ASSIGNMENT 6

THE ORIGINS OF FOOD PRODUCTION

So far we have studied hunter-gatherer societies, which never cultivated the soil or lived off herds of domesticated animals. It was not until about 10,000 B.C., after the Ice Age, that people began to cultivate the soil, to keep animals for their meat, milk, and other byproducts. This development, in itself, was not a revolutionary invention. However, food production had momentous consequences for humanity, as we shall learn in this assignment.

WHAT LIES AHEAD

Assignment Objectives

Upon completing this assignment, you will be able to:

1. Describe and evaluate the significance of the climatic changes that occurred at the end of the Ice Age, and the Mesolithic societies of Europe that adapted to them.
2. Describe and evaluate four major theories of the origins of food production, and three major consequences of same.
3. Be able to describe the dynamics of Gwembe Tonga subsistence agriculture in Central Africa, as a way of understanding some of the realities facing early farming societies.
4. Describe and evaluate the major developments in the emergence of food production in Southwestern and Eastern Asia, and the Americas. This description and evaluation will include the major sites described in this assignment.

WORK EXPECTED OF YOU

This assignment requires you to complete the following:

1. Readings: World Prehistory. Read Chapters 5 thru 7, plus Anthology.
2. Web Exercises: 6-1: The End of the Ice Age, and 6-2: The Gwembe Tonga
3. Written Assignments: Essay on food production.

Lecture 1: Food Production

This week's lecture surveys the origins of food production on a very wide canvas indeed. It covers some fundamental points:

- What exactly do we mean by food production? Why did people make this fundamental shift in a way of life that had lasted millions of years? What are the advantages and disadvantages of settled life and the shift from hunting and gathering to food production?

Lecture 2: Studying Food Production

How do archaeologists study the origins of food production? Why is this development so important? Why are the dietary changes involved of such importance? This lecture examines the methods used to study:

- Plant foods and the transition from foraging to cultivation, also the history of crops,
- The identificaton of plant remains and the study of diet and econology thorugh Paleoethnobotany,
- Zooarchaeological approaches to studying the domestication of animals—sheep, goats, cattle,
- Dietary changes and how we study them—also the study of ancient diet generally.

Film or Guest Lecture TBA

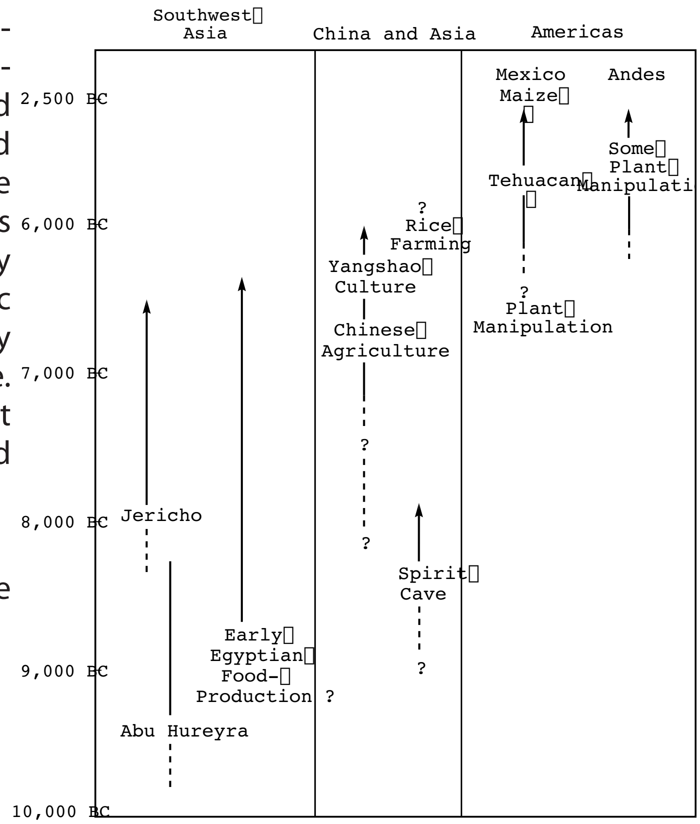
Look to GauchoSpace for information.

Chronology

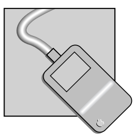
This chronological table is an important one, for it summarizes the chronology of the first farmers in many culture areas of the world. Note the following:

- Food production first took hold in Southwestern Asia, including probably Egypt,
- The date of the first farmers in China may be as early as Southwestern Asia, but is probably slightly later,
- Cultivation was a somewhat later development in the Americas, where the cultivation of lesser known native plants may have preceded that of maize, beans, and other familiar staple crops.

