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ANCIENT CROP HUSBANDRY AT KAMAN-KALEHÖYÜK: 1991 ARCHAEOBOTANICAL REPORT

Summary

Forty-six samples of charred plant remains were collected by flotation. Of these, six have been chosen for analysis: five Middle Bronze Age samples and one Ottoman period sample. The samples are dominated by cereal grain, rachis remains and straw remains. Bread wheat is the main crop, with smaller amounts of two-row hulled barley. Einkorn is sufficiently common in the Middle Bronze Age samples to suggest it too was a crop; emmer wheat (in the Middle Bronze Age) and rye (in the Ottoman sample) may just have been tolerated weeds. The abundance of both grain and chaff in the samples suggests they may be the remains of fodder that has entered the archaeological record through the burning of dung as fuel. There are abundant dung remains in the medieval sample. These samples obviously do not represent the whole range of agriculture at the site; however, small numbers of other crops are present: bitter vetch, lentil, pea, chickpea and grape. The abundance and excellent condition of the plant remains demonstrates that large-scale flotation at Kaman-Kalehöyük will be rewarding.

Introduction

Excavations on the central Anatolian plateau have recovered a wealth of information on the cultures of the first and second millennia B.C. The development of literate civilisations, the development of economically and politically sophisticated city states and empires, and the importance of trade and craft specialisation, are all well documented in excavations at sites such as Kültepe, Boğazköy and Gordion. However, we still know virtually nothing about the relationship between the agricultural economies of these civilisations and the wider political and economic developments. This is particularly unfortunate since agriculture formed the basis of the economy. The excavations at Kaman-Kalehöyük therefore offer a welcome opportunity to look at plant remains from a long archaeological sequence that spans most of this period.
The site

Excavations at Kaman-Kalehöyük began in 1986, directed by Dr. Sachihiro Omura under the auspices of the Middle Eastern Culture Centre in Tokyo. The site lies 3 km east of the town of Kaman, in Kırşehir province of central Turkey (fig. 1). The mound is large, with a circular base 280 metres in diameter, rising to a flat top 16 metres above ground surface. The top of the mound is 1069 metres above sea-level. Average annual rainfall at Kaman is 350 mm, more than ample for productive dryland farming.

Two areas of the mound are being excavated. An area exposure of some 4,000 square metres on top of the southern half of the mound has uncovered extensive Ottoman occupation, with late Iron Age  architecture immediately below. A step trench, currently 25 metres wide, extends down the northern side of the mound (Mikami and Omura 1991) and has reached the Middle Bronze Age. All the samples come from this trench except for sample 24, from the south exposure.

The latest architectural layer (Period I) is the 16th–17th century A.D. Ottoman village. Extensive areas of houses and streets have been excavated in both trenches. Byzantine and Roman pottery was recovered in the preliminary survey of the site and an extensive Roman necropolis lies just east of the mound, but no deposits of these periods have been found in excavation. The Ottoman village lies directly above the latest phase of the Period II levels; evidently the mound was largely abandoned in the intervening two millennia.

The architectural levels of Period II span the Iron Age and Achaemenid periods, c. 1200–400 B.C. The deepest part of the north trench has now reached Late and Middle Bronze Age layers of the Hittite Old Kingdom and Assyrian Colony periods. Very little Hittite Empire material (1400–1170 B.C.) has so far been found on the mound. A small area transitional between Early Bronze Age and Middle Bronze Age cultures has recently been excavated (c. 2050–1930 B.C.); precise dating awaits further excavation. Survey work suggests that extensive Early Bronze Age material will be found as the north trench is deepened.

No extensive burnt level comparable to the Kimmerian destruction at Gordion has been found, but excavation has uncovered numerous smaller episodes of burning. At present, inevitably, little is known about the spatial relationships and functions of the structures in the narrow north trench.

The samples

In 1989 and 1990 Hitomi Hongo, project zooarchaeologist, collected 46 samples for flotation, consisting of small volumes (1 to 10 litres) of soil contexts that were
clearly ashy or rich in charred plant remains. For the purposes of this preliminary study, these samples were hand floated. Soil was mixed with water in a bucket, 5 litres at a time, and as the seeds and charcoal floated to the top, they were poured into a 0.7 mm mesh. After drying, the lots were sieved through a 1 mm mesh and, in order to save time, only the material larger than 1 mm has been studied.1 All the samples were rich in charcoal. Samples from 12 contexts contained seeds; of these the richest six were selected for study.

