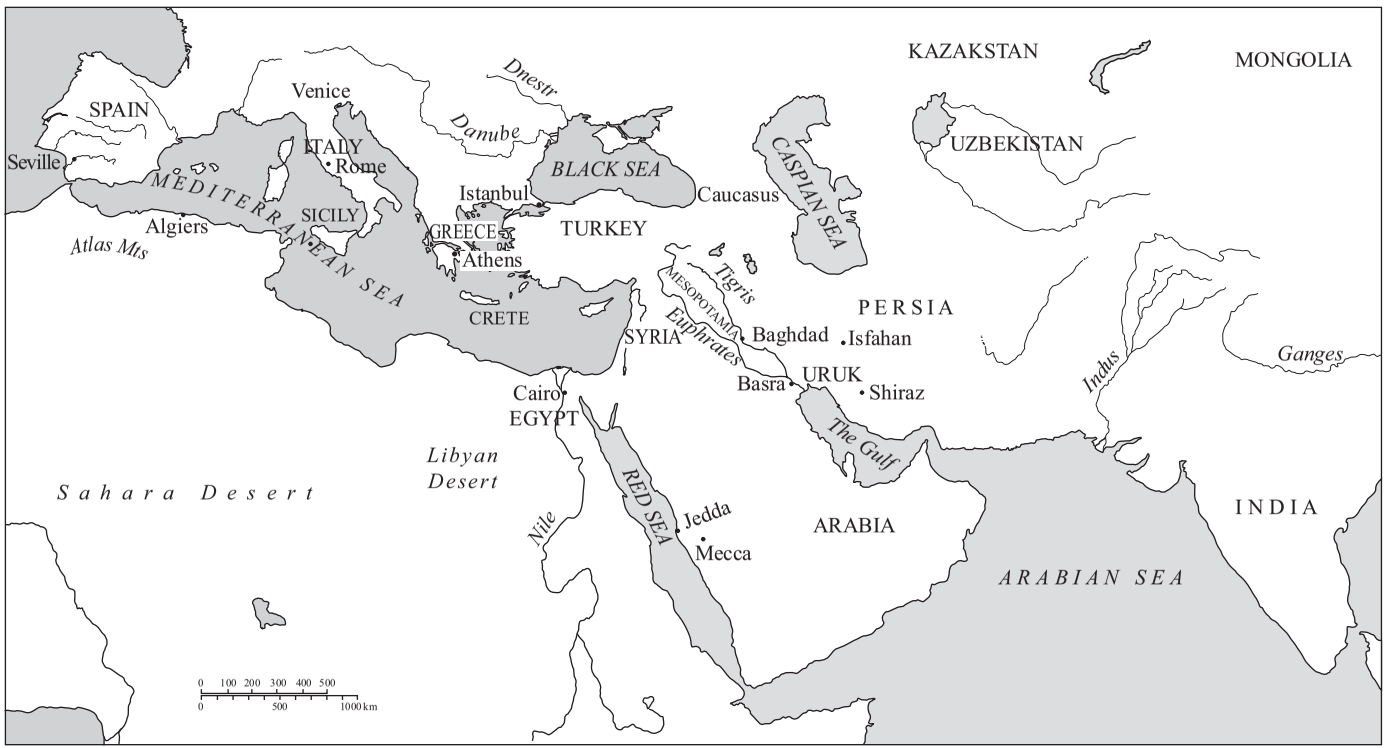

Figure 1.3 The Middle East and the Mediterranean.

foods were eaten together with legumes, such as peas and beans, and vegetables, including onions, garlic, leeks, lettuce, radishes, and melons. The meat of pigs was relatively common but the consumption of beef depended on wealth. Camels were used neither for transport nor food at this time. Fish, including the Nile perch, tilapia, and catfish, were plentiful, especially in the delta but also taken from ponds and preserved by drying and salting. Birds, including pigeon, quail, duck, and geese, were abundant in the delta and often domesticated, serving to recycle household waste and producing eggs as well as meat. Goats were equally useful as recyclers, providing both milk and meat, while pigs were valued strictly for their flesh. Salt was readily available but other seasonings and herbs were more limited. Small birds were sometimes eaten raw, for breakfast. Fruit came from orchards. Some of this fruit, including both dates and grapes, was used to make sweet wine, laid down to age in pottery jars.