The important point is that agriculture appeared more-or-less simultaneously in many parts of the Old World, and the development occurred in a somewhat similar manner in the Americas. Thus, food production was a development in response to broadly similar environmental and economic conditions that appeared in many parts of the world after the Ice Age. It was not a dramatic invention that appeared in one place, then spread all over the globe.



Early Food Production

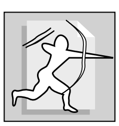


Now a Web exercise …

Web Exercise 6-1: The End of the Ice Age
(30 to 40 minutes)

This exercise shows you the changes wrought by the end of the Ice Age in three ways. First, we look at the effects of glacial retreat, rising temperatures, vegetational changes, and sea level alterations. This part of the exercise deals with these changes on a global level, so that you see them as part of a world ecological system. The second part of the exercise narrows in on the Bering Land Bridge (which we learned about in Assignment 5), and chronicles the dramatic changes in this area after 15,000 years ago. Lastly, we examine some of the ways in which these many changes affected humankind.

When you have finished, please read on …



FOOD PRODUCTION

The first few millennia after the ice Age saw human societies in many parts of the world adopt entirely new lifeways based on agriculture and animal domestication. These new strategies took hold first in subtropical regions.

THEORIES OF THE ORIGINS OF FOOD PRODUCTION

The origins of food production have generated an enormous literature, which goes back more than a century. We now survey the major theories and some of the consequences of agriculture:

World Prehistory: Read Chapter 5 and pages 178-182

When you have read the passage, write a 1-2 page essay outlining:

- What were the major consequences of food production?
- Was the "Agricultural Revolution" good or bad for the people involved?

When you have finished your essay, please return to the Study Guide …

THE REALITIES OF SUBSISTENCE AGRICULTURE

We think it's important that you understand some of the practical and social realities of subsistence agriculture, that is to say, farming without mechanization or other means of intensifying cultivation.

The example we use comes from Central Africa, where the Gwembe Tonga of the Middle Zambezi Valley still used traditional agricultural methods right up to the 1960s. Then, the colonial government of what was then the Federation of Rhodesia and Nyasa land built the Kariba Dam across the Zambezi River, a vast hydroelectric scheme that created a huge lake in the Middle Zambezi Valley. This flooded much of the Gwembe Tonga's ancient homelands and changed their agricultural system for ever.

We visit with the Gwembe Tonga through readings and images in the Study Guide and on the Web site, which introduces you to the people and their environment. In order to give you an idea of the hard you experience the realities of survival in their homeland and learn the dynamics of subsistence agriculture along the way.

Read Anthology: "1. The Gwembe Tonga of the Middle Zambezi Valley."

Web Exercise 6-2: The Gwembe Tonga

OLD WORLD ORIGINS OF FOOD PRODUCTION

Now for the archaeological evidence for food production. This we tackle on a regional basis, as this offers a convenient way of understanding, and comparing agricultural origins and dispersals around the world.

Origins of Food Production: World Prehistory. Read pages 150-155.

Then read: Anthology Section: "2. Early farming at Abu Hureyra, Syria."

And for the rest of the Old World: World Prehistory, pages 155-172, 182-187.

When you have finished, let's move on to the Americas …

MAIZE AND EARLY FOOD PRODUCTION IN THE AMERICAS

Just as in the Old World, the deliberate cultivation of wild plants in teh Americas was not, in itself, a revolutionary development. There is strong evidence that it began with the planting of native roots and grasses as a means of increasing the amounts of such foods available to growing populations. In the fertile river valleys of the Midwest and Southeast, foraging societies were cultivating local native plants like goosefoot and squash as early as 2000 B.C. This was a logical subsistence strategy, given rising populations and the finite amount of wild plant food available in these regions. This kind of cultivation is very different from that which involves wholesale clearance of many areas of wild vegetation and a major dependence on grown crops for much of one's diet. Agriculture of this type, based on maize and beans, developed much more recently, perhaps as early as 5,000 B.C., but later than in the Old World.

Our reading focuses on maize:

World Prehistory. Read pages 172–77 and pages 187–204.

The later reading covers the development of more complex farming societies in the North American Southwest and South/Southeast as a result, in part, of maize and bean agriculture.

