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CHARRED PLANT REMAINS FROM BROGÅRD, SOUTH-WESTERN SWEDEN
New information on Early Bronze Age farming

The analysis of plant macrofossil remains from an Early Bronze Age site is presented. Four hundred and fifty-nine cereal grains where identified, of which 188 were determined to species or variety level. When grains were impossible to identify from morphological characteristics, but were not fragmented, they could be tentatively ascribed to a species or a group of species from size measurements and index calculations. The cereal record has similarities with Neolithic material, as wheat represents a large proportion, and with Late Bronze Age material, as millet, oat and spelt are present. The material from Brogård suggests that the reorganization of the farming community, which is characteristic of the Late Bronze Age, may have started on a smaller scale already during the Early Bronze Age.

Background

In 1989 and 1990, the Hallands Länsmuseer Foundation performed a rescue excavation on a 50,000 m^2 large area at Brogård, in the outskirts of Halmstad in south-western Sweden (fig. 1). The investigated area is situated on a sandy plateau, demarcated by stream cut ravines to the south and west. The investigations revealed prehistoric constructions from different periods. A great majority of the constructions (>4000) were post-holes, as in many other archaeological investigations in southern Scandinavia. Several settlement remains were dated to the Bronze and Iron Ages. True house constructions were dated to the Early Bronze Age (periods II to IV) but most commonly to the Early Iron Age (Carlie 1992).

During the field work, flotation of soil samples from several constructions was carried out. These samples were handed to me for analysis of the botanical remains. A first examination of the samples showed that one of them was rich in botanical remains including mainly cereal grains. The sample originated from a construction dated, by radiocarbon analysis and by its archaeological material, to the Early Bronze Age. This material provided an opportunity to improve our poor knowledge of farming practices during the Early Bronze Age, and to discuss the economic premises for the Bronze Age settlement at Brogård. Therefore detailed analysis of the samples from Brogård was performed.

Sample no.	Species	Number
A 991	Polygonum convolvolus (black bindweed)	10
A 992	Chenopodium cf. album (white goosefoot?)	19
A 1572	Polygonum convolvolus (black bindweed)	1
A 1583	Polygonum convolvolus (black bindweed)	1
A 1846	Polygonum convolvolus (black bindweed)	17
A 3463	Polygonum convolvolus (black bindweed)	5

Table 1: List of the fresh seeds from Brogård.

Methods

The seeds were extracted from the soil samples by flotation during the excavations. No further treatment was performed. The seeds were studied under a binocular microscope with 8 to 50 times magnification. The identification work was carried out using identification keys and seed atlases (Beijerinck 1976; Berggren 1981; Katz et al. 1965; Jacomet 1987). Small seeds (e.g. *Chenopodium*) are present in the samples, which suggests that the flotation process did not favour a selection of large seeds. Therefore, the species composition may be representative of the samples, which is an important observation when the results are interpreted.

Results

From a number of constructions only fresh seeds were found (table 1). It is not believed that fresh seeds can be

Sample no.	Species	Number
A368	Triticum cf. aestivum L. (bread wheat?)	1
	Triticum spelta L. (spelt)	1
	Hordeum vulgare L. (hulled barley)	1
A1336	cf. Caryophyllaceae	1
	cf. Hordeum vulgare L. (barley?)	1

Table 2: List of the species (carbonized seeds) in two samples from Brogård.

