

# Plant stores at pottery Neolithic Höyücek, southwest Turkey

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## Abstract

Eleven samples comprising an estimated 39,000 plant remains were analysed from a burnt destruction level at the pottery Neolithic site of Höyücek, southwest Turkey (radiocarbon dated 7550–7350 uncalibrated bp, 6400–6100 calibrated BC). Large stores of emmer (*Triticum dicoccum*), free threshing wheat (*Triticum aestivum/durum*), lentils (*Lens culinaris*), bitter vetch (*Vicia ervilia*) and chickpea (*Cicer arietinum*) were identified and these plants were interpreted as crops. The low levels of weeds and crop processing by-products suggest most of the samples were remains of stores of human food. Two samples in which wild components (for example, *Triticum boeoticum*, *Medicago*, *Aegilops*) dominated were interpreted as crop processing by-products, presumably stored for fodder. The presence of these stores in a structure interpreted as having a religious function shows that domestic activities also took place there. Comparison with other Neolithic and Chalcolithic sites of west central Turkey demonstrates a good correspondence in the range of crops. The poor representation of barley at Höyücek doubtless reflects the small number of samples from the site.

## Özet

Türkiye'nin güney batısında yer alan neolitik yerleşim Höyücek'teki (Karbon 14 ile G.Ö. 7550–7350 [uncalibrated], MÖ 6400–6100 [calibrated] tarihlenmektedir) yaklaşık 39,000 bitki kalıntısını temsilen 11 örnek incelendi. Önemli miktarda emmer buğdayı (*Triticum dicoccum*), kolay harmanlanan bir tip buğday (*Triticum aestivum/durum*), mercimek (*Lens culinaris*), acı bakla (*Vicia ervilia*) ve nohut bitkisi (*Cicer arietinum*) belirlendi ve bu bitkiler mahsul olarak yorumlandı. Bu mahsul içinde yabancı otların ve yan ürünlerin düşük miktarlarda bulunması, elde edilen örneklerin pekçoğunun insan gıdası barındıran ambarlara ait kalıntılar olduğunu göstermektedir. İçinde yabancı otların çoğunlukta olduğu iki örnek ise (ör. *Triticum boeoticum*, *Medicago*, *Aegilops*) mahsulün işlenmesi sırasında ortaya çıkan ve muhtemelen hayvan yemi olarak depolanan yan ürünler olarak yorumlandı. Bu ambarların bir yapı içindeki varlığının dini bir fonksiyonu olduğu şeklinde yorumlanması, bu alanlarda yaşandığını da göstermektedir. Bu veriler Türkiye'nin orta-batısında yer alan diğer Neolitik ve Kalkolitik alanlar ile karşılaştırıldığında, genel mahsul skalasına uygun bir ilişki göstermektedir. Höyücek'te az miktarlarda arpa bulunması ise, kesinlikle bölgeden alınan örneklerin azlığından kaynaklanmaktadır.

Excavations and surveys in the 'lake district' of southwest Turkey have identified an abundance of Neolithic settlements (Duru 1999). Archaeobotanical reports have appeared for several of these sites, including pottery Neolithic Höyücek (preliminary report only), Erbaba and early Chalcolithic Hacilar and Kuruçay (Helbaek 1970; van Zeist 1983; Nesbitt 1996; Nesbitt, Martinoli in press). Nevertheless, the number of archaeological excavations where plant remains have been studied remains low in this area.

Professor Refik Duru of Istanbul University excavated the settlement mound of Höyücek from 1989 to 1992 (Yakar 1994; Duru 1995a; 1995b). The excavation of 1,100m<sup>2</sup> uncovered the remnants of three architectural phases. The archaeobotanical material originated from storage contexts or accumulations from the 'temple phase', radiocarbon dated to 7550–7350 uncalibrated bp (6400–6100 calibrated BC). The architectural remains consisted of two double roomed rectangular mud-brick buildings, and some other less well

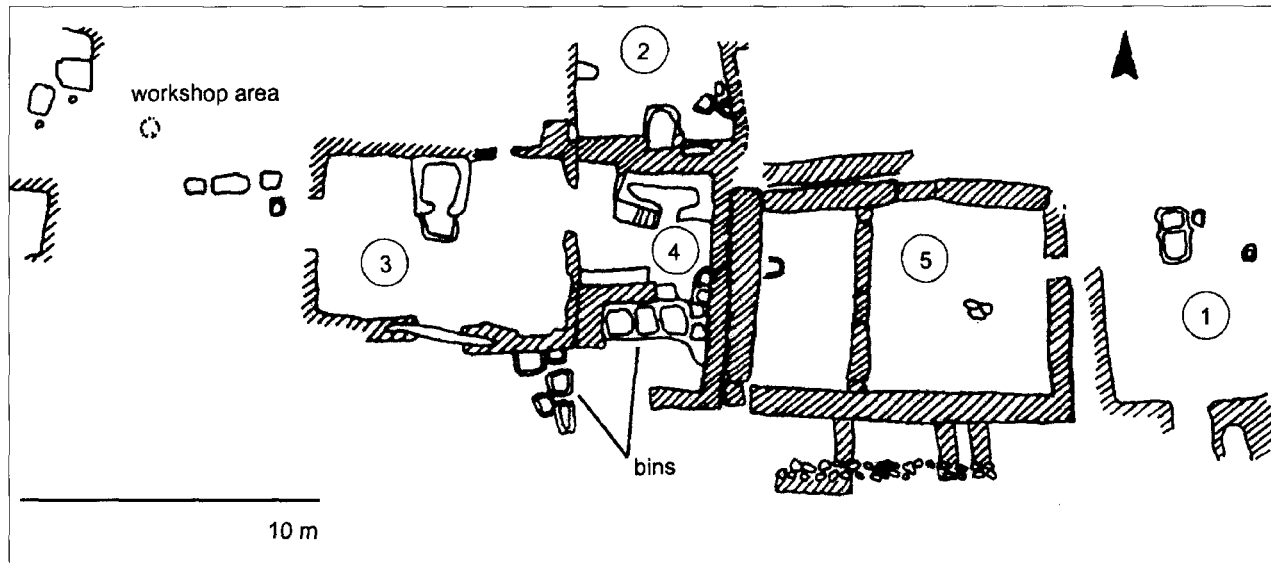


Fig. 1. Plan of the 'temple phase' at Höyücek (after Duru 1995b) with structures 1 to 5

preserved surrounding features (fig. 1). The facts that there were no other constructions on the mound and that the small finds have sacred qualities suggest a religious function of the structure.

The charred plant stores from pottery Neolithic Höyücek are welcome evidence for the state of agriculture and plant use during this early period. However, a sampling regime focused mainly on visible accumulations gives us little basis for a detailed analysis of the patterns of plant resource use. On the other hand, the investigation of plant stores raises interesting methodological questions related to the handling and quantification of this kind of find.

### Sampling and identification methods

Eleven samples were collected from visible accumulations of charred material. Nine samples (samples 1, 2, 3, 4, 5, 7, 9, 10 and 11) derived from a small room interpreted as a 'shrine' (structure 4; fig. 1) and lined in its southern part with clay storage bins: sample 5 came apparently from the proximity of the bins; samples 2 and 7 were collected inside the bins; and the exact locations of the others are unknown. Sample 6 was recorded as coming from the adjoining room (structure 3) and sample 8 originated from the nearby 'workshop' area.