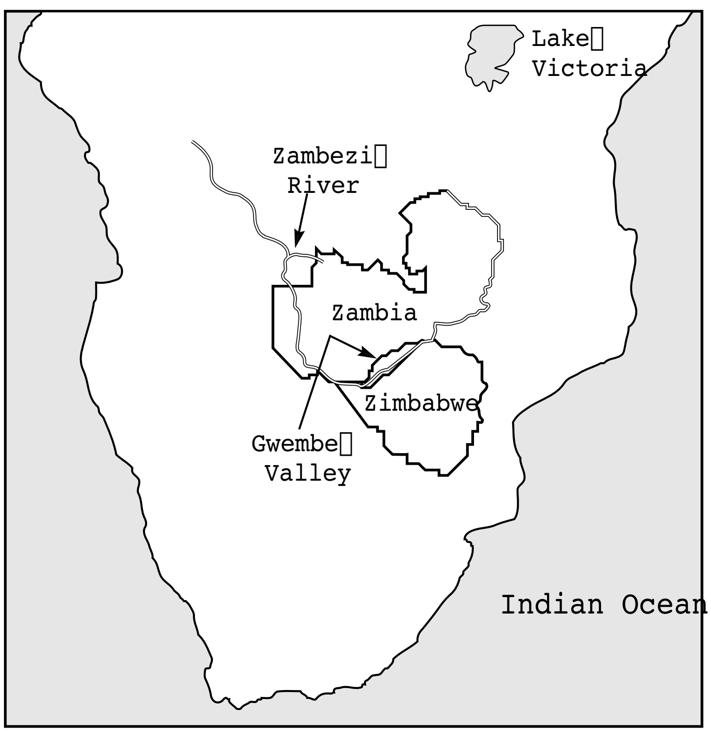
END OF ASSIGNMENT 6

ASSIGNMENT 6: ANTHOLOGY

1. THE GWEMBE TONGA OF THE MIDDLE ZAMBEZI VALLEY

Even today, millions of acres of farming land are tended by shifting cultivators in Africa, Asia, and the Americas. They grow cereals like wheat and barley, also maize, millet, and sorghum. Other groups concentrate on root crops — manioc, yams, taro, potatoes, sweet potatoes, and so on. So varied are the world's environments that there is no such thing as a "typical" shifting cultivator. But all such horticultural societies share a number of common features:

- All use simple technology and labor-intensive methods to clear and cultivate the soil,
- Few of them employ manuring or fertilizer other than ash from burning off cleared brush,
- Their land-use systems depend on an abundance of farming land and relatively low population densities. As long as these two factors remain in balance, their adaptations remain viable and long lasting.



The Gwembe Tonga (sometimes called the Tonga or Valley Tonga) of the low lying, hot Middle Zambezi Valley of central Africa offer an excellent example of how shifting cultivators exploit a mosaic of different soil types. Before they were resettled from their traditional homeland in the 1960s, they lived on the Zambezi floodplain, their lives dictated in part by the great river's annual floods.

The Gwembe Valley is formed by the Zambezi River as it cuts across southern Africa. The valley forms the boundary between Rhodesia and Zambia. In the late 1950s, a dam was built on the Zambezi, just below the valley, forming Lake Kariba. Due to the permanent flooding of their traditional farmlands, the Gwembe Tonga were relocated. Although their traditional way of life was forever disrupted, the data collected by the anthropologists sent in to assess the impact of the relocation, as well as the causes of endemic famine in the area, forms the basis of the simulation.

The Environment

The environment inhabited by the Valley Tonga is one of extremes. Extremes of heat and cold, extremes of rainfall or the lack, and extremes exhibited by the flow of the river. There are three distinct seasons in the region—the rainy season from November to March, the cold season from April to August, and the hot season from August to November. The seasons in turn are marked by monthly and annual cycles of rainfall and changes in the flow of the Zambezi.

The following pages provide you with some indication of the range of variation in river flow and temperature from year to year and during the year. Study these carefully, because some of this information will guide your planting and harvesting decisions during the simulation. When you read the sections on the economic and agricultural dynamics of the Gwembe Tonga, you may want to refer back to the map that follows. Remember that while a Tonga may have intimate knowledge of the soils, topography and seasonal cycle of rainfall, flood, and dry to guide him in the annual rituals of planting and harvesting, you do not. Your success as a subsistence farmer depends on your ability to absorb this information to guide you in making the right choices as you plant and harvest your crops. While there is certainly an element of common sense in the successful farmer, do not underestimate the importance of specialized knowledge in the quest for survival.

Annual River Level Change

As you can see from the graph in the computer exercise, the river level begins to rise in December, and continues rising until March or April. You will also note the dramatic variability in river flow from year to year. If the flood level is not high enough, the Tonga's floodplain fields do not receive the necessary load of rejuvenating silt, and their productivity is diminished. If the river floods too much, the floodplain and river bank fields are exposed too late for planting, or may be too wet to grow the necessary crops.

