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The Eloquent Bones of Abu Hureyra

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# The Eloquent Bones of Abu Hureyra

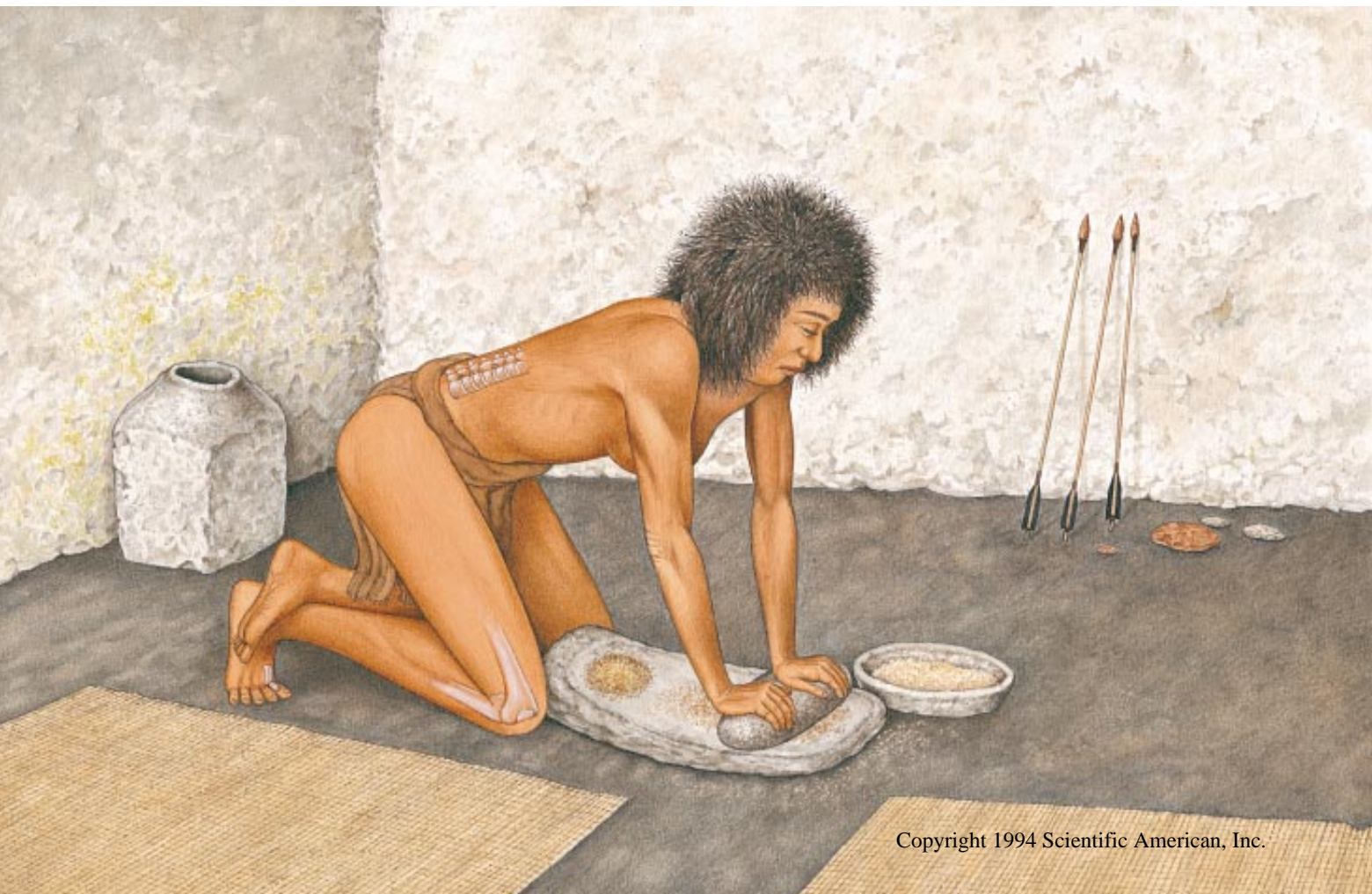
*The daily grind in an early Near Eastern agricultural community left revealing marks on the skeletons of the inhabitants*