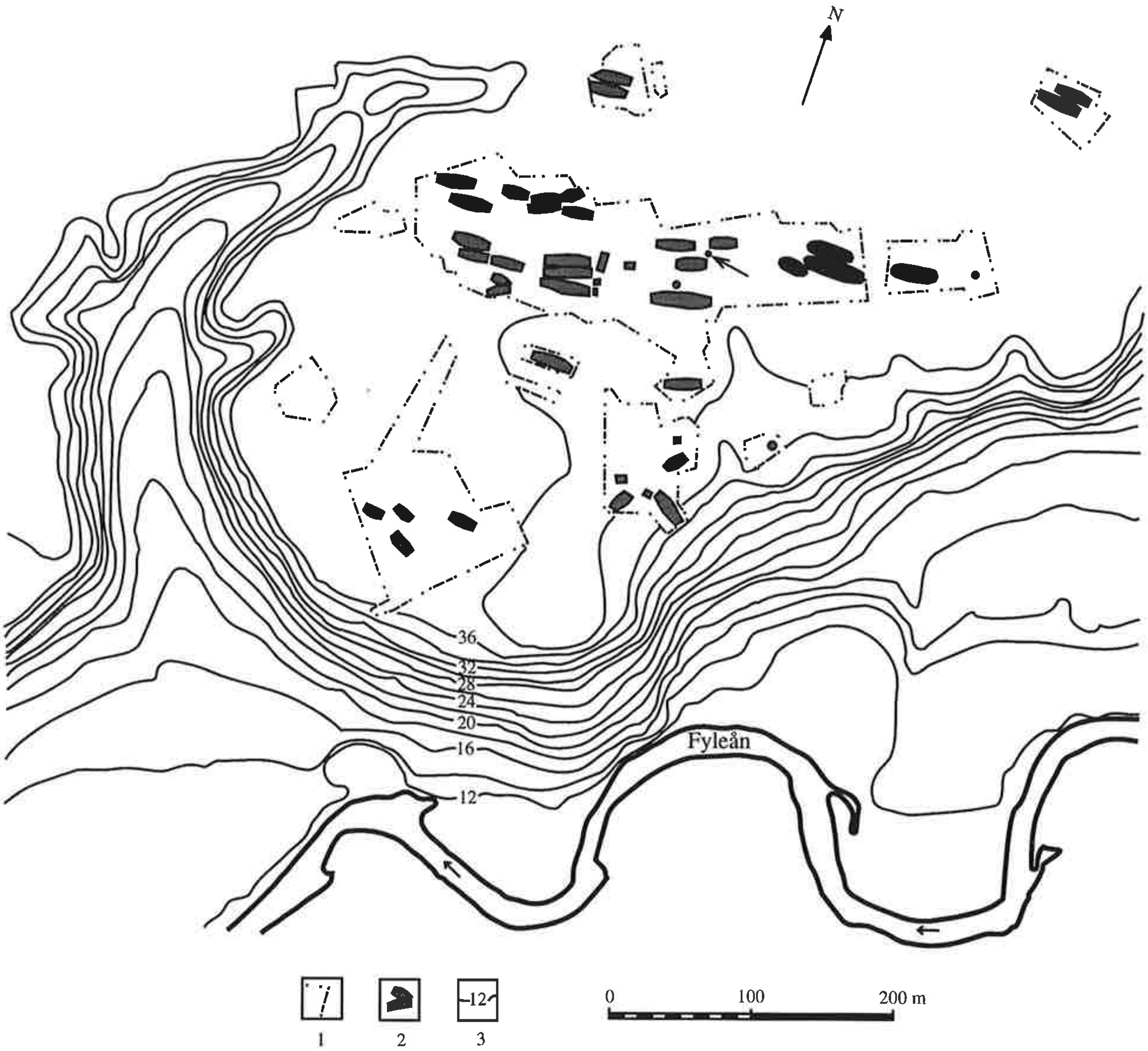


Fig. 1. The investigated area at Brogård. 1 = Limits of excavated areas. 2 = Prehistoric house remains. 3 = Altitude above sea level (2 m contour lines). Houses dated to the Early Bronze Age are shown in black, and houses dated to the Iron Age are grey. The position of structure A1616 is marked with an arrow. Redrawn from Carlie 1992.

preserved in a sandy soil since prehistoric time; they are most probably of a much younger age. In five of the constructions where only fresh seeds were found, black bindweed (*Polygonum convolvolus*) was the only species present. In another construction, seeds of goosefoot (*Chenopodium* cf. *album*) were determined. Both black bindweed and goosefoot (probably white goosefoot) are ruderal plants common in fields, around farms, etc.

Samples from three constructions contained carbonized seeds (table 2). In two of them there were only a few seeds, yet of the same species as those represented in the third, rich sample.