The samples were submitted for analysis in unfloatated condition. To make their sorting easier, they were dry sieved in the laboratory and split into three size fractions ( $>2\text{mm}$ ,  $>1\text{mm}$  and  $<1\text{mm}$ ). The fruits, seeds and other plant parts were sorted under the microscope (magnification 6 to 40 times) and identified with the help of the reference collection housed at the Archaeobotany Laboratory, Institute of Archaeology, University College London. The nomenclature used here follows the tradi-

tional binomial system for the cereals and pulses (Zohary, Hopf 2000: 24) and the *Flora of Turkey and the Aegean Islands* for the wild plants (Davis 1965–1988).

In order to save time, the numerous crop seeds and seed fragments in the  $>2\text{mm}$  and  $>1\text{mm}$  fractions were sub-sampled. The fractions were split with a riffle box into sub-samples of 50%, 25% or 12.5%. These sub-samples were sorted until they comprised between 380 and 500 botanical macro-remains, considered to be reasonably representative of the sample's main components (van der Veen, Fieller 1982). The fragments of cereals and legumes were converted into an estimate of whole grains (see quantification section). Other less abundant remains were entirely sorted from each fraction. The  $<1\text{mm}$  fraction was checked, but had no identifiable seeds. Table 1 gives a summary of the plant remains found in each sample, with the dimensions of the main components given in table 2.

### Quantification

Whole seeds and fruits dominated the Höyücek assemblage. Fragmentation was nonetheless common in several samples, especially for the bitter vetch and lentil seeds, and for the einkorn and emmer wheat grains. Estimating the quantity of whole seeds represented by fragments is a common problem in archaeobotanical research, especially for stored grains and pulses (Jones et al. 1986; Hillman et al. 1995).

When only a few pulse fragments were present ( $<10$ ), their conversion into whole equivalents has been estimated visually. When the bitter vetch and lentil fragments were more numerous, their weight has been converted to the equivalent entire seeds, using the average weight of the whole seeds present in the same sample.

For the hulled wheat caryopses, we tested two common methods of conversion into whole grains: i) the counting of the only fragments bearing a diagnostic feature (in this case the embryo end) as whole grains; ii) the conversion of the weight of all the fragments into whole grains using an average thousand grain weight (TGW) calculated using the whole caryopses present in the same sample.

The absolute number of converted whole grains showed a remarkable difference between the methods. The first resulted in a clear underestimate of the total number of grains (table 3, fig. 2). The second gave a more accurate minimum number of grains present, but was more time consuming. It required the identification of each fragment before weighing, and this still left a large number of unidentified fragments. In addition, this method can only be used when enough whole grains are present in the corresponding sample, or at least assemblage, to allow the calculation of a satisfactory TGW (see table 2).

Even so, both methods resulted in an obvious dominance of einkorn over emmer grain fragments (embryo end counting: 1,460 einkorn/0 emmer converted whole grains; TGW: 3,481 einkorn/10 emmer converted whole grains). The ratios were even greater than for the whole caryopses (2,241 einkorn/275 emmer whole grains). So we can postulate that the fragmentation rate was different for each species: the einkorn caryopses break more easily, probably due to their thin and elongated shape, and are thus over represented in the fragments.

The results for the hulled wheats presented in table 1 have been calculated with the second quantification method (TGW method). The glume bases were each counted as equivalent to 0.5 spikelet forks.

### The sample composition

The eleven archaeobotanical samples consisted almost exclusively of charred seeds or fruits and other fruiting parts, mixed with clay fragments, wood charcoals and sometimes mollusc shells. According to their main component, we could group them into five categories (table 1), detailed here.

#### The einkorn wheat samples

Samples 1 and 4, both from structure 4 interpreted as a 'shrine', had a very similar composition. They also comprised the most varied assemblage with 13 plant taxa. Compressed lumps of agglomerated seeds and chaff, as well as free elements, were simultaneously present. Einkorn, probably a wild type, *Triticum boeoticum*, was the principal element represented, with more caryopses (5,722) than spikelet forks and glume

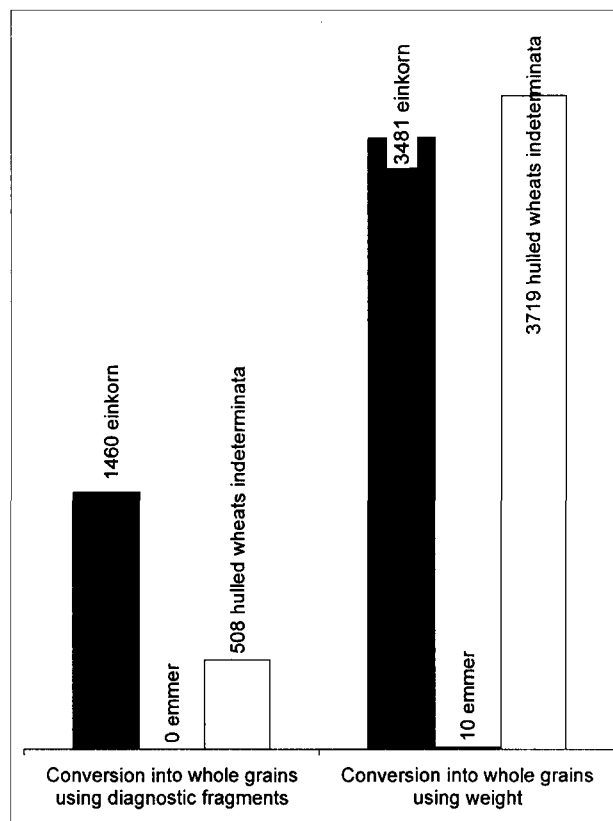


Fig. 2. Comparison between the conversion of fragments in whole caryopses using the 'diagnostic fragments' and the 'weight' method (figures for samples 1 and 4)

bases (1,161, among which 190 were identified as certainly wild, the remaining were of unidentified status). The grains were spindle shaped in dorsal and lateral views, having pointed ends and being widest in the middle. The transverse section was a narrow oval; sometimes one side was slightly concave. The charred grains were matt, bearing distinct striations left by the glumes. The grains found in the assemblage generally belonged to one-grained spikelets. Only 4.6% of the grains had the box shaped cross-sections (straight ventral and dorsal faces) typical of two-grained spikelets (fig. 3.3).