Annual Temperatures

Note the annual cycle of temperature change (graph in computer exercise). The highest temperatures occur from August to October. There is a gradual decline during the rainy season, and then a significant drop in temperatures from April to July — the cold season. The hot season is the period of greatest strain on resources because water and food supplies tend to be in shortest supply then. Survival during these months depends on adequate storage.

Technology

As with many groups of subsistence farmers, the material culture of the Gwembe Tonga is highly functional and fairly restricted, without a great deal of elaboration. This is not to say that they have no arts or crafts, but that they do not have a substantial amount of time to spend on manufacturing goods. Because all of the labor energy involved in food production is human labor (they had no draft animals), there is seldom much time that people have free from agricultural chores to work on other projects. The computer exercise will give you some idea of the aspects of the material culture that directly impinge on survival and food production. Good descriptions of other aspects of their material culture, such as pottery, weapons, drums, toys, etc., can be found in The Material Culture of the Gwembe Tonga, by Barrie Reynolds.

The Tonga had garden shelters built with a low platform. This type of shelter is used to sleep in during the dry season when crops are maturing in the riverbank gardens, away from the village. You would stay here to keep vermin, and hippopotamus from invading your fields at night. They also had a type of mud-plastered granary used to store grains such as millet and sorghum. The peaked, thatched roof helps keep the rains out. The plastering helps to keep rats, birds, and other little thieves out of the food supply. In addition, the Tonga had granaries with walls made of wickerwork, and built on elevated platforms of poles and mud plaster.

The Gwembe Tonga practice what is called slash and burn or swidden agriculture. When a new field is cleared, the men lop the lower branches off the taller trees, and cut down the smaller trees. The branches and other refuse are then piled around the taller trees, as in this picture, and allowed to dry out. Then the area is burned. The burning brings down the tall trees, and returns a certain amount of nutrients to the soil. After a few years, the field will have to be abandoned, or fallowed, in order to recover its fertility. Riverbank and floodplain fields do not need to be fallowed, however, because the flooding river deposits new soil each year — automatically rejuvenating the fields. The men use a variety of iron axes in the process of clearing new fields. They have wide blades and short handles. The bulge where the head is hafted on the handle serves both to secure the head and as an added weight to make the axe more efficient.

All planting and weeding is done with the traditional short-handled hoe. They have a knob on the end of the handle to keep it from slipping out of the hand. The hoe, like the axe, is designed with extra weight behind the head so that it does not have to be swung as hard to do the job. The handles are typically less than three feet long. As a result, both planting and weeding require a great deal of stooping over. Think what your back would feel like after 8-12 hours of weeding with one of these!

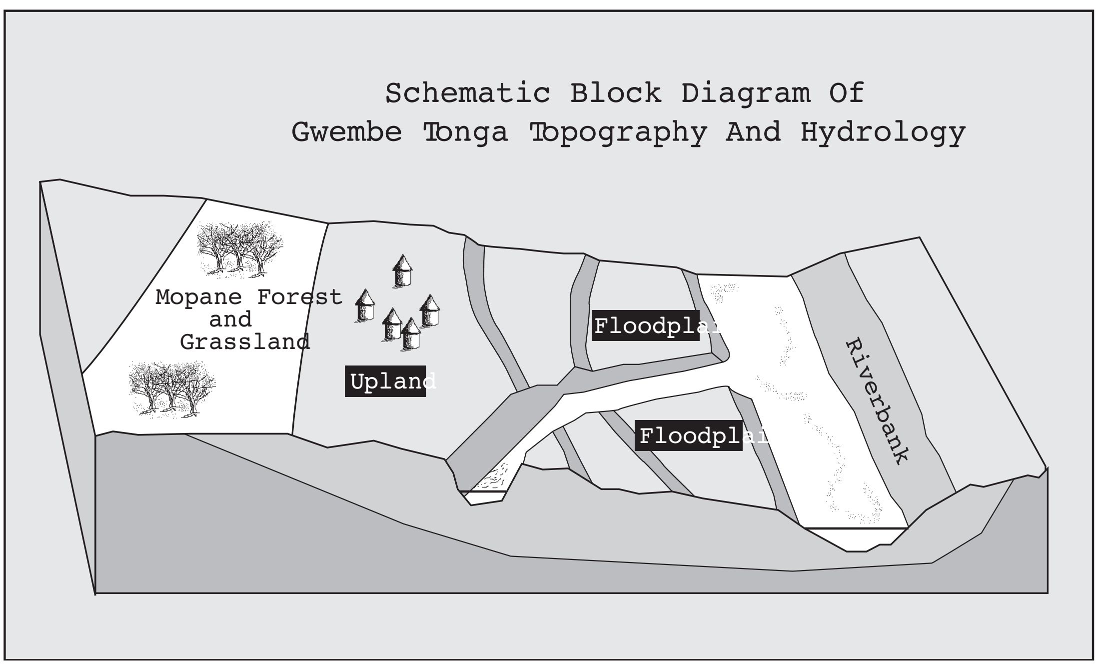
It takes about 90 days for millet and sorghum to mature, and 30-60 days for the various vegetables produced. After the grain is mature it is harvested by hand using a long knife to cut the stalks. The grain is then stored. When the grain is to be used it must be threshed, winnowed, and then ground or pounded into flour. The threshing is done with a light stick, and serves to crack the husks of the grain. The winnowing is done with a large flat basket and separates the grain from the chaff. Final preparation into flour can either be done by grinding, as this woman is doing, or pounding in a wooden mortar and pestle. All of this work is done by women.