Sample A368 is from one of the post-holes in a trench-walled house. A ^{14}C dating performed on material from another post-hole from the same building gave the age of 1580±60 BP (Beta 40194). An iron point was found among the archaeological findings from this structure. The seeds from A368 can thus be dated to the Early Iron Age.

Sample A1336 is from a small pit interpreted as a cremated burial. There are no absolute datings available from this structure. The occurrence of a cross-shaped fibula suggests that the pit dates to the Late Iron Age. The few seeds from the pit do not give support for any proper interpretation. Furthermore, both seeds were badly preserved and did not allow any firm identification.

The structure that provided the richest composition of carbonized plant remains was A1616 (table 3). The construction was almost circular with a diameter of 1.5 m and a depth of 0.3 m, and was interpreted as a garbage-pit (fig. 2). The filling was composed of a humic, dark brownish sand. The bottom part of the pit was rich in

Species		Number
Polygonum convolvolus L.	black bindweed	1
Poaceae sp.	unknown species of grass	1
Bromus secalinus L.	chess	2
Corylus avellana sp.	fragments of hazelnut shells	6
Cerealia undiff.	undetermined cereal grains	185
cf. Hordeum	barley ?	24
Hordeum vulgare (s.l.) L.	barley in general	45
Hordeum vulgare var. nudum	naked barley	51
Hordeum vulgare var. vulgare	hulled barley	15
Triticum cf. aestivum L.	breadwheat ?	4
Triticum spelta L.	spelt	17
Triticum dicoccum/spelta	emmer or spelt	83
Triticum dicoccum Schübl.	emmer	33
Panicum miliaceum L.	millet	3
Avena sativa L.	oat	1

Table 3: List of the species (carbonized seeds) in sample A1616 from Brogård.

charcoal remains and charred cereal grains. The grains were already observed during the field work and, therefore, a larger sample was prepared from this structure. A ^{14}C-dating of charcoal remains that were found mixed with the carbonized grains provided an age of 3470±70 BP (Beta 44780). This date suggests that the garbage-pit was used during the earliest part of the Bronze Age. Furthermore, a house construction located at about 130 m from the pit, was dated to the same period. Thus it is likely that the findings from A1616 are connected to an adjacent settlement.

All the plant material was carbonized except a single fresh seed of black bindweed (*Polygonum convolvolus*). The latter may, as in the case of the constructions mentioned above (table 1), be considered as a recent component. A major part of the material was heavily carbonized, which made the identifications delicate.

Among three seeds of Poaceae, two could be assigned to chess (*Bromus secalinus*). Chess is often found in prehistoric contexts and is considered to be a common weed. Hjelmqvist (1979) is of the opinion that chess may have been intentionally grown. The presence of hazel nutshells (*Corylus avellana*) suggests that hazel nuts were collected and roasted. Hazel nuts may be preserved for a longer time when roasted.

Unfortunately many cereal grains could not be identified to species level. This is the case of 185 grains (Cerealia undiff.) where morphological appearance did not allow any further determination. However, the majority of the cereal grains could be determined to a higher taxonomic level.

Hordeum

Twenty-four cereal grains could be compared to barley (cf. *Hordeum*), because of their shape and size proportions. Forty-five grains were identified with certainty to barley (*Hordeum* sp.). However it was impossible to decide whether it was naked or hulled barley. Finally, fifty-one grains could be assigned to naked barley (*Hordeum vulgare* var. *nudum*) and 15 grains to hulled barley (*Hordeum vulgare* var. *vulgare*).

These results may indicate that naked barley was dominant, representing 77% against 23% hulled barley. However, the characters used for the identification of hulled barley may be very indistinct (Jacomet 1987, table 4.). The unidentified grains of barley may well include the hulled variety. In order to test this possibility, 25 complete and undamaged specimens were measured for length, breadth and thickness.