The identification of the einkorn caryopses as a wild type was based on their extreme lateral compression. However, a broad range of thickness of caryopses was observed (fig. 3.1, 3.2), raising the question of the presence of a mixture of wild and domesticated specimens. The compilation of the breadth and thickness measurements of einkorn grains identified as wild versus domestic from several sites in Turkey, Jordan and Syria resulted in a good discrimination (Peltenburg et al. 2001). The same attempt was made with the Höyücek einkorn grains. The plot diagram in fig. 4 represents the distribution of the thicknesses:

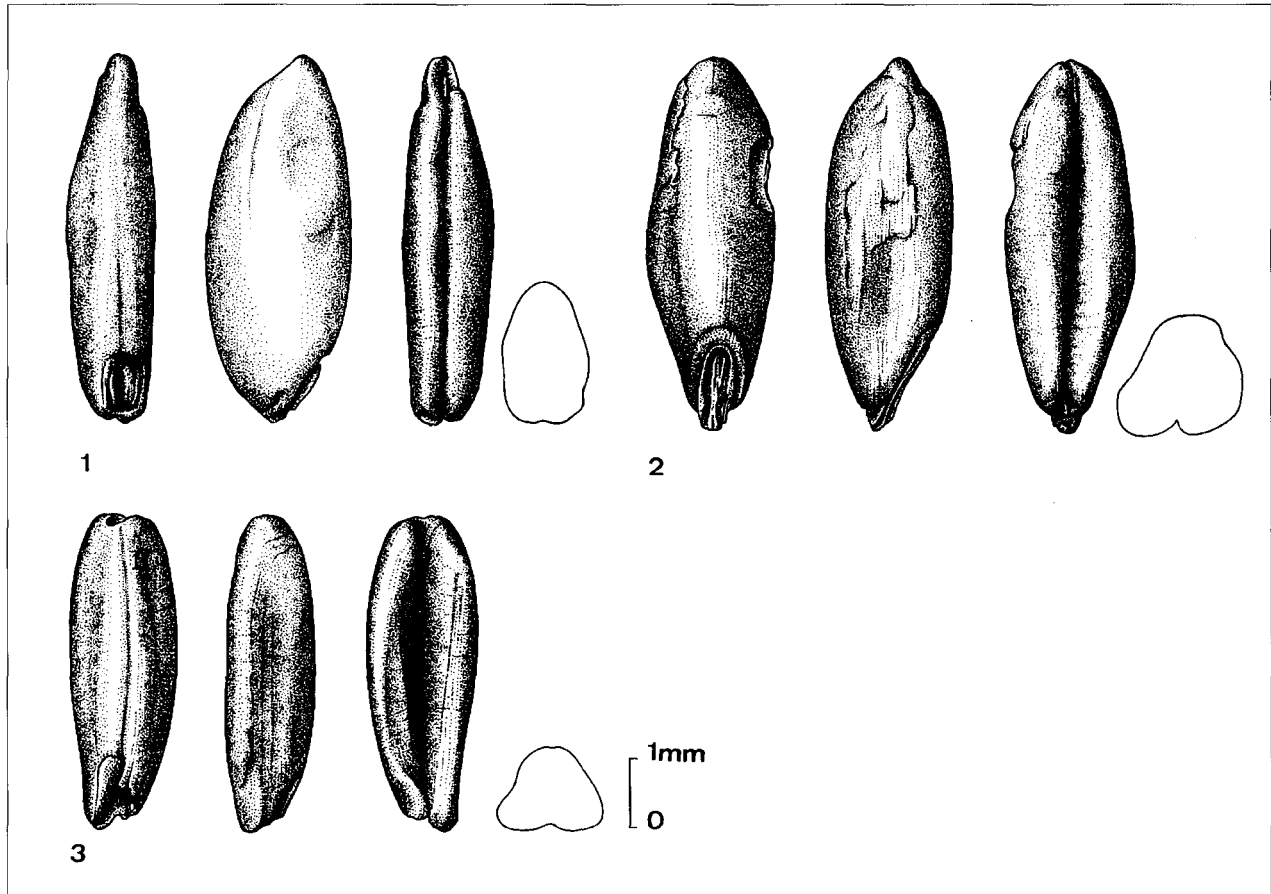


Fig. 3. Wild einkorn (*Triticum boeoticum*) grains. (1) Narrow type (one-grained spikelet); (2) wide type (one-grained spikelet); (3) grain from two-grained spikelet. Drawn by Jane Goddard

breadth of the Höyücek einkorn grains, compared to the subjective attribution to a morphologically narrow 'wild' type or wide 'domestic' type. It shows no clear separation, but rather a broad overlap between the two groups. In comparison with the dimensions of einkorn grains identified as wild (only 10 measurements available) and domestic in ceramic Neolithic Erbaça and early Chalcolithic Kuruçay (no measurements are available from Hacilar), the majority of the Höyücek grains are in the zone of wild einkorn, although some overlap occurs with grains identified as domestic einkorn. Compared to the einkorn caryopses from the Levantine sites (Peltenburg et al. 2001), the narrow einkorn grains from Höyücek are similar in breadth to the wild ones, but are thicker, whereas the wide grains are more similar in size to domestic einkorn. In summary, the einkorn grains uncovered comprise a whole range of forms from a thin 'wild' type, to wider specimens resembling the domestic type.

Wild type chaff remains have been recovered, but no definite domesticated type einkorn chaff. The identification of the threshing remains was based on the general shape, the level and angle of insertion of the glumes, the

shape, orientation and location of the disarticulation scar, the glume width and the shape of the glumes in transverse view (Nesbitt 1993; Hillman et al. 1995). Many einkorn spikelet forks had a clean and smooth scar, typical of a brittle ear (fig. 5.1 to 5.4) and have therefore been attributed to a free shattering wild einkorn wheat (*Triticum boeoticum*). The size and orientation of the disarticulation scar was variable and two types have been recognised: i) a standard spikelet type with narrow scars forming an almost flat angle with the rachis (fig. 4.1); ii) a sub-basal spikelet type with wide scars forming a pronounced angle with the rachis (fig. 4.3). Measurements of the glume width (in lateral view) show a good homogeneity among the Höyücek specimens, although they are clearly thinner than those of modern wild einkorn, possibly an effect of carbonisation. The variability of the relative scar width supports our view that a range of spikelet forks from basal to apical position in the ear was present (fig. 6). In view of the exclusively 'wild' type chaff remains, we consider the variability in grain size to be the result of charring of wild einkorn grains, not the presence of domesticated einkorn grains.