by Theya Molleson

Reconstructing how people lived in ancient times is like detective work: clues are scarce. Inferences must be made from spotty evidence such as bones, durable artifacts and the ruins of habitations. In my work as a paleontologist at the Natural History Museum in London, I knew that a collection of early Neolithic human bones had been brought to England from excavations at Abu Hureyra, in what is now northern Syria. The archaeological work was done in 1972 and 1973—

shortly before the site was due to be flooded by the reservoir behind the new Tabqa dam—by Andrew M. T. Moore, then at the University of Oxford [see “A Pre-Neolithic Farmers’ Village on the Euphrates,” by Andrew M. T. Moore; *SCIENTIFIC AMERICAN*, August 1979]. The skeletal remains of about 162 individuals—75 children and 87 adults, of whom 44 were female, 27 male and 16 of undetermined sex—have been identified from seven trenches dug at Abu Hureyra. The deposits span about 3,000 years.

It seemed to me and my colleagues that the bones might reveal details of the daily life of the Abu Hureyra people and therefore that of other Neolithic groups whose members had made the transition from hunting and gathering to an agricultural economy. The marks of life experience—some wrought by disease, some by work—can be imprinted on the bones and teeth of the skeleton. Close study has indeed yielded a fund of information that might not otherwise have been discovered, particular-



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ly about the women of the community.

Abu Hureyra was inhabited in two different times. The first one was from roughly 11,500 to 10,000 years ago, just preceding the development of agriculture. The pre-Neolithic people of this settlement gathered a wide range of wild seeds, including lentils, einkorn, rye, barley, hackberries and pistachios. They also hunted the gazelles that migrated toward the Euphrates in the spring. The second settlement followed an unexplained hiatus of 200 years. The early Neolithic people of the later settlement cultivated a range of domestic cereals: emmer, einkorn, oats, barley, chickpeas and lentils. All these plants required preparation before they could be eaten. The preparation took much labor and time.

The record of this effort can be read in the bones of the people of Abu Hureyra. One of the first skeletal traits we noticed were signs of extra and sometimes excessive strains caused by the carrying of loads, most likely game, grain and building materials. The evidence was most conspicuous among the young. If adolescents are required to labor in this way, one can expect changes in the shape of the upper vertebrae. That is what we found. It is also probable that the loads were carried on the head: the hook-shaped parts of the vertebrae in the neck are enlarged, indicating that the bones developed a buttressing support. Otherwise, the neck might have wobbled under the weight of a heavy burden. In some individuals, we found degenerative changes in the neck vertebrae that may have arisen from injuries sustained by bearing weight.

These cases were not common. In fact, the general health of the people appears to have been good, except for

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bone deformities that turned up repeatedly: collapsed vertebrae (always the last dorsal one) and grossly arthritic big toes. These malformations were associated with evidence of muscular arms and legs. Clearly, the bones bespoke a demanding physical activity that was also injurious.

For a time, we actually entertained the idea that the people of Abu Hureyra had engaged in some sport or athletics, but crippled ballerinas seemed unlikely to have appeared during the Neolithic. We remained mystified until a colleague who was vacationing in Egypt noticed that the kneeling suppliants depicted on temple walls always had their toes curled forward. This observation suggested that some activity that involved kneeling had produced the pathology that we observed among the residents of Abu Hureyra.

During the excavations, Moore had found saddle querns in the rooms of the houses, abandoned after they had last been used. (A quern is a primitive stone mill for grinding grain by hand; a saddle quern is so named because it resembles a saddle in shape.) I was convinced that the kneeling action consisted of long hours spent grinding cereal grains on the saddle quern. Gordon Hillman of the University of London, who had worked on the plant remains from the site, was not so sure. He pointed out that removing the outer husk of the seeds by pounding them with a pestle in a mortar—another chore done

while kneeling—would have been an essential step in preparing the grains. Probably both tasks were involved in creating the vertebral deformities, but it is unlikely that mortar-and-pestle work caused the toe deformities: the laborer could have changed positions while pounding but not while grinding.