Length/breadth and length/thickness indexes were calculated. The indexes of the unidentified barley grains were then compared to those for the identified naked and hulled barley grains from Brogård (fig. 3). The indexes of 23 unidentified barley grains (92% of the measured grains) correspond to those of hulled barley. However, there is an overlap with naked barley, and only ten grains

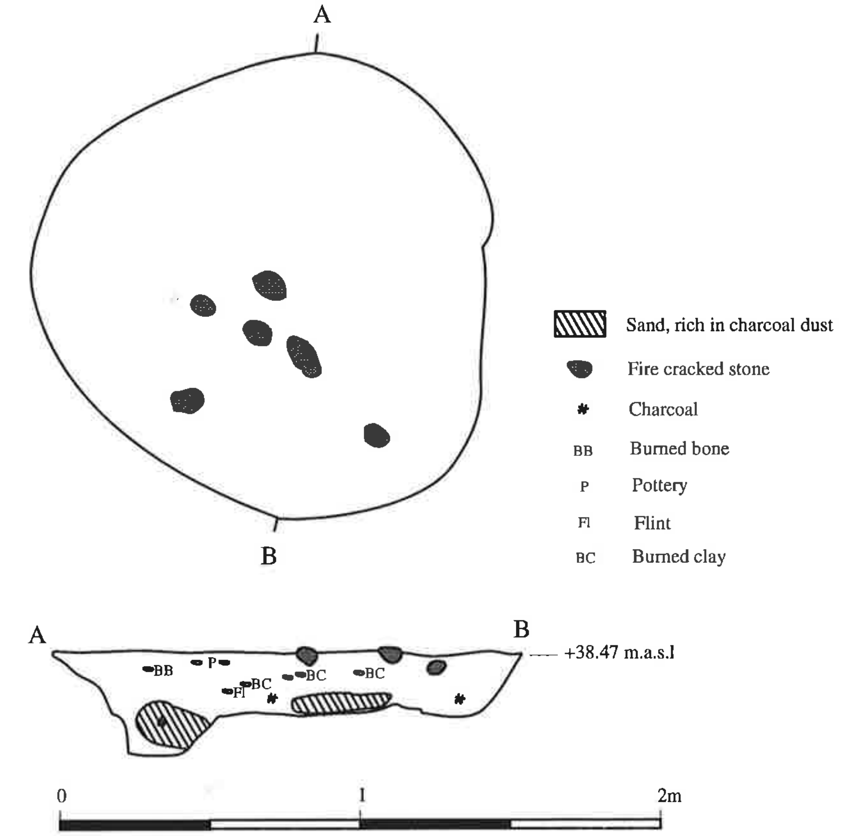


Fig. 2. The garbage pit, A1616. The analysed sample was taken from the lowermost part of the pit.

	Length			Breadth			Thickness			
	max.	min.	average	max.	min.	average	max.	min.	average	n
Triticum dicoccum	5,7	3,8	4,79	3,1	1,6	2,38	2,8	1,4	2,1	28
Triticum spelta	6,2	4,1	5,03	3,1	1,6	2,13	2,3	1,3	1,68	17
Triticum cf. aestivum	5,5	4,5	4,82	3,1	2,8	3,01	2,5	2,1	2,32	4
Hordeum vulgare ssp. vulgare	5,6	3,4	4,52	3,6	1,9	2,66	2,8	1,4	2	42
Hordeum vulgare ssp. nudum	5,7	3,6	4,9	3,1	1,9	2,44	2,3	1,2	1,89	11

Table 4: Length-, thickness- and breadth measurements of the identified cereal grains from sample A1616.

(40% of the measured grains) are outside the index group representing naked barley. Taking these results into account, hulled barley would represent 27% (15+10 grains) to 42% (15+23 grains) instead of only 23%

Moreover, the proportion of hulled barley would be even higher if we assume that 40% to 92% of the forty-five unidentified grains of barley, may be assignable to hulled barley. In this case hulled barley would represent 13% to 23% of the total cereal grains (table 6).

However, it is important to mention that size relationships alone are insufficient as criteria to distinguish different barley types with certanity. Nevertheless, it is probable that naked barley is more common than hulled barley in the material from Brogård.

Triticum

On the basis of breadth and thickness measurements, four cereal grains may be compared to bread wheat (*Triticum* cf. *aestivum*) (table 4). This identification is, however, somewhat uncertain.