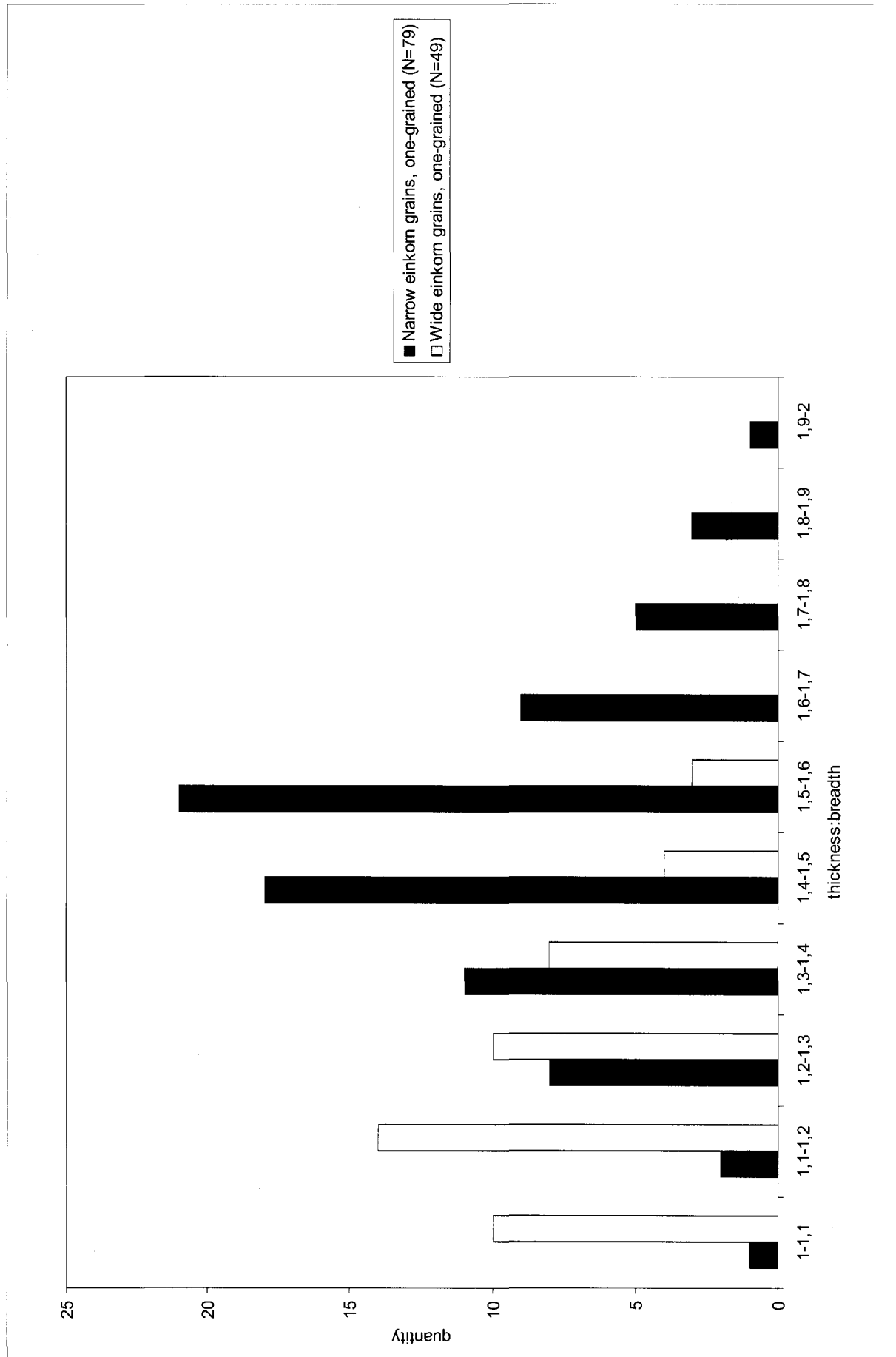


Fig. 4. Distribution of thickness : breadth ratios of einkorn grains showing no clear separation between narrow and wide caryopses



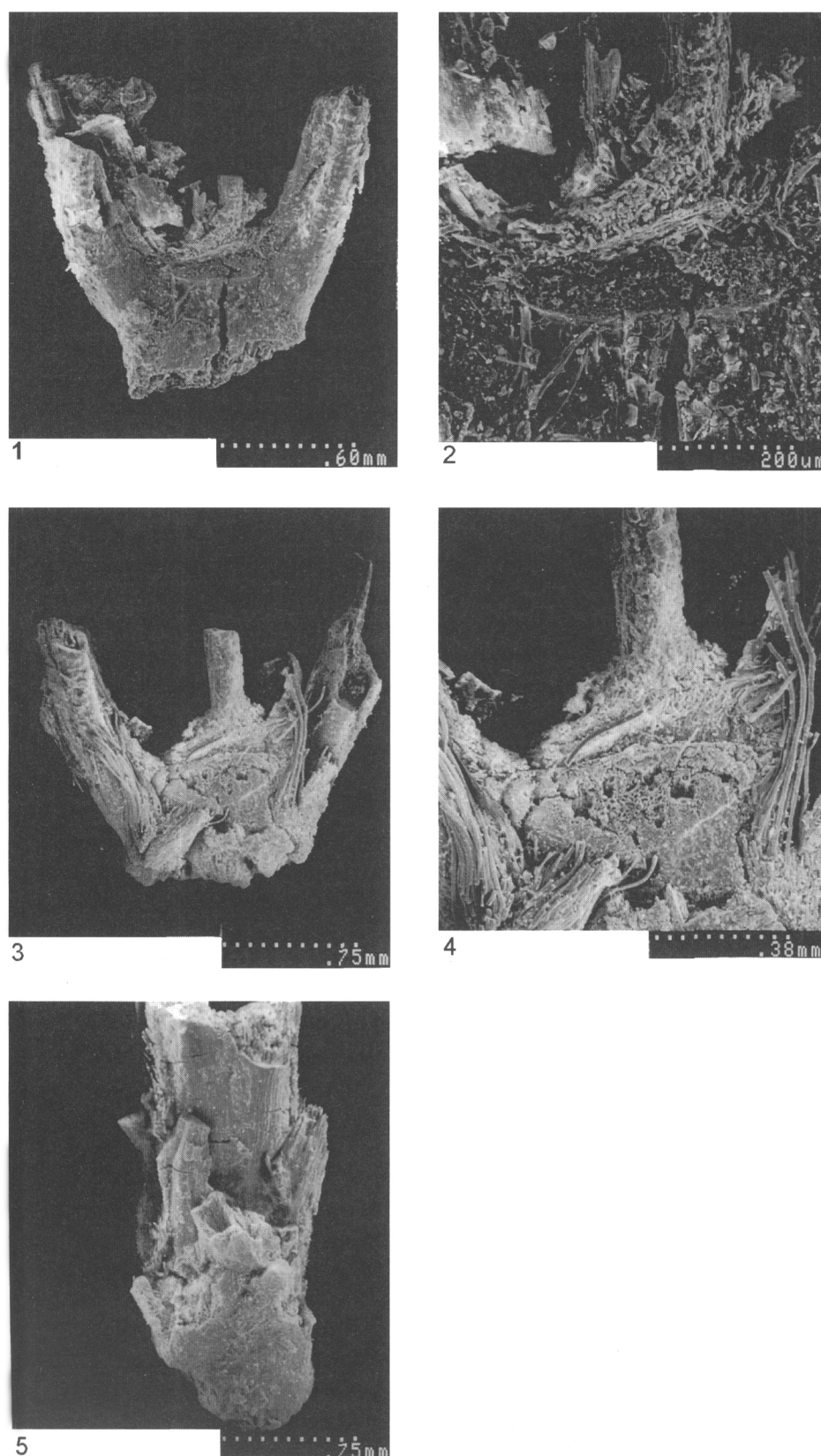


Fig. 5. Scanning Electron Micrographs. (1) Wild einkorn (*Triticum boeoticum*) standard spikelet fork with detail of the clean, smooth scar in (2); (3) wild einkorn (*Triticum boeoticum*) sub-basal spikelet fork with detail of the clean, smooth scar in (4); (5) tough rachis fragment of rye (*Secale cereale*)