Economic Dynamics

As mentioned earlier, all labor energy involved in Gwembe Tonga agriculture is human labor. There are no mechanized cultivation or processing aids, not even draft animals to drag a plow or grinding wheel. As a result, a good measure of the productive potential of an individual rests on the amount of other people's labor they can count on. Husbands have access to the labor of their wives and children, women have access to the labor of their children.

Tasks that require more labor than that to which a person has direct access require an exchange. Thus, you might ask your brothers and other relatives to help in clearing a new field. In exchange you feed them a meal, perhaps brew some beer for them. In the long run, by helping you they have ensured that you will help them when they need assistance — either with your labor, or with food if something should happen to their crops. Regardless of the amount of land an individual may own, if they do not have the labor resources to adequately guard it from predators, or to weed it, or to harvest the crop, they still may not be able to adequately feed themselves and their family. Conversely, someone with plenty of available labor, but insufficient land will have the same problem of not being able to fully take advantage of the available resources.

Among the Gwembe Tonga, each adult generally has ownership of one or more fields. Thus husbands and wives each have their own fields. Wives work in their husband's fields as well as cultivating their own. Their children are available labor for both sets of fields. Both husbands and wives also retain individual ownership of the products of their fields. Both have their own storage facilities. Wives feed their children, their husbands, and themselves from their stores until they run out. When the wife's stores do run out, she must then call on her husband to provide food from his stores to feed the family until the next crop is ready for harvest. The husband in turn can call on other relatives for food if his stores run out — provided that they have sufficient food to share. Thus, although individuals are essentially responsible for producing sufficient food for themselves and their immediate labor pool, there is a simple social safety net in the event of



natural calamities such as ruined crops, elephant attacks, etc.

This system does a good job of mitigating the effects of localized calamities. On the other hand, more general catastrophes such as long term droughts affect everyone in the network so that when one person runs out of food and begins depleting other people's food supplies (in an environment where everyone's productivity is now lower) the entire system can become swamped very quickly and general famine ensues. As you will see in the simulation, while things are good everything works fine, but when things get bad, they deteriorate very rapidly and people start dying.

The Agricultural Dynamics

The drawing illustrates the general agricultural dynamics of the Gwembe Tonga. There are three types of fields: 1) Riverbank fields for vegetables and tobacco during the hot dry season, 2) Floodplain fields for sorghum and vegetables in the cold dry season, after the flood waters have receded, and 3) Upland fields for millet and some vegetables in the rainy season. Upland fields must be fallowed after about 5 years of cultivation in order to recover their fertility. In order to survive the full annual cycle, an individual must have access to upland and floodplain fields, and should have at least one riverbank field to fall back on for vegetables in the hot dry season. Grain is the staple food, and although it is supplemented with meats, vegetables, and wild plant foods, insufficient grain harvests will seriously affect the viability of any family.

The trick to surviving as a subsistence farmer is balancing the food requirements of your labor pool, the amount of productive land available to you, and the labor necessary to take advantage of the productive potential of the land.

Having completed this reading, turn to the computer and embark on the computer exercise.