So it was the preparation of grain for eating that was the most demanding and labor-intensive activity of the settlement, as it still is in many places. The grain had to be pounded every day because the seeds would not keep once they were dehusked. The dehusking with mortar and pestle and the subsequent grinding in a saddle quern would have taken many hours. What we had found on the bones, then, were the telltale signs of long hours spent at such labor. Also evident were marks of injuries, perhaps caused by using the saddle quern with too much enthusiasm or haste.

Querns and rubbing stones found at Abu Hureyra suggest how such wear and tear came about. The querns were set directly on the ground rather than mounted on a plinth or other raised structure, a practice followed in later times (debris surrounding the querns supports the conclusion that each was found where it had been used). Thus, the individual using the quern would have had to kneel.

Picture the operation. The grinder puts the grain on the quern and holds



**GRINDING GRAIN** on a saddle quern, a daily task for Abu Hureyra females, put strain on several of the joints. On her knees, the woman repeatedly pushed the rubbing stone forward and then pulled back to her starting position. The activity, taking up several hours a day, affected particularly the

bones shown above: the big toe, the spine and the leg. The toe is hyperflexed and damaged; the spine shows bony growths of the vertebrae; the leg, pictured with the femur (thigh bone) at the top and the tibia (shin bone) below it, has a buttress along the shaft of the femur and bony growths at the knee.



the rubbing stone with both hands. On her knees (yes, it was women's work, as we shall see), with toes bent forward, she pushes the stone toward the far end of the quern, ending the stroke with her upper body almost parallel to the ground so her arms are at or near the level of her head. On reaching the far end of the quern, she jerks back to her starting position. I call this part of the grinding action the recoil. The movement that raises the arms as the grinder pushes forward employs the deltoid muscles of the shoulder. During this stroke, the arms also turn inward, a motion accomplished by the biceps muscles.

It is precisely the places where the deltoid muscles attach to the humerus (the long bone of the upper arm) and the biceps muscles to the radius (one of the two forearm bones) that are markedly developed in these individuals. The overdevelopment of the muscles was symmetrical, affecting both arms equally. On the forearm of these individuals, the radial tuberosity—the bulged area of the radius where the biceps muscle

attaches—is particularly noticeable.

Kneeling for many hours strains the toes and knees, whereas grinding puts additional pressure on the hips and, especially, the lower back. The characteristic injuries we found on the last dorsal vertebra were disk damage and crushing. Such injuries could occur if the grinder overshot the far end of the saddle quern during the forward push or recoiled to the starting position too quickly or vigorously.

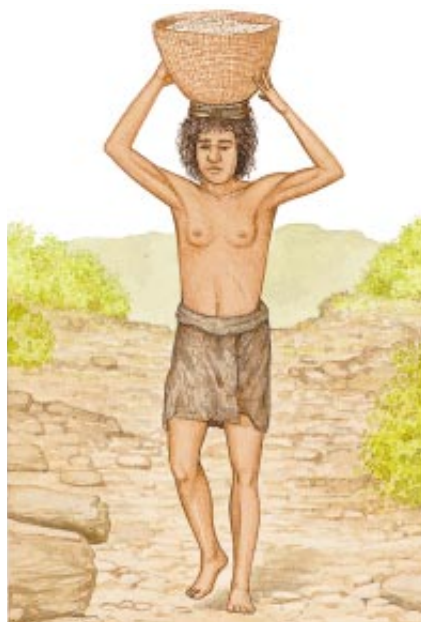
During grinding, the body pivots alternately around the knee and hip joints. The movement subjects the femurs (thigh bones) to considerable bending stresses. These bones thus develop a distinct buttress along the back to counteract the bending moments imposed from the hip and the knee as the weight of the body swings back and forth across the saddle quern. The knee also takes a lot of pressure because it serves as the pivot for the movement. Thus, the joint surfaces enlarge. All these effects appear on a set of bones we studied. The femurs were curved and buttressed. The knees show bony

extensions on their articular surfaces.