Eurasia

The two most influential transitions to the new modes of food production, precursors of what was to happen in Egypt, occurred independently in Southwest Asia and China. It is significant that the first and best-known of these transitions occurred at the interface of Africa with Eurasia, running through the narrow Levantine corridor to the west of the Syrian Desert and curving in an arc through the Tigris and Euphrates river valleys (modern Iraq) to form the so-called Fertile Crescent (Figure 1.3). The transition did not simply mark the movement of humans out of Africa into a new environment but had to wait many millennia for the climate change, and the short-lived climate reversals, of the early Holocene. It was here that wheat and barley were domesticated from wild cereal varieties, and sheep and goats brought into the fold, in some of the earliest domestications (Brown *et al.*, 2009: 103–9). Not only was this small region of southwestern Asia significant for its agricultural revolution; it also formed the focus of influential cultural movements and saw the birth of some of the world's great religions, each with its particular food rituals and taboos.

By 5000 BP the people of the Fertile Crescent had added domesticated legumes such as lentils, broad beans, peas, and chickpeas to wheat, barley, and rye, and pigs and cattle to the sheep and goats. Technologies were developed to store grains and meat, to help provide food throughout the year. Animals were exploited in new ways, notably by harnessing them to provide motive power in the work of agriculture, increasing productivity through their capacity to pull heavy plows, and by using their manure as fertilizer. Cows, goats, and sheep were also milked, providing new food products, such as cheese, ghee, and yoghurt. These new ways of using animals in the food system not only were important within the agricultural zone of Southwest Asia but also enabled the

Figure 1.4 China and Southeast Asia.

development of efficient nomadic pastoral economies which spread beyond the region into the Russian steppes, where agriculture did not follow (Kohl, 2007:158–66).

Irrigation and drainage systems enabled the intensive settlement of fertile lowland valleys, where the first urbanized states of Mesopotamia were created. Grains were ground to make flour, and bread was baked. Pottery was used to make storage jars and to cook over fires and in clay-baked ovens. Most cooking involved boiling, steaming, roasting, or baking, effectively extending the range

of what was palatable. Fermentation, in ceramic jars, was used to make beer and wine and domesticated olives were cured to make oil. Orchard fruits, such as date, fig, pomegranate, and apple, also became common around 5000 BP. By this time, domesticated animals had largely supplanted their wild relatives and the collecting of wild grain was no longer a profitable use of time. The food system of southwestern Asia had taken on a familiar character. A cuisine, a gastronomy, was taking form.

The second most significant center of domestication and agricultural transition was in China, where rice was domesticated by about 9000 BP on the Yangtze River (Figure 1.4). By 5000 BP large-scale wet-rice farming was firmly established and had spread recently into southern and southwestern China and to Taiwan (Chi and Hung, 2010; Zheng *et al.*, 2009). This development was associated with substantial human migration and population growth. New fields were opened up by the burning of marshes and the reclamation of land, and the soil was tilled using wooden spades and harvested with sickles made of bone. Plows, drawn by water buffalo, were not known. In the north, millet varieties were domesticated on the Yellow River by 8000 BP, and these found their way south, where they joined rice and tubers (yams and taro), and a long list of vegetables from leeks to lotus roots (Bettinger, Barton and Morgan, 2010).

Hunting, fishing, and gathering remained important in China, particularly in the Yangtze valley and in marginal areas, including for buffalo, deer, rhinoceros, elephant, alligator, and tortoise; carp; waterfowl such as cormorant, egret, duck, and heron; and wild fruits such as peaches, plums, acorns, and nuts (Jing, Flad and Yunbing, 2008). It was an eclectic mix of foods. These activities remained vital throughout mainland and island southeastern Asia, where tropical environments offered an abundance and the tubers were much more important in the diet. Cattle, sheep, and goats were domesticated, valued for their meat and fat, not their milk. Rice cultivation, associated with domesticated and transportable animals, notably pigs, had already made a firm imprint but remained to gain regional hegemony. As in Mesopotamia, a cuisine was still in the making, lacking texts and cookbooks.