Three periods are represented: three samples from the Assyrian Trading Colony period (1930–1730 B.C.); two samples from the Hittite-Assyrian Colony transitional period (c. 1700 B.C.), and one sample from the Ottoman period (16th–17th century A.D.).

The plant remains

Results of the analysis are given in tables 1 and 3. In all, 4938 seeds and chaff fragments were analysed. Some samples were partially sorted (50% or 12.5%), and the figures for these have not been multiplied up in the tables. Since the main purpose of this first study was simply to get an indication of the archaeobotanical quality of the material, weed seed identifications are not given. Most of the weed seeds represent common agricultural weeds, but the abundance of *Stipa* (feather-grass) seeds is unusual.

Identification criteria

Wheat

Three cultivated species are present, of which by far the most common is bread wheat. Identification of the grains as those of a free-threshing wheat (e.g. bread wheat or macaroni wheat) is based on their rounded, uncreased flanks and rounded cross-section, and on their greatest width being at the embryo end of the grain. There is considerable variation in shape, with many very compact grains, some bordering on spherical. As is usual with ancient free-threshing wheat grains, most are less than 5 mm long, and there is much variation in size. Two grains are shown in figure 2.1 and 2.2; note slight grooving on the flanks of the second grain. Although this is a typical emmer character, the overall appearance of the grain is certainly that of a free-threshing wheat. Some overlap in characters is typical, but the overall appearance is distinctive.

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1 Once full-scale archaeobotanical work starts at the site, a pump-driven flotation machine will be built, and lots will be collected on the standard mesh size of 0.3 mm.
The identification of bread wheat (*Triticum aestivum*), rather than of macaroni wheat (*T. durum*), is based on the chaff remains. The appearance of the rachis segments, which form the central “stalk” of the cereal spike, is highly diagnostic. In this case, the flared, somewhat obovate “shield” shape of the rachis segments, the longitudinal creases down each side, and the thin “lips” left below the glume bases after the glumes break off (fig. 2.3) all unequivocally point to bread wheat. The Kaman bread wheat would have been broadly similar to the traditional bread wheat landraces that still grow in central Turkey today. The ancient grains are, however, markedly shorter than those of current day bread wheats.

The graph of internode lengths (fig. 3) shows that the Kaman internodes fall most often into the 2–2.49 mm class of length. The internode length is important because it is the main character that separates bread wheat (*T. aestivum*) from club wheat (*T. compactum*). Bread wheat has lax ears, typically with about 20 spikelets in an ear 6–18 cm long; club wheat has more compact ears, with roughly the same number of spikelets compressed into a spike 3.5–6 cm long (Percival 1921: 60). Naturally the internodes of club wheat are much shorter than those of bread wheats. How do the lengths of the Kaman internodes compare to those from other sites, and to modern uncharred material? So far, we only have substantial numbers of measurements from one other site, Early Bronze Age Dilkaya in eastern Turkey (unpublished work of the author). At Dilkaya mean lengths of bread wheat internodes in two samples were 3.04 mm and 2.99 mm; an asymmetrical distribution of lengths means that these averages are disguising modes of around 3–3.6 mm. The Kaman internodes are markedly smaller (average 2.61 mm, mode 2–2.5 mm).

Comparison with modern material is complicated by the effects of charring, which shrinks rachises (Villaret-von Rochow 1967: 33–37). Even allowing for this, the Kaman rachises, like the Dilkaya material, seem to fall between the size of recent club wheat internodes and bread wheat internodes, and I doubt that they could usefully be referred to either species; I have therefore used the term “bread wheat” in its broadest sense, to mean a hexaploid free-threshing wheat. As more internodes become available for measurement, we should be able to determine whether two types of bread wheat, comparable to bread wheat and club wheat, were in fact grown at Kaman, and investigate the degree of variation in internode length between different sites. As the key morphological character of club wheat, the compact spike, is controlled by a single gene, it may well be a

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2 Internode lengths have been measured using the system of Stefanie Jacomet (1989: fig. 5): from the point at which the lower end joins the next internode (often the point at which the rachis breaks) to the point at which the torn off surface of the glume base meets the edge of the internode. This is easier shown than described: the points are marked by the two arrows in figure 3.2 in this paper.
Ancient crop husbandry at Kaman-Kaleköy: 1991 Archaeobotanical Report

Table 2. Measurements of wheat chaff from Kaman-Kaleköy.

a. Breadwheat internodes.