Thirty-one grains of emmer (*Triticum dicoccum*) and seventeen grains of spelt (*Triticum spelta*) could be identified with certainty. Furthermore, eighty-three cereal grains could be assigned to the group of emmer/spelt (*Triticum dicoccum/spelta*). Fifty-four of these seeds were measured and indexes were calculated (fig. 4). Index values of both emmer and spelt were published by several authors (see for example Jacomet et al. 1989; van Zeist 1968).

The length/breadth and length/thickness indexes of emmer and spelt show a very small overlap (table 5, fig 4). In the material from Brogård, spelt has in general a larger length/thickness index than emmer. Jacomet (1987) reports a length/thickness index of 2.3 for emmer, and of over 2.5 for spelt.

Among the fifty-four unidentified cereal grains of the emmer/spelt group, ten (19%) fall into the index area of spelt, and thirty-eight into the index area of emmer (fig. 4b). Moreover, four grains lie outside the index area of emmer, but still may be ascribed to emmer, as the indexes are very low. Two grains cannot be ascribed to any of the two species. Thus forty-two grains (78%) can be assigned to emmer with good probability. When taking these results in account the proportion of emmer in relation to spelt reaches 71%.

The proportion of emmer would be even slightly larger (73%) if we assume that 78% of the eighty-three grains belonging to the emmer/spelt group are emmer.

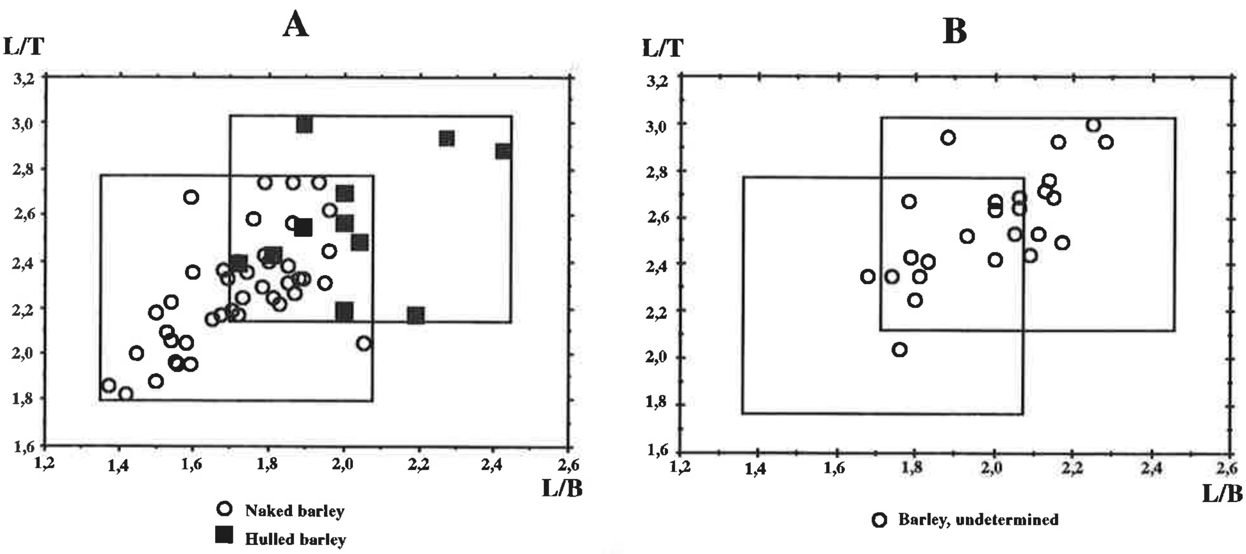
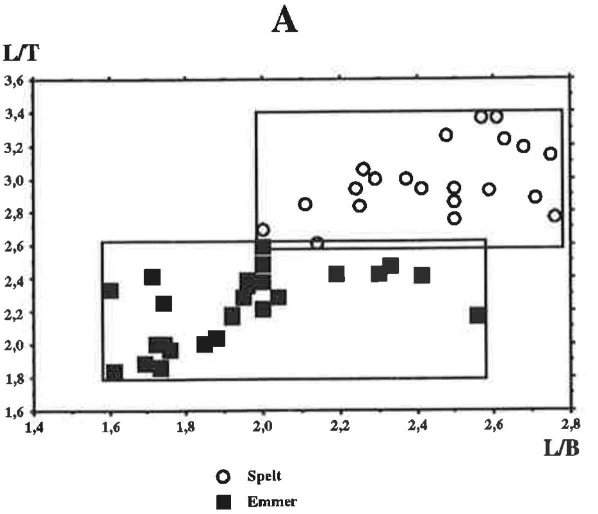