The feet are also subjected to heavy pressure as one grinds grain on a quern. The toes are curled forward to provide leverage, which is supplied in large part by the big toes. In the remains from Abu Hureyra, the first metatarsal joints of the toes are enlarged and often injured. There are also signs of cartilage damage: smooth, polished surfaces at the metatarsal joint indicate that bone had rubbed on bone. In some individuals, a gross osteoarthritis had developed. In one case, the right big toe is much more severely affected than the left. Although an infective origin for this condition cannot be ruled out, perhaps the grinder was in the habit of resting one foot on the other to relieve the pain. Just such a position is shown in a model, illustrated in J. H. Breasted's *Egyptian Servant Statues*, of an Egyptian woman using a quern.

The changes to the arm, thigh and toe bones that we observed affected the overall bone morphology. This result would come about only if the stresses had been applied to the bones for long

#### LOAD BEARING

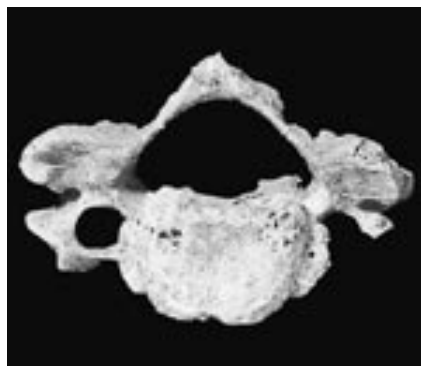
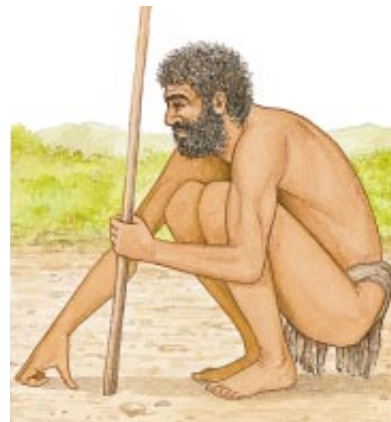


**BONE ABNORMALITIES** appeared among the people of Abu Hureyra as a result of the activities depicted here. Carrying loads on the head deformed the bones of the upper spine; the pitting on the vertebra indicates disk damage. Pounding grain in a mortar and pestle and operating a quern strongly developed the arm muscles, as reflected by the bulging in the two humerus (upper arm) bones (*top of photograph*),

#### USING MORTAR AND PESTLE



#### SQUATTING AT REST



hours daily while the individual was still growing. Travelers have observed such activity quite recently. Michael Aster writes in *A Desert Dies*: "Life in the [Saharan] oasis seemed to grind on at its own pace. For the women this was literally true, for they spent much of their time grinding grain on their hand mills.... I often watched Hawa as she placed a few grains at a time on the stone-base and let them trickle down as she ground them, sweeping the flour into a bowl every few minutes. After an hour or so her little daughter, aged about nine, would take over and begin grinding furiously. It might take several hours to produce enough flour for one meal."

**W**e wanted to know whether members of both sexes ground grain at Abu Hureyra. Finding the answer proved difficult. The skeletons were so fragmented that we had to devise a way of determining the sex of an individual from the specific bones that showed the changes we believed resulted from using a saddle quern.

Measurements of the first metatarsal bone of the foot demonstrated that it was generally larger in males, and by this means we could see that most of the bones showing the saddle-quern effects were from females.

We concluded that the grain was usually prepared by the women and girls in the household. A rather loose division of roles thus appears among these early Neolithic people. The inhabitants of Abu Hureyra must soon have discovered that the most efficient way to operate was to divide up the work of supplying food. We can assume that the men hunted and, with the advent of agriculture, cultivated food plants. The women of the household took on the job of grain preparation—a laborious task, or rather a series of tasks, that occupied many hours a day and could lead to back, knee and toe injuries. These are the repetitive stress injuries of the Neolithic. There is no need to assume that this division of roles implies any inequality between the sexes or between roles—that comes later.

The women were not the only ones

to suffer. The coarsely ground grain had an appalling effect on everyone's teeth. One precaution necessary with all grain products except sifted flour is careful sorting to remove hard kernels and small stones. The number of fractured teeth among the early Neolithic people of Abu Hureyra bears witness to a failure to do this sorting effectively—and probably to an absence of sieves. For the same reason, awns or glumes from the outer covering of the grains remained in the flour and occasionally became lodged between the teeth, causing gum infection. On the other hand, caries (tooth decay) was rare. Apparently the flour was not sufficiently refined or cooked (if it was cooked) to provide the right environment for the bacteria that cause cavities.