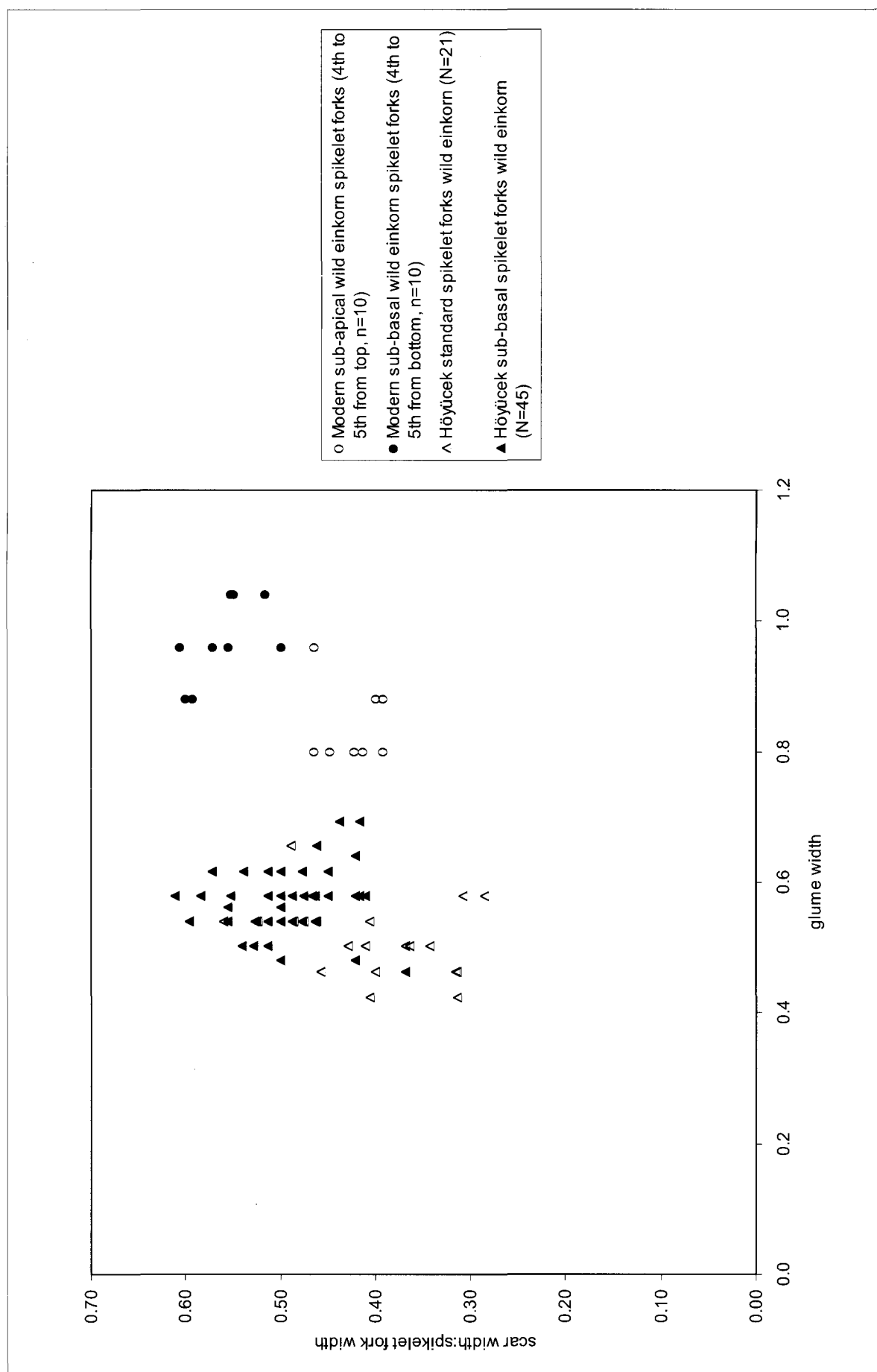


Fig. 6. Scatter diagram of glume width over the scar width : spikelet forks width ratio of fossil and modern einkorn showing that a range of spikelet forks from basal to apical is respresented

The second important component of this category of samples was the seeds (651) from a *Medicago* species. They were laterally compressed, reniform to cordate with a smooth surface. The hilum was small and round, sitting in a notch. Fragments of slightly falcated pods, sometimes with seeds still in situ, were also present. Their venation was weak and the broad suture vein was often the only part surviving. No precise identification has been attempted due to the lack of modern comparison material. It is nonetheless certainly a wild pulse with indehiscent fruits, similar to *Medicago*. These finds are of some interest, perhaps indicating storing of crop by-products, more improbably the use of a local and unique medic crop or the deliberate gathering of large quantities of seeds from wild stands.

The third important component of these two samples was emmer wheat (285 caryopses, three spikelet forks). The caryopses were of a typical domesticated type (*Triticum dicoccum*) with a flat to concave ventral surface, pointed embryo end, blunt to rounded apex and, often, clear compression lines preserved towards the embryo end. The dorsal surface had a more or less well preserved hump just above the embryo. The caryopses were rather thin (table 2). Most of them came from two-grained spikelets (many pairs of emmer caryopses have been preserved in the position they have in a two-grained spikelet) and 2.4% from one-grained spikelets (with a convex ventral face). Only terminal spikelet forks of emmer were present among the chaff, identifiable by their rachis rotated 90° relative to the glume base.

Fragments of rye rachis have also been uncovered in these samples. The shape of the upper part of the rachis segment is diagnostic, showing the insertion points of the glumes laterally low under those of the grains and providing a typical triangular shape to this part (fig. 5.5). The rachis is very thin in side view and the different segments are smoothly fused. Typical for a non-shattering rye is the break in the middle of a segment, rather than between the segments. The identification of rye fits well with recent evidence for its presence as an early domesticated cereal, albeit one that was not necessarily grown as a pure crop. Today, several weedy rye forms exist in Turkey with non-shattering, semi-shattering and fully-shattering components (Zohary, Hopf 2000), and domesticated rye is often a tolerated weed of wheat.

Among the grains, several caryopses from a free threshing cereal attributed to *Secale* or *Triticum* have been found, with a blunt apex, straight and parallel flanks and a rather high embryo cavity (fig. 7.2). The typical transverse cell pattern of rye, however, could not be observed, even at high magnification. A few grains of hulled barley (*Hordeum vulgare*) were also present.

Most of the other wild plants uncovered were common agricultural weeds and were present only in small numbers, apart from goatgrass (*Aegilops*). *Aegilops* glumes (19) and caryopses (163) were present. The grains were oval in ventral view, slightly spindle shaped but thin in profile. The cavity of the embryo was broadly rounded. The grains have only been identified to genus level because of the great similarity between the various *Aegilops* species. The shape of the glumes has allowed somewhat better identification. Narrow at the base, wide in the upper part, strongly veined, the glumes are fused in a largely rounded and funnel shaped spikelet. Comparison with modern material has shown most similarities with *Aegilops umbellulata*, a common weed in Turkey, although *A. geniculata* and *A. columnaris* are also potential identifications.

Three fragments of terebinth nuts (*Pistacia*) were recovered in these samples, bearing the characteristic feature of the hilum depression. In addition, isolated remains of bitter vetch, grass pea and lentils have been found.

In summary, the 'einkorn samples' contained a majority of einkorn (grains and chaff) with 'wild' characteristics, although the presence of 'domestic' type grains cannot be excluded, together with wild small seeded legume (seeds and pods), domestic emmer (mainly grains) and wild *Aegilops* (grains and chaff). They have a mixed character, with the presence of a whole range of minor taxa.