<table>
<thead>
<tr>
<th>Sample 22</th>
<th>min.</th>
<th>1.87</th>
<th>1.29</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=12</td>
<td>avg.</td>
<td>2.61</td>
<td>1.65</td>
</tr>
<tr>
<td></td>
<td>max.</td>
<td>3.94</td>
<td>2.11</td>
</tr>
<tr>
<td>Sample 24</td>
<td>min.</td>
<td>1.40</td>
<td>1.13</td>
</tr>
<tr>
<td>n=24</td>
<td>avg.</td>
<td>2.61</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td>max.</td>
<td>4.68</td>
<td>2.03</td>
</tr>
</tbody>
</table>

b. Einkorn and emmer wheat spikelet forks (samples 22 and 28).

<table>
<thead>
<tr>
<th>Spikelet</th>
<th>Width</th>
<th>Scar</th>
<th>Glume</th>
<th>Relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>mm</td>
<td>Width</td>
<td>Width</td>
<td>Width</td>
</tr>
<tr>
<td></td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
</tbody>
</table>

| Einkorn – sub-terminal spikelet forks | min. | 1.73 | 0.47 | 0.37 |
| n=7 | avg. | 1.33 | 0.48 | 0.54 |
|     | max. | 1.44 | 0.51 | 0.62 |
| Einkorn – standard spikelet forks    | min. | 1.09 | 0.55 | 0.47 |
| n=84 | avg. | 1.48 | 0.81 | 0.61 |
|     | max. | 1.83 | 1.09 | 0.74 |
| Einkorn – all spikelet forks         | min. | 1.09 | 0.43 | 0.47 |
| n=91 | avg. | 1.47 | 0.78 | 0.60 |
|     | max. | 1.83 | 1.09 | 0.74 |

| Emmer – standard spikelet forks      | min. | 1.44 | 0.62 | 0.70 |
| n=8 | avg. | 1.63 | 0.79 | 0.82 |
|     | max. | 1.95 | 0.98 | 1.05 |

relatively recently evolved form of wheat, and therefore one which would not turn up in the archaeological record. One point of interest is that the internodes from the Ottoman sample KL 24 and the Middle Bronze Age KL 22 have similar lengths.

The glume wheats, einkorn and emmer, are both represented. These more "archaic" forms (in that they more closely resemble their wild ancestors) are quite distinct from the free-threshing wheats. The glumes (outer husk of each spikelet) are tough and the joints between the rachis segments are relatively weak; therefore on threshing the spikes break up into spikelets, in which the grains are still enclosed by the glumes.

Here the einkorn and emmer remains have survived mainly in the form of spikelet forks. A spikelet fork is the heavy, woody base of the spikelet which survives charring; in contrast, the lighter chaff, such as the palea, lemma and
upper part of the glumes usually burns away (fig. 6.1). The usual criterion for separating einkorn and emmer spikelets—the appearance of the top of the glume—cannot be used, as this part only rarely survives in charred material, and we must turn to more subtle criteria. Two main characteristics were used:

a. Appearance of the glumes in side view (fig. 6.2, 6.3). In einkorn these have a smooth glossy appearance. Although numerous longitudinal splits usually appear in the surface of the lateral part of the glumes, these are clearly not integral creases or veins. In emmer the surviving part of the glumes has a matt appearance, with clear longitudinal veining or striations.

b. Overall appearance in front view. In einkorn, this is more sinuous and gracefully curved. There is usually a marked corner where the glumes merge with the rachis. In emmer the glumes tend to have straighter lines and merge imperceptibly with the rachis.