2. Early Farming at Abu Hureyra, Syria

Abu Hureyra in Syria's Euphrates Valley is arguably the earliest known farming settlement in the world. Meticulously excavated by Andrew Moore and specialists in environmental archaeology and early agriculture, Abu Hureyra provides an unusually complete picture of what happened at the threshold of foraging and food production, as this passage shows:

Abu Hureyra began as a small village of simple pit dwellings, houses dug partially into the ground, then roofed with branches and patches of reeds supported by wooden posts. From the very beginning, this was a year-round settlement, yet the inhabitants lived off game and wild plant foods. In 11,500 B.C., only a few families lived at Abu Hureyra, but the location was so favorable three hundred to four hundred people crammed into a settlement of timber and reed huts by 10,000 B.C.

Excavating the inconspicuous dwellings took days of careful work with trowels and brushes, distinguishing the harder, undisturbed soil from the softer fill of the house pits. Inch by inch, Moore traced the outlines of the houses, the rooms of which were interconnected. The dwellings lay in sandy earth and thick ash deposits accumulated by generations of domestic hearths. Here was the real treasure house at Abu Hureyra, a relatively uniform mass of ash containing the end products of centuries of hunting and foraging. Moore and his team sifted every square inch of the trench through fine screens. Laboriously, they passed hundreds of cubic feet of occupation deposit through flotation machines, acquiring large samples of charred seeds and fruits. Flotation gave Moore what everyone had been looking for, large samples of cereal grains and other seeds from the very dawn of farming.

The principle of flotation is simple, designed to separate mineral grains from organic materials such as seeds by taking advantage of their different densities. Large samples of earth are poured into a screened container and agitated by the water pouring onto the screen. The light plant remains and other fine materials float on the water and are carried out of the container through a sluiceway, which leads to fine-mesh screens, where the finds are trapped, wrapped in fine cloth, and preserved for the botanists. The heavy sludge of mineral grains, in the meantime, sinks to the bottom of the flotation container. Early flotation devices consisted of little more than an oil drum with a fine screen set in them. An excavator would use dozens of buckets of water to process small numbers of samples, repeatedly dismantling the machine to empty out the sludge. Flotation was so laborious that even a few samples would take hours to process.

Moore's colleague Anthony Legge used a flotation machine designed to process large soil samples as fast and efficiently as possible. It used a series of settling tanks so carefully screened water could be recycled through the machine again and again. A large flotation tank stood at the highest level, fitted with an inlet pipe that pumped air into the body of the tank at a constant rate. Detergent was added to the water to help separate the seeds from the soil. Once air was bubbling through the tank, a sample was poured in. All fine elements floated to the surface and were carried away by the water down an outlet and through two "flot sieves," gossamerlike screens that caught the finest residues. Meanwhile, the heavier elements and soil residue descended to the bottom of the main tank and were flushed out through a sludge outlet onto an extremely fine mesh screen. Here, tiny beads, stone tools, and fish vertebrae were sieved from the sludge, which washed into the settling tanks below.

Thanks to the flotation machine, Moore acquired 712 seed samples from soil deposits that comprised a bulk of over 132 US gallons (5001). Each sample contained as many as 500 seeds from over 150 different taxa, all of them edible. He brought in botanist Gordon Hillman to examine his vast collections. Abu Hureyra's occupation deposits were ashy and uniform, preservation conditions ideal for large-scale flotation. By looking at the plant samples, Hillman could study the landscape almost as easily as if he was walking across it.

Abu Hureyra lay in a strategic location in 10,500 B.C. Below was the moist Euphrates floodplain, while a grassland steppe stretched away from the site, just as it does today. Within easy foraging distance were open forests, where oaks and other nut-bearing trees abounded. Today, assuming pristine environmental conditions, you would have to walk at least 75 miles (120 km) west toward the Mediterranean before reaching the boundary between oak forest and steppe. In 10500 B.C., more rain fell in spring and early summer, so the forest lay much closer to Abu Hureyra. We know this because Hillman found fruit stones and seeds of the hackberry tree, plum, and medlar in the village, also the white-flowered asphodel, another denizen of the same vegetational zone. No one could have exploited such resources on a large scale unless they were within reasonable walking distance.

How far did people have to walk to the forest? Hillman found pistachio fruit in the deposits but no wood charcoal, as if the trees grew too far away for the branches to be gathered as fuel. Today the nearest pistachio trees grow on highlands 56 miles (90 km) away. In 9500 B.C., Pistachio groves probably grew in lines along low wadi terraces within a short distance of the village.

During the moist springs and early summers, wild wheat and two ryes were staples at Abu Hureyra. Again, such wild cereals grew at the boundaries between oak forest and open steppe, flourishing on deep, well-drained soils for some distance beyond the tree line. In the absence of modern farming and grazing, they might grow within 60 miles (100 km) of Abu Hureyra today; in 10,500 B.C., they could be harvested much closer to the settlement.