Fracturing was only one problem. The grains, even after being pounded and ground, yielded a hard meal that was exceedingly abrasive. Apart from the damage caused by rock powder from the grindstone, the flour itself rapidly wore down the teeth. Many people lost teeth at an early age. Moreover, scanning

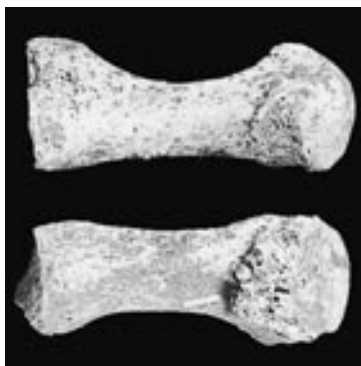
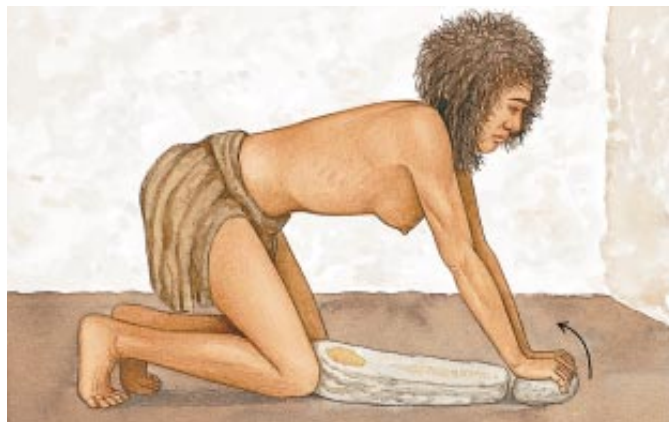
electron micrographs of teeth from Abu Hureyra show pits comparable in size to those that date stones and other hard objects make on the teeth of nonhuman primates.

Something had to be done about the horrendous wear on the teeth. The archaeologists at Abu Hureyra had occasionally noticed the imprints of woven mats in plaster from later levels of the settlement. This finding was evidence that the people had by then mastered the skills of weaving. The invention of the sieve—an application of the principles of weaving—would have meant that grain could be sifted from grit and coarse chaff. Women in the Near East today can operate a sieve so deftly that they produce three piles on it: stones, chaff and grains. They then flip the stones into the palm of the hand. The result is fewer fractured teeth. We have no direct evidence of sieves at Abu Hureyra, but tooth wear is notably less severe in the later times.

Some way also had to be found to contain the harvested grain in order to bring it in from the fields.

where the deltoid muscles attach, and in the two radius (forearm) bones (*bottom*), where the biceps muscles attach. Squatting to rest put strain on the knee, resulting in this notched patella (kneecap). Using a quern damaged the last dorsal vertebra; wedging and pitting indicate crushing and disk damage. Also affected were the bones of the big toe; here there is wear near the right end of the upper toe bone and severe osteoarthritis near the right end of the lower bone.

#### USING QUERN





Baskets may have been the solution. We noted strange grooves on the front teeth of individuals from the later levels at Abu Hureyra. In making a basket, three canes have to be maneuvered at once. Because the hands are occupied holding the first staves of the basket, the teeth are used to control the working canes. Clark S. Larsen of the University of North Carolina at Chapel Hill has illustrated how a modern Paiute Indian woman holds the canes between her teeth. The habit of weaving in this way forms grooves on the surface of the front teeth. The grooves are almost identical to those we have observed on the teeth from Abu Hureyra.

The skeletal evidence for weaving and basket making is rare among the bones we studied, presumably because the skills for those crafts were confined to a few people. Those individuals are all from one part of the settlement, which suggests a craft area. Such specialization would be a natural outcome of any division of roles. Role specialization allows the development of expertise, speed and improved technology. If an expert is relieved of the need to produce her own food, she can manufacture more than enough sieves or baskets to supply the community. Any surplus can be used in trade.