While the above criteria have been used to identify the Kaman spikelet forks, two numerical characters have been used as an independent control:

c. Glume width. Measured in side view, at the level of the rachis scar (fig. 6.1); this is Helbæk’s “dimension B” (Helbæk 1970: 205). This measurement has given excellent results with mixed populations of einkorn and emmer spikelets from Chalcolithic sites, with only slight overlap between the two populations. Here the results (fig. 4, 5) are less clear as there are so few emmer spikelets. However, a good separation is apparent. A slight degree of overlap around 0.7 and 0.74 mm is typical.

d. Relative scar width. The disarticulation scars of emmer and einkorn are much the same width; however, as the einkorn spikelet is overall rather narrower, its scar width is therefore relatively larger. In modern populations relative scar width (width of the scar divided by width of the spikelet at the same level) gives good separation. This is rarely the case in ancient samples, as figure 5 shows for the Kaman material. However, the graph does isolate a group of einkorn spikelet forks with very narrow scar widths (fig. 6.3). These are from the penultimate spikelets at the top of the einkorn spike. The terminal spikelet in einkorn is small and sterile (and rarely survives charring), resulting in only a small scar on the spikelet below.

Only a few emmer and einkorn grains were recovered (fig. 2.4). Some einkorn grains were exceptionally narrow, and probably represent wild einkorn.
Barley

The morphology of the barley grains and the internodes points clearly to two-row hulled barley, the most common barley of central Anatolia today. The grains are straight (occasionally with slightly asymmetrical furrows, but with a regular overall appearance; figure 6.4). The small number of twisted grains suggests that fields may have contained a few plants of six-row hulled barley, identifiable by its distinctive twisted lateral spikelets. However, there are no chaff remains from this type. All the Kaman barley internodes have the small, clearly separate lateral spikelet nodes, flanking the separate large central nodes, that characterise 2-row barley.

Rye

Two of the Ottoman grains had the unmistakable bullet shape of rye (fig. 2.5).

Pulses

Only a few pulses were seen, but all belong to easily identifiable species (bitter vetch, lentil, pea, chickpea).

Fruits

Only two kinds are represented. More examples of the grape pip will be necessary before it becomes clear whether wild or domesticated types are present; the evidence from the texts (and archaeobotany at other sites) is that vines were extensively cultivated by the Middle Bronze Age.

Hawthorn trees are common in woodland and as remnants of woodland in central Anatolia, and the fruits are still eaten by shepherds.

Dung

Sample 24 (Ottoman) contains numerous fragments of dung and dung ash. The partly charred dung fragments consist of a tangled mass of plant tissues (resembling fragments of leaf and straw) gummed together. The white lumps of ash are similar under high magnification, except that they have a hard, white, siliceous
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appearance. Both classes of material match well to ashes from modern dung fires, and to ancient dung from Early Bronze Age Dilkaya.

Taphonomy of the samples

The abundance of weed seeds, rachis fragments and culm nodes makes it immediately clear that we are not looking at stored, clean grain samples of the kind often found, for example, in burnt pots. Since the "seed" material is mixed with large amounts of fuel (twiggy charcoal, dung), it seems as if the plant remains are entering the archaeological record either after being burnt as fuel, or after burning for refuse disposal. In either case, it is the byproducts of crop cleaning that are being burnt.

The interpretation of any of these samples as straightforward waste-byproducts is complicated by the presence of large quantities of grain. For example, sample 22 contains 147 wheat internodes, 46 culm nodes and 103 weed seeds. These would seem to indicate that we are dealing with the coarse sievings of a cereal crop; that is, the fraction retained in a large mesh that allows the grain to fall through (Hillman 1984: 10) However, the sample also contains 336 wheat grains, an unacceptably high number to lose into the byproduct fraction. One possibility is that we have the remains of whole sheaves of wheat being burnt, but this still does not explain the large number of grains, or the fact that the ratio of grain: internodes varies so much between samples. Although everyday charring of floor sweepings leads to the charring of a similarly eclectic range of charred material, the density, basic uniformity in composition, and consistently good preservation of these seeds argues strongly against random processes of preservation.

There is one deposition route that leads to the charring of large quantities of chaff and grain: the burning of dung. When fodder is given to farm animals, undigested seeds and other plant tissues pass intact through the animal gut and are excreted as a component of dung (for examples of studies on the seed content of modern dung, see Bottema 1984, Miller 1984). If the dung is gathered and burnt as fuel, the seeds will be charred and enter the archaeological record. Similarly, if chaff is mixed with the dung before burning (common practice today), this too will be charred. I have interpreted a very similar assemblage of seeds from the Early Bronze Age site of Dilkaya, on Lake Van, as the remains of dung burning.

Only sample 24 actually contains dung remains, but its composition is otherwise similar to that of the other samples and it seems reasonable to conclude that.