Outside these two influential centers, southwestern Asia and China, new food production systems emerged through diffusion and, to some degree, local invention. The spread of the "Neolithic package," made up of cereals, cattle, pigs, and sheep, was sometimes the work of farmer-colonists but more often the result of adoption and adaptation, with many discontinuities where the package was not initially accepted in whole or in part (Barker, 2006: 364–6). This pattern of acculturation was true of most of Europe, where the elements of the package were all exotics with their roots in a semi-arid region and required time to acclimatize to an ecosystem barely recovered from deglacia-

tion. Farming began spreading along the Mediterranean coastline by about 7500 BP, adjusting fairly easily. On the other hand, although domesticated cereal crops and cattle had reached as far as Scandinavia by 5000 BP, hunting and gathering remained economically and culturally important.

To the east, a shifting frontier developed between the cultures of wheat and the cultures of rice. Caught in the middle, generally unawares, early sedentary hunter-gatherers across much of Asia exploited wild plants and animals but shifted slowly into small-scale horticulture and rudimentary herding. At 5000 BP the Indus valley was on the verge of urbanism, with an elaborated agriculture of millet and wheat, together with an awareness of rice that was still to develop in water-fed cultivation (Wright, 2010). Similarly, rice was still finding its place in much of the Indian subcontinent, including the Ganges valley. Regions to the north demonstrated a growing commitment to pastoralism and varieties of mixed farming.

Korea and Japan were both following the Chinese path by 5000 BP, though with greater emphasis on fish and shellfish. In the rainforests of mainland and island southeastern Asia, which had been connected landmasses in the Last Glacial Maximum, minimal manipulation by hunter-gatherers was sufficient to enhance the productivity of plants such as bananas, sago, pandanus, swamp taro, and wild rice. These were gathered while meat was obtained from wild cattle and water buffalo, deer, rhinoceros, turtles, tortoises, crabs, fish, and shellfish. By 5000 BP, when the present-day coastline was already clearly demarcated, wet-rice farming was just beginning to get a foothold, in the islands as well as the mainland of southeastern Asia. A number of significant early domestications occurred in the region, however, notably the chicken from the wild red junglefowl nearly ten thousand years ago (Sawai *et al.*, 2010).

Although New Guinea is formally included among the islands of the Pacific, its experience is more closely associated with that of the islands of southeastern Asia. During the Pleistocene, lower sea levels enabled relatively easy movement throughout the region, though Wallace's Line (passing between Bali and Lombok) marks a significant biological boundary where the persistent sea divided the Asian flora and fauna from that of Australia and New Guinea. Down to 8000 BP New Guinea had been connected with Australia by an isthmus across the Arafura plain, and its hills remained above sea level three thousand years later as the Torres Strait islands. However, New Guinea did not share the languages of the wider region but had its own, which effectively set it apart. Equally important, settlement in the coastal lands of New Guinea developed slowly, whereas the interior highlands had been peopled as early as 30 000 BP when open grasslands, good for hunting, flourished. Warming in the early Holocene took forest higher into the mountains, and it was in these elevated valleys that early farming emerged, independently, in response to the changing ecology or the need for a more reliable food resource throughout the seasons of the year.

This early farming was based on the cultivation of locally domesticated taro, deliberately moved into the highlands, and later the banana, which was also first domesticated in New Guinea. Agriculture began to replace foraging-cum-horticulture perhaps as early as 10 000 BP. By 5000 BP intensified cultivation was based on irrigation and drainage ditches, with plantings in mounds or raised beds (Denham and Haberle, 2008). Other important crops included yams, sugar cane, sago, and pandanus. Pigs, already domesticated in Indonesia and perhaps ultimately China, were introduced to the food system, though probably eaten only at feasts. This example of early agriculture, without substantial urbanism, is important in emphasizing the role of stress – the need to adapt to a changing environment in a specific niche – in the transition from hunting and gathering. The transition was not complete or universal, with significant regional and chronological contrasts in patterns of plant exploitation. Around 5000 BP most of New Guinea's peoples remained seasonally or wholly dependent on the food they could find in forest, stream, and sea. It was not obvious to everyone that farming stood in binary opposition to hunting and gathering or that it was the way of the future.