From a different part of the settle-

ment came evidence for another group of craftswomen. We noticed that several jaws found there have enormously enlarged joint surfaces, together with extremely uneven wear on the teeth. To display this pattern of wear, the teeth must have been subjected to immense crushing forces that abraded the lower teeth on the outside and the upper teeth on the inside. In some cases, the wear extends right down to the root.

Tetsuya Kamegai of Iwate Medical University in Japan has found similar changes among Maori people who chew plant stems to make fiber string. Some years ago J. D. Jennings of the University of Utah described the marks on quids chewed by worn teeth. The quids, made by people of the same epoch as the Abu Hureyra community, are found by the thousands at Danger Cave in Utah. The cave yielded pieces of cord made of chewed bulrush stems and mats bound with the cord. I believe mats were being made in a similar way at Abu Hureyra, a view also supported by the impressions of matting found during the excavation.

Some 7,300 years ago the new technology of pottery making brought great changes to the community. Pottery vessels provided a container in which grains could be soaked and

cooked. That made the cereals so much softer that wear on the teeth was significantly reduced, as can be seen in scanning electron micrographs.

Cooked cereal is also tastier and easier to digest. Cooking releases the carbohydrates from the grain and makes them easy for the digestive system to absorb. One result was porridge, which soon had a dramatic effect on the community's population structure. A single consequence is evident in the unmet fracture of a woman's jaw; it is unlikely that she could have survived if a nutritious gruel or porridge were not available. Much more significant is that once porridge was available, women could give it to infants in place of breast milk. The mothers, too, consumed a diet quite rich in carbohydrates. The result of early weaning and better nourishment was to increase fertility substantially by reducing the interval between births.

This effect can be seen in the much larger proportion of infant skeletons recovered from the pottery levels compared with their percentage in the earlier strata. The proportion is so high as to suggest that infants were at increased risk of dying from disease, presumably because the rising population density gave more opportunity for pathogens to spread from one person to another. Some of the children have a thickening and pitting of the eye sockets, known as *cribra orbitalia*, that probably was the result of anemia following long-term infection by parasites.

It is from the pottery levels that we find evidence of dental caries. The change in food preparation, with greater emphasis on cooked cereals made into bread and porridge, created sticky foods that adhere to the teeth and provide a medium for the growth of the bacteria that cause caries.

Abu Hureyra was abandoned about 7,000 years ago, as were many other Neolithic sites in the Near East. One cannot say why; disease, famine and climatic change are all possibilities. Abu Hureyra, although it was a structured society, remained egalitarian to the end—at least in terms of burial practices. But during the Neolithic, roles probably became more defined and more circumscribed.