#### *The free threshing wheat samples*

Samples 5 and 7 from structure 4, found respectively near the bin and inside the bin, have been labelled as 'free threshing wheat samples'. The wheat grains were stored almost in a pure state (7,695 of a total of 7,747 items), only some lentils, a few indeterminate cereal rachises and three weed seeds were present.

The identification of the free threshing wheat is based on the curved and smooth flanks, rounded apex and embryo end of the caryopses in ventral view (fig. 7.1). The grains tend also to be broader than they are high, but there is considerable variation in shape with rather elongated or compact grains (table 2). The caryopses come from a free threshing wheat, either tetraploid or hexaploid (*Triticum aestivum/durum*). Only one rachis fragment bearing the diagnostic features for the identification of the ploidy level (Hillman 2001) has been identified (in sample 10). The shield shape and the presence of two veins running down the abaxial face of the rachis fragment point to a hexaploid form (*T. aestivum*), but the abscission parts of the glumes are badly preserved, preventing a reliable identification.



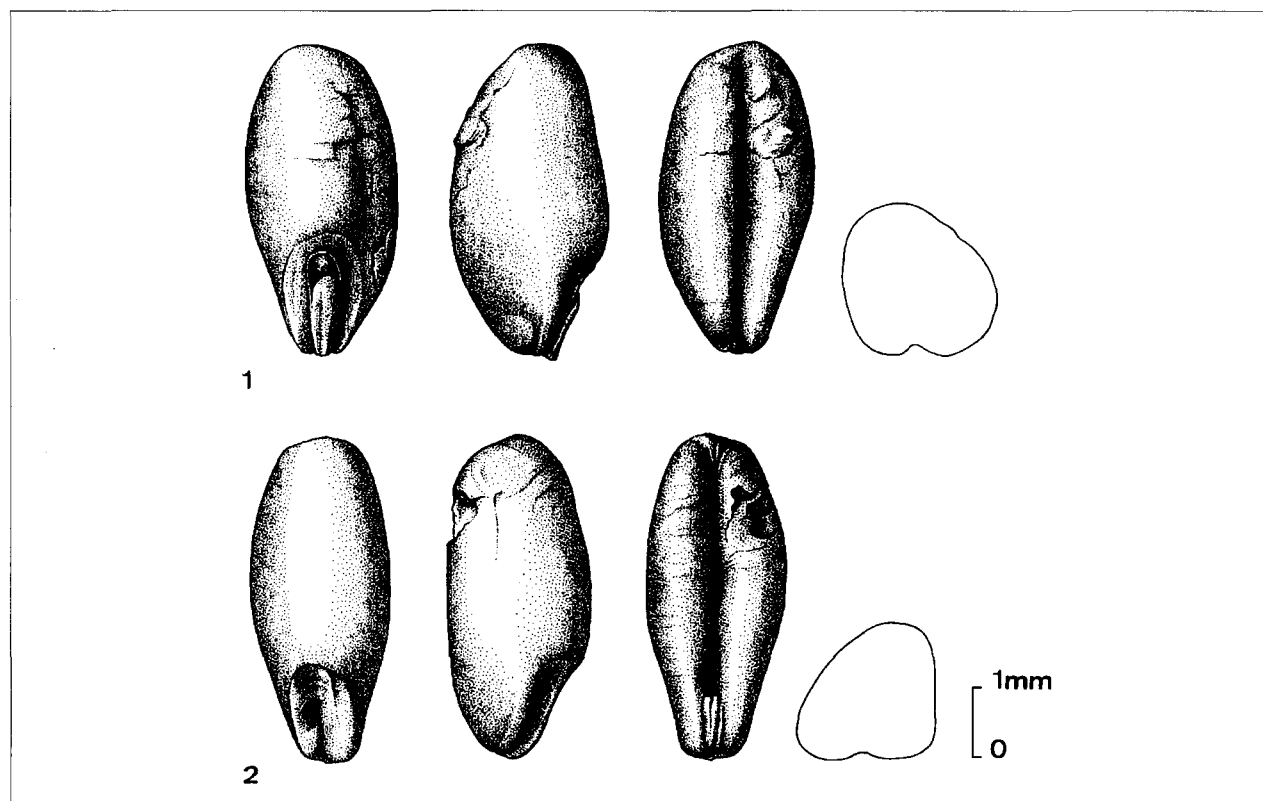


Fig. 7. (1) Free threshing wheat grain (*Triticum aestivum/durum*); (2) possible rye grain (*Secale/Triticum*). Drawn by Jane Goddard

#### The lentil samples

Sample 6 from the room adjacent to the shrine (structure 3) and sample 9 from structure 4 have a similar composition, dominated by lentils, with a fair amount of einkorn and emmer wheats, whereas sample 11 (structure 4) is almost exclusively comprised of lentils. The lentil seeds are sub-circular in side view, elliptical in cross-section and show strong lateral compression with a marginal hilum and radicle. The testa surface, where it was preserved, was smooth. The Höyücek specimens varied in length from 2.16mm to 3.28mm, with an average value of 2.76mm (table 2). Although the size of these lentils is still small, their presence as such a large amount and together with domesticated wheats, suggests domesticated status (*Lens culinaris*).

In addition to einkorn and emmer grains and chaff, some hulled and naked barley grains, naked wheat grains, bitter vetch grains, *Aegilops* and a few other wild plants have been recovered from these samples.

#### The bitter vetch samples

The bitter vetch seeds are the main components of samples 2 (from inside a bin), 3 and 10, all coming from structure 4. Seeds of this species have a characteristic tetrahedric shape, with a radicle extending from the top onto the base of the seed in the middle of one face. Other

pulses present in the samples are grass peas, lentils and peas. The grass pea (*Lathyrus*) diaspores are laterally compressed with a rectangular or triangular rounded profile, depending on their position in the pod. The base of the seed is flattened and the top is sharp. Many of them are 'axehead' shaped. The grass pea seeds of this type can belong to several species, but regarding their size range (table 2), domestic *Lathyrus sativus* can be excluded. Only three pea seeds (*Pisum*) have been recovered. The seed coat is lacking, so we cannot tell if they are wild or cultivated. The samples contained a few other weed and cereal taxa.

#### The chickpea sample

The chickpea sample was found outside the building, in a 'workshop area'. It was very clean, dominated by chickpea and lentil grains, with some bitter vetch grains and fragments of rye rachis. The chickpea seeds are sub-rectangular, with lobed cotyledons and a shortly projecting radicle. The seed coat, when preserved, is smooth. Seed morphology and size are compatible with *Cicer arietinum* and its wild progenitor *Cicer reticulatum*. Because the area lies well outside the modern natural distribution of the wild progenitor in southeast Turkey, the chickpea seeds from Höyücek have been attributed to *Cicer arietinum*.