Fig. 3: Plots of the length/thickness indexes (L/T) and length/breadth indexes (L/B) of the identified naked and hulled barley (A) and the unidentified barley specimens (B) from Brogård. The index areas for both naked and hulled barley (A) are also shown in the plot of the unidentified barley (B).



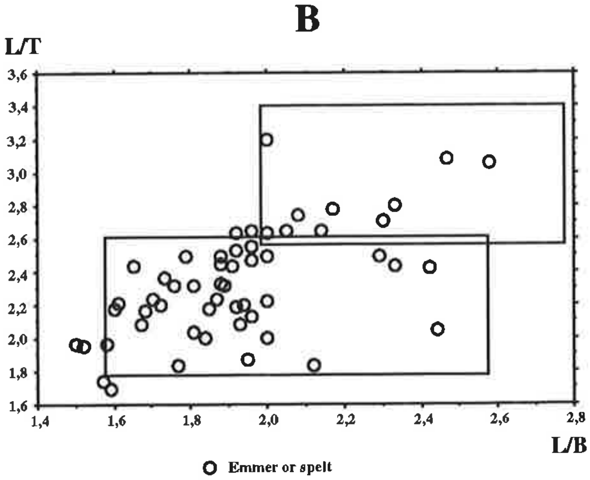


Fig. 4: Plots of the length/thickness indexes (L/T) and length/breadth indexes (L/B) of the identified spelt and emmer grains (A) and the unidentified grains (B) from Brogård. The index areas for spelt and emmer (A) are also shown in the plot of the unidentified wheat grains (B).

Avena and Panicum

Apart from wheat and barley, one grain of oat (*Avena sativa*) and three seeds of millet (*Panicum miliaceum*) were found in sample A1616.

Discussion

The material from Brogård provides new insights into the discussion on farming during Early Bronze Age. There are very few published findings of cereal grains from this period. In Sweden only five sites with a sum of fifty-seven grains (imprints in potsherds) are reported (Hjelmqvist 1979). Interestingly, one of these sites, Kårarp, is located just outside Halmstad. In Denmark two settlement sites with finds of cereals from the Early Bronze Age are known. The Danish findings are complemented with preserved plant macrofossils from the famous oak-coffin graves (Jensen 1985).

It is important to remember that the Early Bronze Age material from Brogård is from one single construction. It is therefore not correct to state that this sample should be representative of farming during Early Bronze Age, or around Brogård at that time. In Lindebjerg (Fyn, Denmark), Rowley-Conwy (1979) showed that the distribution of cereals within a site can vary remarkably. The composition of cereal grains found inside a house construction was to three fourths made up of naked barley. In two pits outside the house, 82% and 92% of the preserved cereal grains were emmer.

The fact that small seeds and chaff are totally missing in A1616 indicates that the seed sample represents threshed and sieved crop. Considering the findings from this structure (e.g. pottery, flint debris, burned bones), it is not likely that A1616 would be a storage pit or a roasting pit. The pit was probably filled with different kinds of refuse and garbage, which also explains its distance from the houses. People would probably store things close to where they are living, and refuse at a longer distance from the dwelling. The cereal grains were found concentrated in the pit (pers. comm. Lennart Carlie). This fact suggests that the grains were deposited at one occasion and that the sample may represent the product of a single harvest.

As discussed above, there are two different ways to calculate species frequencies and relationships using only the grains identified on the basis of reliable morphological criteria, or adding the grains identified with the help of size measurements (table 6).

The frequencies and relationships calculated in this study have to be considered with caution as a large number of cereal grains could not be determined to species or variety level. However, the following general conclusions may be drawn:

1. Wheat and barley are present in similar proportions
2. Einkorn (*Triticum monococcum*) is absent.
3. Emmer is more common than spelt.
4. Naked barley is at least as common as hulled barley, and may represent the largest proportion of the total species.