Australia

By 5000 BP, the first people of Australia had already accumulated 50 000 years of knowledge of the unique food resources of the land and surrounding seas. This long and close association with the land and its resources had not, however, led to the creation of agrarian societies similar to those in the other continents. Rather, in common with most regions of the world, Australia was the home of people who remained at core successful hunter-gatherers. Archeological evidence of intensification, incipient agriculture, and domestication exists but is almost all confined to the last millennium and to particular regions of the continent (Gerritsen, 2008). More significant in the longer term was aboriginal use of fire – the primal force in the manipulation and management of the landscape and food resources – employed as a variety of "firestick farming," highly effective for its purposes.

Managed burning of the Australian bush facilitated hunting by creating small areas of open grassland which attracted wild animals and exposed them to the weapons of the people. The land animals were largely endemics and often unusual, as a result of the long isolation of the continent and its separate evolution. The same was true of the plants. Broadly, plant foods provided a majority of the diet, together with large game and fish, but varying from region to region and season to season. Desert people probably ate the smallest proportion of meat.

Around 5000 BP the Australian climate was becoming drier and more variable, increasing the amount of land in desert and scrubland, making life harder for hunter-gatherers by reducing wild marsupial and reptile populations

Figure 1.5 The Americas.

and requiring that more of the plant food had to be obtained by digging up roots, rhizomes and tubers, with seasonal fruit such as the bush tomato and quandong (Hiscock, 2008; Keen, 2004; Lourandos, 1997). Temperate and alpine zones saw the use of plants, including cycad seeds (zamia) which require detoxification to be made edible, tree ferns and bracken, grasses and warrigal greens, as well as freshwater fish and eels, yabbies and waterfowl, macropods

(kangaroos and wallabies), emus, and insects such as sugar ants and Bogong moths that swarmed seasonally. Coastal economies depended on fish, mollusks, crabs, dugong, seals, and turtle eggs, but often also relied on more seasonal resources like yams, fruits, and berries, and on kangaroos and wallabies. The tropical north offered greater abundance.

The Americas

The people of the Americas, the New World for later Europeans, were relatively recent arrivals, though some scholars argue for dates significantly earlier than the 15 000 BP accepted here. Once they had established a foothold, however, the hunters and fishers who crossed the Bering Strait moved rapidly along the 7500 miles (12 000 km) western edge from Alaska to Patagonia, encountering a great range of ecosystems along the way (Figure 1.5). They spread more slowly eastward through the great mountains and plains, crossing the Mississippi, into the eastern woodlands of the north, and in the south venturing into the Amazon rainforest. The resource-rich islands of the Caribbean remained unpeopled as late as 7000 BP and some of them much longer.

The food resources of these strongly contrasted regions were varied but down to 5000 BP typically exploited by hunting, fishing, and gathering. Hunting dominated in North America and was often highly specialized. In the far north – the tundra and the boreal forests – caribou, moose, and deer were the primary prey. On the northeastern Atlantic seaboard, caribou and beaver were hunted, but less important in the diet than walrus, whale, and seal. On the plains, bulky bison were ambushed and stampeded, people stalking the migratory herds over great distances. In the eastern woodlands, hunting and gathering became more generalized, with an emphasis on acorns and hickory nuts, seed-grasses, bottle gourds, and squashes, the latter among the earliest cultivated plants. By 5000 BP people were beginning to manage and manipulate seed plants, such as sunflower and marsh elder, to induce larger seeds with thinner coats, but no significant seed domestications occurred in North America. Maize was still to come, from the south. In the dry southwest, small game such as rabbits predominated, along with a much larger proportion of plant foods, including the fruit of the prickly pear and mesquite.

Domestication began early in the dry highlands of Central America (Mexico), and by 5000 BP there is evidence of cultivation of maize, beans, chili peppers, avocadoes, bottle gourds, squash, and amaranth. However, the cultivators of these plants remained basically hunter-gatherers and the transition to farming and village settlement did not occur until about 3500 BP. The tropical lowlands of Central and South America were relatively dry in the early Holocene, covered by scrub and savanna rather than rainforest, so that the emphasis was once again on hunting and fishing. Large mammals,

such as sloths, peccaries, and llamas were hunted, along with rodents, birds, snakes, tortoises, and turtles. Tree fruits and nuts, fish and shellfish, legumes and other plants also contributed to the diet in early Central and South America. In the tropical forest, a wide range of smaller animals was hunted. Hunter-gatherers used fire to open up niches where grazing animals might be attracted and roots and tubers allowed to prosper. It was here that they learned how to make toxic plants, notably cassava and zamia, safe for humans to eat, by leaching out the bitter juices. This remained a low-level food production system down to 5000 BP, however, not fully appropriated to domestication or the refined agricultural technologies that were soon to emerge.