## Interpretation

### *Taphonomy and the nature of the samples*

The charring of the plant remains probably happened during one or a few fire episode(s) and the plant assemblage is therefore unlikely to be representative of the range of plants used throughout the site and over the seasons. However, some evidence about the nature and provenance of the samples can be gathered. Indication from one sample from inside the bins showed that a fully processed and very clean free threshing wheat store was present in structure 4 (sample 7). This cereal was presumably grown as a pure crop. The other free threshing wheat sample contained also lentils, but this probably resulted from post-depositional mixing. The second bin sample comprised a fully processed and clean bitter vetch store, although with some admixture of grass pea and lentil seeds. The two other bitter vetch samples showed a recurrent association between bitter vetch, lentils and grass pea. These different pulse species most probably grew together in the fields and were, intentionally or not, stored together. As indicated by the total absence of weeds and harvesting by-products, the bitter vetch/lentil/grass pea store was probably destined for fodder or for human consumption after detoxification by leaching and cooking. The frequent association between the different pulse taxa in the samples could suggest deliberate mixed cropping, a relatively common practice reported in ethnographic reports (Butler 1992), or a high degree of contamination of the fields. However, it does not necessarily mean that the different pulses were used together. They could still be separated with a later sieving or sorting (Jones, Halstead 1995).

The chickpea sample is almost pure, apart from the presence of lentil seeds and several bitter vetches. Chickpeas had, probably, a cultivated status. With only one sample, we cannot say if these plants grew together, or if the mixture resulted after deposition.

In the case of the lentils, the presence of glume wheats in two of the three samples showed that there was no recurrent association between the two crops. In contrast, bitter vetch seeds seem to be regularly present in the lentil samples, attesting once again the close association existing between the different pulse crops. The mixture with glume wheats and *Aegilops* remains probably resulted after deposition, in disturbances associated with the destruction fire.

The nature of the hulled wheat samples is more puzzling. All the remains are relatively large, the cereals, grasses and legumes have been charred as spikelets or respectively as pods, and probably result from the same processing stage. However, the number of caryopses is much higher than that of chaff remains, although this

could be attributed to the better survival of the grains than the chaff in charring, as demonstrated experimentally by Boardman and Jones (1990).

Most wild einkorn wheat populations found today in central Anatolia are weedy forms, growing in disturbed areas such as fieldsides. Its past natural distribution probably did not include southwest Turkey (Nesbitt, Samuel 1996; Zohary, Hopf 2000). Local harvesting of wild einkorn stands is therefore unlikely, particularly in view of the fact that Höyücek represents a well developed Neolithic economy with established cultivation of cereals. The dominance of wild components and the high variety of taxa could instead point to a harvesting by-product. We suggest that wild einkorn weeds infested an emmer harvest, together with *Medicago*, *Aegilops* and some other weeds. The contaminants were separated from the crop by coarse sieving, in which most of the emmer spikelets were retained, but the narrower einkorn spikelets (and some smaller emmer spikelets, especially the apical ones) fell through and were stored for later use, possibly as fodder. The broad range of wild einkorn grain size could result from a co-evolution with the emmer crop, leading to a certain mimetism or to hybridisation. Why these samples were present in the 'shrine' remains open to question.

### *Regional context*

Plant remains from other Neolithic and Chalcolithic excavations in west central Anatolia are shown in table 4. For the cereals, the presence of both naked and hulled wheats at Höyücek is typical of Anatolian sites from the pre-pottery Neolithic to the Chalcolithic period. Naked wheats (*Triticum durum* and *Triticum aestivum*) appear in Turkey from the pre-pottery Neolithic B (PPNB) onwards, and are present at nearby earlier sites such as Can Hasan III (Hillman 1978) and Aşıklı Höyük (van Zeist, de Roller 1995).

The presence of rye fits well with recent evidence for rye as a Neolithic domesticated cereal, although one that may not have been cultivated as a pure crop until much later. Domesticated rye is known from PPNB levels at Can Hasan III and from Abu Hureyra in northern Syria (de Moulins 1997), but is present at few Near Eastern sites.

Both hulled and naked barley are present, but only as contaminants, and their true status at Höyücek is unknown. At earlier sites in the pottery Neolithic period, such as Çatalhöyük (Helbaek 1964; Fairbairn et al. 2002) and Erbaba, naked barley is the most common form. At pottery Neolithic Can Hasan I (Renfrew 1968, personal observations) and in the Early Chalcolithic sites, hulled barley is dominant. The relatively abrupt appearance of naked barley towards the end of the PPNB period and its

disappearance before the Chalcolithic period is highly puzzling. The grain of naked barley is much easier to process for food, because it does not have the silica rich inedible lemma and palea ('hull') bonded to the grain. In hulled barley, the hull must be removed before consumption by humans. In principle, naked barley is a more satisfactory crop if (as appears to be the case throughout Turkish prehistory) it is being grown for human consumption. The absence of barley stores at Höyücek is almost certainly a chance result of recovery of plant remains from a small area of destruction.

Bitter vetch and lentil are present at Höyücek and well established at PPNB and pottery Neolithic sites. The status of chickpea in the pottery Neolithic has been rather ambiguous. It occurs in small quantities at Neolithic sites, so the large, pure sample at Höyücek is an important record, suggesting that it is cultivated by this time, rather than being gathered from the wild. The status of pea is also ambiguous: although abundant at some sites, the morphology of the seed coat (not preserved in the Höyücek material) suggests that wild peas (possibly cultivated) were involved. As at other pottery Neolithic sites, the grass pea seeds may represent the occurrence of *Lathyrus cicera* as a weed. The domesticated form of grass pea (*Lathyrus sativus*) is first documented in this area at the late Chalcolithic site of Kuruçay (Nesbitt 1996).

### Conclusions

Structures 3 and 4 (fig. 1) in particular have been interpreted as shrines because of the presence of altar-like features and small finds such as marble bowls (Duru 1995a; 1995b). The recovery of plant stores presumably intended for human consumption and for fodder show that the building was also used for stores that relate to domestic activities. The presence in structure 3 of an oven and a group of mortars and querns outside a door to structure 3, suggest that domestic activities such as food processing and preparation also took place here. So, if these buildings were used for religious practices, they also had a function in the storage and processing of food and fodder plants.

The study of 11 store samples gave just a small insight into the plant use of a Neolithic community in southwest Turkey. The evidence of large scale crop storage combined with the standardised shape and size of some crop seeds led us to the conclusion that agriculture at Höyücek was well established. However, with the archaeobotanical data obtained, it is not possible to understand the pattern of plant production and use for this site. The role of wild plants such as fruits, nuts, seeds and possibly roots and tubers, for example, should not be underestimated, although the small number of samples did not reveal their presence at Höyücek.

### Aknowledgements

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Sample Location	1	4	4	5	7	6	9	11	2	3	10	8
	4	4	4	4	4	3	4	4	4	4	4	8
Main component	Einkorn	Naked wheat	bin	Lentils	Bitter vetch	Chickpea						
<b>Cereals - grain</b>												
Plant part												
Einkorn 'wild' 1 and 2 grained grain	3698	2024				62	238					Total
Emmer 1 and 2 grained grain	218	67				93	204					6022
Hulled barley grain	1	2					5					582
Naked barley grain								1				8
Free threshing wheat grain				616	7079		9					1
Rye/wheat (cells indistinct) grain	2	13										7704
Cereals (unidentified) grain							10					15
Hulled wheat grain	3360	625				113	362		2			12
												4460
<b>Cereals - chaff</b>												
Einkorn (wild) spikelet forks (incl. glume bases)	158	32				6						196
Einkorn (status uncertain) spikelet forks (incl. glume bases)	844	127				11						982
Emmer spikelet forks (terminal)	1	2										3
Free-threshing wheat rachis												1
Rye rachis	10	6										18
Cereals indet. rachis fragments				2								2
Hulled wheat spikelet forks (incl. glume bases)	56	24				7			1			88
<b>Pulses</b>												
Bitter vetch seed	1.5	2				10	8	55	660	2433	562	10
Chickpea seed												3741.5
Grass pea seed		1							91		22	511
Lentil seed	7	7	46	1	7050	464	5702		35	28.5	34.5	114
Pea seed									3			13724
Large pulse seed	1								44		36	3
												100
<b>Nuts</b>												
Terebinth nut seed/fruit fragments	1	2										3
<b>Wild plants</b>												
Goatgrass whole glumes	6	13										19
Goatgrass grain in spikelet		2										2
Goatgrass grain	130	31					17					178
Brome grass grain	1											1
Galium seed								1				1
Liliaceae seed											1	1
Medicago-type seed	415	236										651
Polygonaceae seed	1		1				1					3
Buttercup seed												1
Vaccaria pyramidalis seed		1										1
Unidentified seed	2	3										82
<b>Total</b>	8912.5	3221	663	7084	7410	1316	5778	835	2463.5	656.5	891	39230.5