For 500 years the Abu Hureyra people not only exploited a wealth of plant foods close to hand, they also had access to a reliable meat supply. Anthony Legge collected over sixty thousand bone fragments, about 80 percent of them from small, fleet-footed gazelle. Back in the laboratory, he noticed that these were not only from adult specimens but included numerous bones and teeth from very young animals. Legge measured the heights of thousands of "milk" molars, the immature teeth used by gazelle from birth until they are about a year old. Gazelle are so rare in the Near East today that Legge had to go the University Museum of Zoology in Moscow to measure comparative skulls, from living gazelle herds in Turkmenia. He found the milk teeth fell into easily distinguishable groups, unworn, from very young specimens, and heavily worn molars, such as were typical, in Turkmenia, of animals about a year old. Examination of the heel bones revealed a similar pattern, with those of very immature beasts, young adults, and fully adult gazelle forming three distinct groups.

Legge realized such a killing pattern came not from the hunting of individual beasts, where the hunters tend to concentrate on animals in their prime, but from mass seasonal kills, where an entire herd was taken at once. As was the case on the North American plains, such techniques require large numbers of people, open country, and some kind of suitable topography or artificial fences. Legge knew the life cycle of a gazelle herd is highly synchronized. In northern Syria, gazelle give birth in late April and early May. Thus a herd slaughtered during these months would contain a high proportion of very young and year-old beasts.

The structures used for ancient Near Eastern gazelle drives only turned up in the 1920s. Pilots on the Cairo to Baghdad airmail run photographed archeological sites from the air, including large stone enclosures about 500 feet (150 m) across, with narrow entrances. Long stone walls fanned out from these to form a large V. According to nineteenth-century travelers' accounts, hunters stampeded gazelle herds down these strategically placed defiles, as they emerged from small valleys.

Gazelles are small animals, about 24 inches (61cm) at the shoulder. Legge found a good sampling of all the body parts at Abu Hureyra, as if the hunters were taking their prey close to the village, then carrying the carcasses back home for butchering and drying. No one knows exactly where the killing enclosure was, but the teeth and heel bones make Legge certain the kill took place over a few weeks in early summer. This is the time when gazelle moved northward out of the desert to drop their young in a moister environment, where the females had access to green vegetation as they produced milk. Once they reached the Euphrates Valley, they split up into small groups, making mass killing impossible, before returning to the desert in July. Mass killings provided a predictable, abundant source of animal protein each spring. For a millennium and a half, the people of Abu Hureyra lived off a bounty of game and plant foods so rich the local population rose by leaps and bounds.

The gazelle migrations provided the villagers with a predictable food source, as did the annual harvests of wild grains and nuts, and a growing, permanent settlement flourished off this interlocking set of easily stored foods, which reappeared year after year as long as climatic conditions remained so favorable. But they did not remain favorable forever. Two large flotation samples reveal a startling change about 11000 B.C. People stopped gathering tree fruits from the forest fringe, as if the groves were no longer within range of the village. At the same time, they increased their exploitation of wild cereals, including feather grass and asphodel seeds. According to Hillman, such grasses and plants would prosper as the forest retreated in the face of drier conditions and the low-lying vegetation received more sun as the overlying canopy thinned.

Four hundred years later, the change is even more dramatic. Asphodel and wild cereal grains vanish from the village. Even pistachio fruitlets are less common, while drought-resistant clovers and medicks become staples. These are standby foods, edible plants that require extensive preparation to detoxify them before consumption, a fallback when easily edible cereals are hard to find. Abu Hureyra was in the grip of a prolonged drought cycle. Even valley bottom plants become rarer, as if the Euphrates only occasionally overflowed its banks.

Abu Hureyra lay in an always semiarid region, where even minor shifts in rainfall patterns could cause major vegetation changes. Thus the changes in plant exploitation detected by Gordon Hillman were almost certainly due to climatic change, to a significant reduction in moisture during spring and early summer. They also coincide with significant forest retreats in the pollen diagrams from Lakes Huleh and Zeribar in the same general region.

At first, Hillman argues, the Abu Hureyra people adjusted to the new conditions by turning to small-seeded grasses and other standby foods. But, after years of good living, the village had swelled to as many as three hundred to four hundred people, a population density far beyond the constraints imposed by a mobile existence. By this time, too, they may have stripped many acres of woodland for firewood, further degrading the environment. As food supplies declined, annual droughts intensified, and stress levels rose, there was only one course of action left, to abandon the settlement.