2. 1, 2. Bread wheat grains KL 28; 3. Bread wheat internode KL 24. The arrows show the points from which the internode length is measured; 4. Einkorn grain KL 5; 5. Rye grain KL 24.

I have not yet measured any of the Kaman grains, but the overall impression is of large, prime, grain rather than small, runt, grain.
Table 3. Summary scoresheet and ratios for Kaman-Kalehöyük.

<table>
<thead>
<tr>
<th>Period</th>
<th>Old Hittite</th>
<th>Assyrian Colony</th>
<th>Assyrian Colony</th>
<th>Ottoman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample number</td>
<td>7</td>
<td>11</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>Litres floated</td>
<td>10</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>% sorted</td>
<td>50</td>
<td>100</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

**CEREALS (CORRECTED)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Grain</th>
<th>Spikelet forks</th>
<th>Internodes</th>
<th>Cereal culms</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Einkorn</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>Einkorn</td>
<td>14</td>
<td>2</td>
<td>3</td>
<td>44</td>
<td>11</td>
</tr>
<tr>
<td>Emmer</td>
<td>9</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Bread wheat</td>
<td>106</td>
<td>10</td>
<td>16</td>
<td>112</td>
<td>11</td>
</tr>
<tr>
<td>Barley</td>
<td>44</td>
<td>0</td>
<td>0</td>
<td>44</td>
<td>0</td>
</tr>
<tr>
<td>Cereal</td>
<td>20</td>
<td>44</td>
<td>0</td>
<td>144</td>
<td>0</td>
</tr>
</tbody>
</table>

**PULSES**

| Total | 11 | 0 | 2 | 6 | 3 | 0 |

**FRUITS**

| Total | 0  | 1 | 1 | 1 | 1 | 0 |

**WEED SEEDS**

| Total | 171 | 11 | 132 | 103 | 97 | 63 |

**RATIOS**

- Glume wheat – grain: Spikelet forks: 1:3.3:0.2:1:0.6:1.45:1.7:3
- Bread wheat – grain: Internodes: 1:0.3:1.5:2:1:0.1:1:0.4:1.0:2:1.4:3
- Barley – grain: Internodes: 1:0.1:0.1:0.0:3:4:0:1:0.1:17:0:1:6:0

* Grain fragments have been allocated to whole grain scores on the assumption that the relative proportions of species in both the whole and fragmented classes is the same. Thus, if one third of the intact grains in a sample is barley, I have assumed that one third of the fragmented grains is barley too.

In the light of a taphonomic consideration of the samples, we cannot assume these archaeobotanical samples are representative of the food plants in use. A much wider sampling programme will be necessary for that. But is there anything we can say about Middle Bronze Age farming?

- Bread wheat, two-row hulled barley and einkorn are certainly crops. The abundance of einkorn in sample 28 suggests it is more than just a contaminant of bread wheat. Emmer may be a crop contaminant. Of the pulses, bitter vetch, lentil, pea, and chickpea were grown, but we can say nothing about the relative quantities. Similarly, from this small suite of samples we can say nothing about fruits, oil-plants and spices.

How does the Kaman material compare to other second millennium sites? Little more information is available to us now than when Hoffner summarised the archaeobotanical evidence in 1974 (Hoffner 1974: 56–59), drawing mainly on plant remains recovered in west and southeast Anatolia. However, the conclusions he drew, that bread wheat and two-row hulled barley are the important cereals from the third millennium onwards, are borne out by this study.

Two further sets of plant remains have been studied. Seven samples, reported by van Zeist (1988) and Hillman and Nesbitt (unpublished study), are available from Ikiztepe, a large settlement mound on the Black sea coast. The four samples from early levels (currently assigned to the Early Bronze Age) are all dominated by emmer. The three Middle Bronze Age samples that contain cereals are dominated by free-threshing wheat (bread/macaroni wheat). While the number of samples is small, they certainly suggest a shift to free-threshing wheat by the end of the Early Bronze Age. Exactly where the einkorn of Kaman-Kalehöyük fits into this pattern of change is unclear; it was cultivated by farmers at the village of Alaca Höyük until 1970 (Gordon Hillman, personal communication) and may...
well have survived in central Turkey after it became extinct elsewhere. For example, it disappears from sites in southeast Turkey at the beginning of the Early Bronze Age. Two samples have been published from Late Bronze Age (14th to 13th CBC) storage deposits at Boğazköy (Hopf, 1992). They consist of naked barley, emmer wheat and free-threshing wheat grains. At present, it is difficult to assess how these two small samples fit into the wider picture outlined above.