In the Caribbean islands of Cuba, Hispaniola, and Puerto Rico, first colonized between 6000 and 5300 BP, the few large land animals, including sloths of up to 550 lb (250 kg), insect-eaters, rodents, and flightless owls, were hunted, together with manatee, monk seal, and turtle. The sloths were extinct by 4000 BP. Fish and shellfish were also important in the diet of these fast-moving hunter-gatherers. At first, they moved along the coasts, where progress was easiest, but by 5000 BP they were beginning to burn the forest, to help in the hunt, and planting fruit trees brought from Yucatan in the niches they had opened up, hinting at the first stages of an incipient agriculture.

The only agricultural economies claimed for the Americas at 5000 BP were located on the arid coast of Ecuador and northern Peru, and in the high Andes. Although lacking maize, a system of domestication and cultivation was associated with sedentary settlement, pottery-making, and monument-building, beginning to emerge no earlier than 6000 BP. However, these first farmers depended heavily on the sea for their subsistence, taking advantage of the rich resources delivered by the Humboldt Current, hunting sea mammals, fishing, and collecting shellfish. Domesticated plants included squashes and gourds, lima and jack beans, guava, and tubers such as cassava, sweet potatoes, and potatoes, suggesting early contact with the high Andes where the ancestors of the Inca Empire combined plant husbandry with the domestication of animals.

In the high Andes, disturbed niches created by the herding and corralling of llamas, and fertilized by their manure, encouraged the growth of weedy plants, including the herb quinoa – valued for its leaves and more importantly its seeds, which were vital to the making of soups, stews and porridges – and also primitive forms of potatoes and yams, which were selected for growth and edibility characteristics. On the dry coastal plains, irrigation was just beginning to become important by 5000 BP, but terracing and irrigation were still unknown in the highlands (Heggarty and Beresford-Jones, 2010; Denevan, 2001). These faltering early stages of agricultural development were soon to be followed by remarkable transformations that created complex societies and powerful agrarian states.

Seven claims

A number of claims can be made for the fundamental role of food in the early development of human biological and cultural history. Some of these arguments are directly related to the kinds of foods that were eaten and to technologies of food production, while others are mediated by environmental factors. All of the claims have been influential but have had to compete with alternative hypotheses, such as those which attribute causation directly to ecological factors and long-term environmental change.

The first and most influential claim is that changes in the availability of food resources in the late Pleistocene help account for the emergence of early hominins, specifically their upright stance, bipedalism, bigger and better brains, and stone tool-making. This argument is generally linked with the "savanna hypothesis," which represents these developments as responses or adaptations to the emergence of the dry savanna as a habitat type in east Africa in the late Pleistocene (Rotilio and Marchese, 2010). Transformation of the ecosystem and the landscape had consequences both for the kinds of potential food sources available to hominins and for the technologies appropriate to its hunting and gathering. The shift from wetter forest habitats, suited to "apelike" species finding their food safely above ground, to the challenging open landscape of savanna with its many wild animals had dietary and hence anatomical consequences. Critics of this influential hypothesis have in recent times advanced an alternative in which hominins evolved in enclosed woodland habitats rather than as hunters in exposed landscapes (Bobe and Behrensmeyer, 2004; Potts, 1998). Other interpretations see the two habitats and food systems as combined rather than mutually exclusive.

A second claim is that the development of meat-eating had a direct impact on human anatomy, including increased body size and increased ability to run and to throw, and on cognitive capacity. This argument is closely associated with the savanna hypothesis since the lack of fruited forests meant a changed diet in which meat played a much larger role. Human beings remained omnivores, however, merely choosing to increase the proportion of meat in their diets, following patterns determined by shortages and seasonality. Attempting to be pure carnivores was too dangerous, because of the unreliability of supply and because humans had to compete with mammalian carnivores, notably lions and spotted hyenas, that were strong and dedicated. The physical changes in *Homo* derived from the demands of the hunt, the need to defend carcasses from other predators, and to themselves scavenge meat from animals killed by their carnivorous competitors. An alternative solution for early hominins seeking protein was to rely on small, easily killed animals, notably invertebrates such as insects, but doing so demanded a cost-benefit analysis which weighed the energy derived against the energy required to obtain an adequate quantity of such small animals.