What could have caused the drought? Moore and Hillman believe it was a well-documented incident in global cooling. Between 11000 and 10000 B.C., European pollen samples document an intense cold snap after many centuries of more benign conditions. Temperatures in the north were so cold they were close to those of the late Ice Age. Even fossil beetle faunas reflect the renewed cold. Scientists call this the Younger Dryas episode, the last cold snap before temperatures rose once again, a time of tundra vegetation, before forests advanced to their modern limits. This brief cold interval was so intense it turns up in sea-temperature readings recovered by examining deep-sea cores taken in the Pacific. The cold snap also appears as a well-defined episode in Greenland ice cores. A contemporary pollen core from Lake Huleh in the Jordan Valley south of Abu Hureyra shows a sudden decline of tree cover at the expense of dry steppe. The reversal lasted for 1,000 years, the result of cooler temperatures and a reduction in moisture during spring and early summer, the very circumstances documented by Gordon Hillman from Abu Hureyra's plant remains. The Younger Dryas triggered a revolution in human life by driving people into oases where agriculture began.

Hunting and foraging is a highly flexible way of wresting a living from the environment. Even after centuries of permanent settlement the established communities of the Levant could adopt a seemingly logical alternative in the face of drought. They could disperse into smaller family groups and range widely over the landscape, moving closer to the familiar plant foods that had sustained them in earlier times. As the drought intensified and forests shrank, the people abandoned much of the open steppe and places like Abu Hureyra, falling back on better-watered zones, on natural oases. Even those who were lucky enough to live near permanent springs and ample surface water may have suffered food shortages. It was these oasis dwellers, living at places like Jericho in the Jordan Valley, who witnessed the first tentative experiments with farming and animal domestication. A combination of abundant water, fertile soils, dense stands of cereal grasses, and wild goats and sheep nearby gave them an advantage over their less-fortunate neighbors. By 10,000 B.C., the Jerichoans were growing cereals and pulses.

As more favorable conditions returned, the new economies spread rapidly. By 9700 B.C., a new settlement appeared at Abu Hureyra. A much larger village rose on the mound, a closely knit community of rectangular, one- story, mudbrick houses, separated by narrow lanes and courtyards. Each multiroom family dwelling had black burnished plaster floors. At first, the inhabitants followed their predecessors' example and combined cereal farming with gazelle hunting. Then, about 9000 B.C., they switched over abruptly to herding goats and sheep, perhaps because of overhunting. It was a hard life. When biological anthropologist Theya Molleson examined the skeletons from the village, she found ample evidence of work injuries. She also observed malformations of the toes, knees, and lower vertebrae in the skeletons of all the adult women, a condition due almost certainly to hours of grinding grain. This is some of the earliest evidence for division of labor between men and women in human history.

Domestication occurred remarkably quickly but involved major changes in wild cereal grasses. In the wild, such grasses occur in dense stands, growing with a brittle joint, known as the rachis, between the stem and the spikelet with its seed. This allows the ripe grain to fall to the ground and reseed, or foragers to harvest it simply by knocking the stem against a basket at the exact moment of full ripeness. In contrast, domestic cereals have a rachis so tough and strong they can only be harvested with a sickle or by uprooting the plant, effectively giving humans control over the timing of the harvest. Botanists Hillman and Stuart Davies developed a mathematical model of the domestication rate by harvesting wild wheat plots in eastern and central Turkey, employing a variety of methods, then using the yield and loss figures to calculate the amount of time it would take for the entire crop to achieve the tough-rachis state of domesticated wheat. They found if the crop was harvested in a near-ripe state by sickle reaping or uprooting, then full domestication would have been achieved within the remarkably short period of 20 to 30 years. If the crops were reaped when less ripe, the process would have taken longer, perhaps as long as two centuries. Had those cultivating the wild grain noticed the high proportions of semitough rachised grasses, then they could have planted them in separate plots, accelerating the process of domestication by as much as half.

During the stressful centuries of the Younger Dryas, some communities living in well-watered locations like Abu Hureyra, and clustered along the Jordan Valley, first cultivated the soil and domesticated the herds of wild goats and sheep, which needed standing water to survive. As wetter conditions returned and the centuries of drought were forgotten, farming and herding took hold like wildfire, spreading from coast to interior, from lowlands to uplands, throughout the fertile crescent of Mesopotamia, into Turkey and the Nile Valley. This rapid adoption of farming was the true revolution in human history, the catalytic development that led to cities, civilization, and, ultimately, to the modern world.