In the Iron Age there is evidence from other sites of a major change. Summer crops such as common millet (*Panicum miliaceum*) and foxtail millet (*Setaria italica*) appear (Nesbitt and Summers 1988), opening up a new season of cultivation. Unlike winter crops such as wheat, barley and the common pulses, summer crops need a hot growing season. They are planted in early summer, harvested in late summer. The exact period in which summer crops appeared in central Anatolia, whether they were irrigated, and their economic impact, are questions that will be addressed using the long archaeobotanical sequence from Kaman.

Although there is just one medieval sample, it has some intriguing features. Emmer and einkorn are virtually absent, which may mirror its decline in central Turkey by this time, and there is more dung in the sample than charcoal. This may reflect increased reliance on dung and, thus, increased deforestation, but more samples are needed.

**Agriculture in the ancient texts**

Historians and archaeologists of the historic period in the Near East often hold the view that there is no need to collect seed or bone material from excavations because better information is already available in the texts. In the main part of this paper, I have aimed to demonstrate that archaeobotany has the potential to look at site taphonomy and, more broadly, economic and environmental change. In comparison I would like to look at the potential of textual evidence to address the same questions.

There are two main sources to be considered: tablets found at Hittite sites, and those from Assyrian sites.

**Hittite texts**

Many tens of thousands of inscribed tablets have been excavated at Bogazköy, the Hittite capital, spanning the period from the 17th to the 12th century B.C. Almost all of these are concerned with diplomacy, law, religion or myth.

Although agriculture is often referred to, there are few details and little quantitative economic data.

The standard textbooks consider Hittite agriculture to be a straightforward matter: the texts show that emmer wheat and barley were the main crops; peas, beans, onions, flax, figs, olives, grapes, apples, apricots, and possibly pears, medlar and pomegranates were also grown (Gurney 1990: 65–66; Macqueen 1986: 96–97).

However, Hoffner’s authoritative survey (1974) of all Hittite texts referring to food or agriculture demonstrates two things: firstly, that the meanings of around half the words used for food plants in Hittite texts are still completely unknown; secondly, that most of those identifications made are but tentative hypotheses. In practice, it has only been possible to suggest identifications where Hittite scribes used a Sumerogram; that is, a Sumerian term as a shorthand substitute for a Hittite term. This requires two assumptions; firstly that the meaning of the Sumerogram is the same as it was in Sumeria, and secondly, that the word has been correctly identified by Sumerologists in the first place.

Hoffner finds that seven words may refer to cereals: one word is prefixed by a Sumerogram that may indicate “wheat”; one is similarly prefixed by “barley”. Hoffner (1974: 68–69) considers the wheat term (ZIZ) to be a general term for wheat, or possibly even a specific term for bread wheat, rather than the specific meaning of emmer wheat that it has in Mesopotamia. If this identification is correct – and the archaeobotanical evidence from Kaman-Kalehöyük for the overwhelming abundance of bread wheat strongly supports it – then the presumed role of emmer in Hittite agriculture turns out to have no support in the texts.

Five fruits can be fairly reliably identified, as the Sumerograms are well known in Sumerian texts (Postgate 1987b), and there are ample confirmatory details in the Hittite texts (e.g. that grapes are used to make wine, that figs are sweet and full of seeds). These are: grape, fig, date, pomegranate and olive. Dates would have to be imported from southern Syria or further south; olives could come from the Mediterranean coast or parts of southeast Turkey. Other identifications, such as plum, apricot, apple and cornel remain tentative, and at least 10 words used in Hittite texts for fruit and nuts remain untranslated.

For the pulses, Hoffner offers words for lentil, chickpea, bitter vetch and broad bean. The identity of all these words is still doubtful (Postgate 1987a; Stol 1985), although there is evidence from Kaman-Kkalehöyük that at least the first three crops were indeed grown. For vegetables and garden plants, Hoffner identifies cumin, coriander, cucumber, leek, onion and garden cress.

There are occasional references in the texts to crop processing: harvest with sickles, threshing, winnowing, and storage of grain and chaff. Irrigation of fruit trees is mentioned once, irrigation ditches are referred to twice. There are many
references to centralised bread-making activities. Food is sometimes described, although identifications are often obscure, and many practices are clearly strictly for ritual purposes. Beer and wine are made.