The third claim is that it is not so much meat in itself that matters but rather the act of cooking. The application of heat, supplied by fire, not only made meat more palatable but also increased the amount of energy derived from its consumption. Cooking and the emergence of *Homo erectus* went together, with consequences for human development much the same as those associated with meat-eating. Cooking also made hard-to-chew and hard-to-swallow plant food, particularly roots and tubers, more edible.

The fourth and closely related claim is that the diet shift associated with the emergence of agriculture about 10 000 BP instigated dramatic changes in the continuing process of human evolution. In particular, the shift to grains, legumes, and dairy products, and the production of fermented food and drink, placed selective pressure on genetic variation and induced rapid polygenic adaptation. Populations evolved genes to cope with tubers and alcohol, for example. Parallel genetic change, as recent as 3000 BP, occurred when people moved into high-altitude regions, such as Tibet, and had to cope with reduced oxygen in the atmosphere (Peng *et al.*, 2010).

The fifth claim sees the origins of language in the cooperative communication essential to hunting and scavenging and the associated distribution of meat, and interprets the dispersals of the great language families of the world as a product of the adoption and diffusion of agriculture. The importance of this claim is that it sees the replacement of languages as the outcome of a combination of demographic, social, cultural, and political forces, all of them having their roots in food production systems. Old World language families such as Indo-European began their expansion between nine and six thousand years ago, suggesting a close association with the origins of agriculture (Heggarty and Beresford-Jones, 2010).

The sixth and most comprehensive claim is that the transformation of food production systems beginning about 10 000 BP – the central element in the Neolithic Revolution – is the most profound transition in human cultural history, as argued, for example, by Susan Foster McCarter (2007: 1). Rather than being at the mercy of the natural environment and its wild resources, humans gained control of their food, manipulating the seasonal cycle of availability and climatic uncertainty. In order to more efficiently cook, store, and consume food, first farmers enthusiastically embraced ceramic technologies, which became markers of their cultural development. Cooking in a ceramic vessel had many advantages compared to roasting or boiling over an open flame, or using hot rocks, the only methods available before pottery. Increased food supplies enabled rapid population growth, sedentary settlement, long-term decline in the economic role of food production, the development of specialization and exchange, and the growth of other sectors of economic activity. These changes led directly to hierarchy, stratified social organization, and social complexity.

The seventh claim, growing out of the sixth, contends that the technologies of agrarian systems created the necessity for state-organized societies and the conditions for the development of "civilization." Central to this cultural shift were concepts of non-communal property, the need for boundaries, fences and walls, for numeracy and measurement, and hence for written records and maps of landholdings. The need to regulate water, both for drainage and irrigation, led to the central management of resources and to state systems. Sedentary settlements and urban living created a need for exchange, markets, prices, and money. They also placed great pressure on natural resources, resulting in environmental depredation and degradation (Crowe 2000: 231–6). Inequality followed inevitably, along with conflict, conquest, and war. So did the flowering of art, philosophy, and literature. All of these characteristics of civilized society – good and bad – can be traced back to the new system of producing and distributing food.

These last two claims give a greater role to human agency and individual choice than do the first five. It is no surprise then that the last two, both of them founded on the transition from hunting, fishing, and gathering to agriculture, are the ones to have been subjected to the most critique and questioning. Although radical thought may see *Homo sapiens* as the prime agent in the world's modern environmental crisis, the evolution of the species is understood as unstoppable, and much the same applies to meat-eating, cooking, and the development of language. It is fair to argue that without a cognitively developed *Homo sapiens* there would have been no agriculture, but it is more common to claim that the transformation of food production is the true cause of the planet's problems or, more optimistically, the source of the world's cultural creativity, however short-lived it may be. For good or ill, the working out of these developments formed the centerpiece of the era from 5000 BP, and throughout these millennia the central driver was almost always food.

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