The incorporation of role in the so-

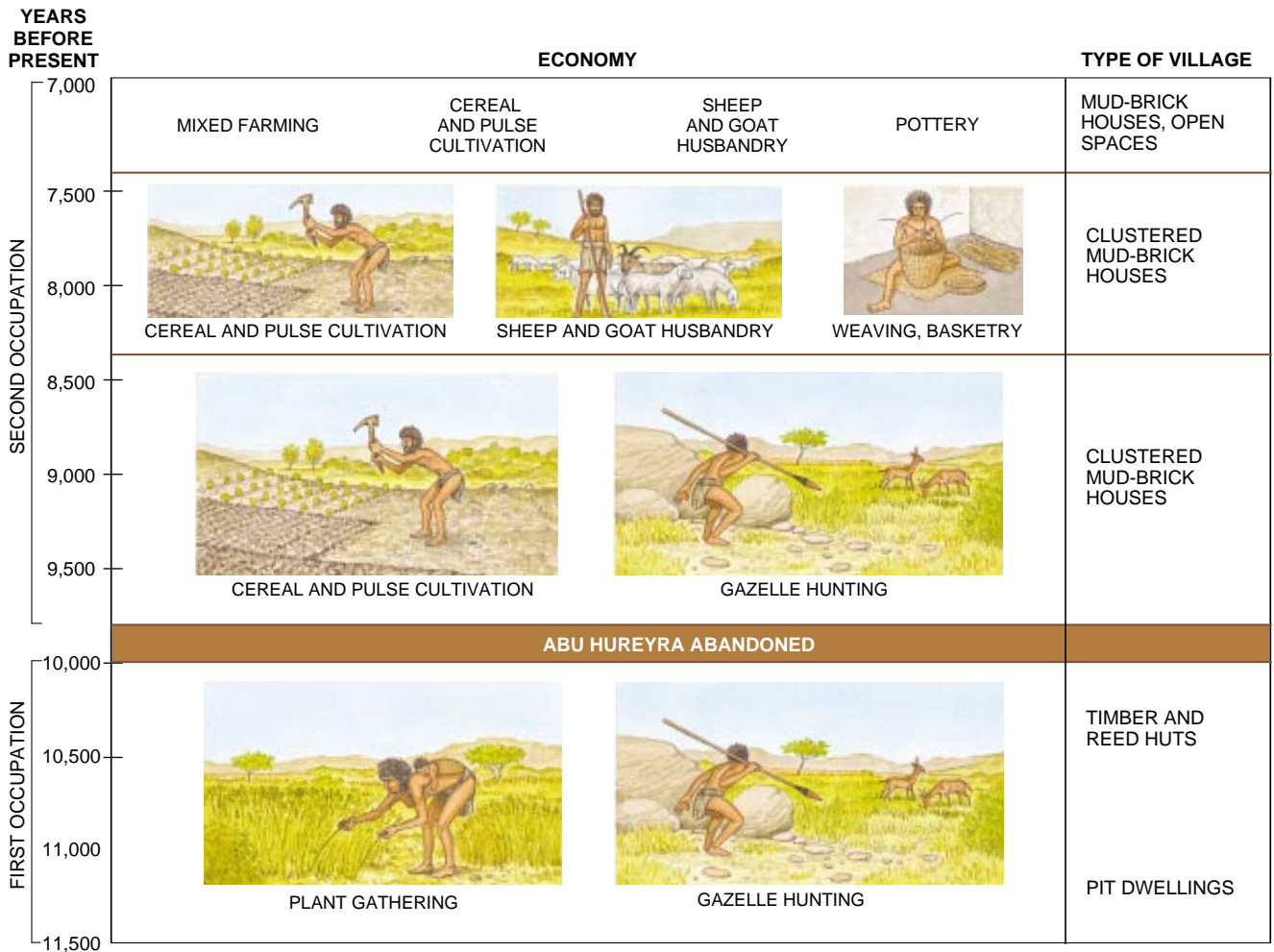
## EATING



## WEAVING



**TOOTH WEAR** was severe among the early Neolithic people of Abu Hureyra. The coarse flour produced by grinding on a quern abraded teeth. Pulling canes through the teeth while making baskets resulted in deep grooves.



**ABU HUREYRA'S CHRONOLOGY** extended through two different occupations of the site over some 4,500 years. The first occupants were pre-Neolithic people who lived primitively and

did not farm. Early Neolithic people of the second occupation gradually came to the cultivation of crops, the domestication of animals and such crafts as pottery and basket making.

cial fabric is reflected in the burial practices. The dead were buried under the floors of the houses or in pits in the yards outside. Many more women than men are buried in the rooms. This was their domain, where they had lived and worked. The women, it seems, had specific parts of space bounded by the limits of the house; their territory was a frame for their activities. John Gold of Oxford Brookes University sees this territoriality as a fundamental expression of social organization. The role boundaries established in life were maintained after death. The skeletal changes indicating how women spent their days—grinding, spinning, making baskets and mats—reflect a commitment in terms of time and economics that constitutes role specialization.

The very division of roles may have encouraged people not immediately immersed in preparing food to develop crafts. Crop cultivation, in fact, created its own challenges. Water had to be conveyed to seedlings for irrigation; ani-

mals had to be kept from destroying the crops; and harvested grain had to be transported. These problems provoked the exploration of technologies to solve them. Vessels, fences and baskets were devised, and certain people became expert in making them.

At Abu Hureyra, we see a progression of changes that can be understood in the light of such innovations. The

improvements brought problems that called for further innovations. There was a constant progress toward a better life—a striving that continues to this day. Abu Hureyra represents the first step on the path toward civilization. But signs of wealth, class, elite institutions and scholarship have not been found in this settlement. We must look for them elsewhere.

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