Table 1. Plant remains recovered at Höyücek



		SW (mm)	SFW (mm)	GW (mm)	SW:SFW		
<b>Wild einkorn chaff</b>	min.	0.39	0.96	0.42	0.29		
standard spikelet forks (N=21)	aver.	0.58	1.40	0.51	0.41		
	max.	0.85	1.73	0.65	0.56		
	min.	0.54	1.28	0.46	0.37		
sub-basal spikelet forks (N=45)	aver.	0.75	1.52	0.57	0.49		
	max.	0.96	1.85	0.69	0.61		
		L (mm)	B (mm)	T (mm)	L:B	T:B	average TGW
<b>Wild einkorn caryopses</b>	min.	4.32	0.80	1.60	2.69	0.96	
narrow caryopses 1-grained (N=80)	aver.	5.32	1.31	2.05	4.12	1.58	4,17 (N=1290)
	max.	6.64	2.08	2.40	6.50	2.30	
	min.	4.00	1.04	0.96	2.86	0.85	
narrow caryopses 2-grained (N=17)	aver.	5.09	1.49	1.54	3.47	1.05	4,05 (N=95)
	max.	5.76	1.84	2.00	4.62	1.92	
	min.	3.60	1.28	1.44	2.12	1.00	
wide caryopses 1-grained (N=49)	aver.	4.20	1.67	2.04	2.54	1.23	
	max.	4.72	2.08	2.40	3.12	1.50	
	min.	3.76	1.52	1.52	2.03	0.80	
<b>Domestic emmer caryopses</b>	min.	3.76	1.52	1.52	2.03	0.80	
2-grained (N=74)	aver.	5.34	2.22	2.20	2.42	1.00	10,27 (N=178)
	max.	6.16	2.72	2.80	3.29	1.62	
	min.	5.36	1.92	2.16	2.58	1.08	
1-grained (N=4)	aver.	5.68	2.02	2.34	2.82	1.16	
	max.	5.84	2.08	2.56	2.96	1.33	
	min.	3.28	1.52	1.52	1.45	0.83	
<b>Free-threshing wheat caryopses</b>	min.	3.28	1.52	1.52	1.45	0.83	6,18 (N=1213)
(N=57)	aver.	4.05	2.29	2.24	1.79	0.98	
	max.	4.88	3.00	2.72	2.27	1.24	
<b>Lentil seeds</b>	min.	2.08	1.20	2.16			6,41 (N=2516)
	(N=60)	aver.	2.75	1.63	2.76		
		max.	3.36	2.08	3.28		
<b>Bitter vetch seeds</b>	min.	1.84	1.76	1.92			7,55 (N=3067)
	(N=60)	aver.	2.35	2.21	2.40		
		max.	2.88	2.76	2.96		
<b>Grasspea seeds</b>	min.	2.24	1.60	2.48			
	(N=73)	aver.	3.27	2.86	3.36		
		max.	4.16	3.72	4.32		
<b>Chickpea seeds</b>	min.	3.60	2.80	2.48			
	(N=12)	aver.	4.04	3.33	3.02		
		max.	4.56	3.56	3.36		

Table 2. Measurements of the cereals and pulses from Höyücek. Key: SW scar width; SFW spikelet fork width; GW glume width; L length; B breadth; T thickness; TGW thousand grain weight

Sample	Taxon	(1) Embryo end fragments		(2) All fragments, converted to whole grain equivalent using TGW			(3) Whole caryopses	
		quantity	%	weight	quantity	%	quantity	%
1	einkorn	772	100.00	7.84g	2024	99.61	1674	88.85
	emmer	0	0.00	0.06g	8	0.39	210	11.15
	Total	772	100.00		2032	100.00	1884	100.00
	<i>Indet</i>	344		15.2g	3182		178	
	<i>hulled wheat</i>							
4	einkorn	688	100.00	4.44g	1457	99.86	567	89.71
	emmer	0	0.00	0.02g	2	0.14	65	10.28
	Total	688	100.00		1459	100.00	632	100.00
	<i>Indet</i>	164		3.12g	537		88	
	<i>hulled wheat</i>							

Table 3. Comparison of grain counts reached by (1) counting embryo ends of fragments, (2) weighing fragments and converting using 1,000 grain weights, compared to (3) counts of whole grains

Site	Aşıklı Höyük	Can Hasan III	Çatalhöyük	Erbaba	Hacılar (VI)	Höyücek	Can Hasan I	Hacılar (III-I)	Kuruçay
Period	Pre-Pottery Neolithic B	Pre-Pottery Neolithic B	Pottery Neolithic	Pottery Neolithic	Pottery Neolithic	Pottery Neolithic	Pottery Neolithic	Early Chalcolithic	Late Chalcolithic
Years uncal. BP	8900-8500	8400-7700	7850-7600	7800-7400	7700-7400	7550-7350	7500-7000	7300-7000	6700-6550
Einkorn	*	*	+++	+	*	-	-	*	+
Emmer	*	*	+++	+++	*	*	*	*	+++
Free threshing wheat	*	*	++	++	*	*	*	*	++
Rye	-	*	-	-	-	*	*	-	-
Hulled barley	?	-	+	-	*	*	+++	*	+++
Naked barley	*	-	++	++	*	*	*	*	-
Lentil	*	*	+++	++	*	*	-	*	+++
Bitter vetch	*	*	+	+	*	*	-	*	-
Pea	?	-	+++	+++	?	*	*	?	++
Chickpea	?	-	+	-	-	*	-	-	+
Grass pea	-	-	?	?	-	?	-	-	+++
Flax	-	-	?	-	-	-	-	-	+++
References	Van Zeist and de Roller 1995	Hillman 1978	Helbaek 1964; Fairbairn et al. 2002	Van Zeist 1983	Helbaek 1970	This report	Renfrew 1968; Nesbitt (unpub.)	Helbaek 1970	Nesbitt 1996

Table 4. Presence of the major cereal, pulse and oil crops in Neolithic and Chalcolithic sites in west central Turkey. Key: \*present (of unknown status); + grown as admixture or unimportant; ++ grown as pure crop but second-rank; +++ grown as pure crop, clearly important; ? of uncertain domesticated status. These are subjective rankings