Assyrian texts

In Mesopotamia cuneiform tablets are found from 3200 B.C. onwards. Before 2000 B.C. tablets are written in Sumerian (the source of the Sumero-Sin vocabularies used in the Hittite period); after 2000 B.C. in Akkadian ("Babylonian" dialect in southern Mesopotamia, "Assyrian" in the north). In contrast to the Hittite texts, many tablets deal with agricultural matters (usually in the context of trade and land tenure), and these have generated a large literature on the agricultural economics of ancient Mesopotamia (e.g. the *Bulletin on Sumerian Agriculture*, 1984–). However, although of ancillary interest, they tell us nothing about what was happening in Anatolia.⁴ Equally, Mycenaean Greek Linear B tablets are of the right period, but are likely to be of peripheral relevance to central Anatolia.

Potential of the textual evidence

Hoffner’s work shows that the textual evidence has limited potential in identifying or quantifying the cereal crops. Even the most basic identifications are unclear. The textual data could prove useful for vegetables and spices, which are usually under represented in the archaeological record.⁵ Once a good corpus of archaeobotanical results has been collected, we may be able to reassess the meanings of words for food plants in the Hittite texts.

Texts have little more to offer for crop husbandry: the agricultural year and the techniques of crop husbandry are so well known from ethnographic work that the scanty details of the texts have little to add. Irrigation is briefly mentioned in three texts, showing that it was practiced by the Hittites, but only archaeobotanical work will show whether it was applied on an economically significant scale (i.e. to field crops).

For foods the texts are more useful: there is much information on bread, beer and wine, and if this can be tied in with excavation of food preparation areas, the texts will help flesh out the picture. However for a regional or diachronic perspective on agriculture and food, we must look to archaeological data.

Conclusions

This study has had two purposes: to demonstrate that Kaman-Kalehöyük has the potential to give a good archaeobotanical sequence and, secondly, to show that the archaeobotanical data has archaeological relevance to the Bronze Age levels of Kaman.

Three main aims can be defined for the Kaman archaeobotanical studies:

1. To test the hypotheses that significant agricultural change took place in the period 2000–600 B.C., and to integrate this with wider economic and political changes. Specific questions include:
   a. What crops were grown (and wild foods harvested)? Which were the most important?
   b. What were the techniques of crop husbandry? Was a high-input regime (e.g. with irrigation) in practice?
   c. To what extent did crop species and crop husbandry techniques change through time? How much regional variation was there?
   d. How were plants used for food?

2. To investigate spatial distribution of plant remains, both in secondary contexts and in burnt levels.

3. To look at vegetation change through the charcoal (and dung) record.

The quantity and quality of the plant remains are amongst the best that I have seen from any site. Even with just six samples, good evidence for the range of species grown, and the taphonomy of the samples, has been obtained. When large scale sampling and machine flotation begin at the site in 1992 a much wider sampling program will be possible. This should recover a range of samples that are more representative of human plant use, including *in-situ* food deposits from the burnt areas (pots of grain have been seen during excavation, but not yet sampled).

A good sequence of material also has potential to address the vexed question of Bronze Age and Iron Age chronology. Grain samples have the great advantage for radiocarbon dating of representing just one season's growth, in contrast to charcoal which could consist of rings spanning a number of years, from a tree cut

⁴ Old Assyrian texts dating between 1910 and 1780 B.C. have been excavated from Assyrian trading colonies in Anatolia, at Kültepe, Alişar and Boğazköy (Lewy 1971: 709). They record the routine business correspondence of the traders with Ashur, in their Mesopotamian homeland. A few brief, highly ambiguous, references to cereals throw no light on contemporary agriculture in Anatolia (Hoffner 1974: 59).

⁵ For a rare case in which unusual conditions of preservation led to the recovery of a wide range of fruits and vegetables, see Cheryl Haldane's work on the archaeobotany of the Late Bronze Age Ulu Burun shipwreck (Haldane 1990).
in old age and then reused several times. Individual dates for the historic period are of limited value owing to the large error limits, but a sequence of radiocarbon dates from a 1500 year sequence would be a valuable cross-check on the historical chronology.

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Ancient crop husbandry at Kaman-Kalehöyük: 1991 Archaeobotanical Report