	L/B			L/T			
	max.	min.	average	max.	min.	average	n
Triticum dicoccum	2,56	1,60	1,95	2,59	1,83	2,22	26
Triticum spelta	2,76	2,00	2,44	3,37	2,61	2,98	21
Hordeum vulgare ssp. vulgare	2,42	1,72	2,02	3,00	2,17	2,57	11
Hordeum vulgare ssp. nudum	2,05	1,37	1,72	2,74	1,82	2,27	42

Table 5: Length/breadth - and length/thickness indexes of the identified cereal grains from sample A1616.

5. Oat and millet are present.

When the seed material from Brogård is compared with previously known findings of Early Bronze Age in Sweden (table 7), differences and similarities can be observed. Wheat seems to be generally more common than barley, and the most common species is emmer. It is interesting to note that in two sites einkorn is present, whereas it is absent in the material from Brogård. On the other hand bread wheat, oat and millet were found in Brogård, but were never recorded before in Swedish sites of the Early Bronze Age. Bread wheat (mostly as club wheat, *Triticum compactum*) is known both from Neolithic times and the Late Bronze Age (Hjelmqvist 1955, 1979). But millet (*Panicum miliaceum*) has never been found in the Neolithic sites of Scandinavia. Helbæk (1952a) has found millet in an Early Bronze Age site on the island of Bornholm. Both oat and millet are relatively common in findings from the Late Bronze Age in Sweden (Hjelmqvist 1979).

If we compare the values of the wheat/barley relationship obtained from Neolithic and Late Bronze Age sites, a somewhat complicated picture appears for the Neolithic Age, whereas a more consequent composition of cereal types is recorded for the Late Bronze Age. During the Neolithic, which represents a rather long time period, the composition of cereals varies significantly. Hjelmqvist (1979) separates two different forms of farming during Early Neolithic times. The first one is dominated by naked barley and bread wheat, and the second one by einkorn and emmer. Moreover, naked barley seems to be the most important crop during the Early Neolithic. During later phases of the Neolithic, the wheat species tend to be more common. During the Late Bronze Age, barley is the dominant crop. The total Swedish material of this period, altogether 14 sites, is two thirds composed of barley. Naked and hulled barley are in most cases represented in equal proportions. In addition, new crops appear, such as millet and oat (table 8).

In the material from Brogård there is a weak dominance of wheats. Emmer and naked barley appear to be the prevalent crops. These characteristics are closer to those known from Neolithic sites. But there are also similarities with the records from Late Bronze Age sites, namely the presence of millet, oat and spelt wheat. The spelt wheat has, in many ways, a unique position among the prehistoric cereals. Its origin, evolution, and propagation in Europe are badly understood. In Denmark, there are a few finds of spelt dated to Neolithic time. In the Bronze Age sites of Denmark and Sweden, spelt is recorded together with other cereals, however generally in very low proportions. Spelt was probably not used as an important crop before the Iron Age (Helbæk 1952b, Jørgensen 1979).

	(A)		(B)	
Cereal-type	Number	%	Number	%
Naked barley	51	20,7	55-78	22,4-31,7
Hulled barley	15	6,1	33-56	13,4-22,7
Barley in general	45	18,3	-	-
Σ Barley	111	45,1	111	45,1
Bread wheat	4	1,6	4	1,6
Emmer	31	12,6	96	39,0
Spelt	17	6,9	35	14,2
Emmer/spelt	83	33,7	-	-
Σ Wheat	135	54,9	135	54,9
Total sum	**246**		**246**	

Table 6: List of the different cereal types from A1616. A = Numbers and percentages of cereal grains identified from morphological criteria only. B = Numbers and percentages of cereal grains identified from morphological criteria and size measurements.

The cereal composition from Brogård differs from that of known Late Bronze Age material as barley, and especially hulled barley, represents a relatively low proportion of the crops. In Brogård the wheats have higher frequencies than expected from a Late Bronze Age site. Moreover, it is noteworthy that einkorn is totally lacking in the material from Brogård, whereas it tends to be very common, and often as well represented as emmer, in Scandinavian Neolithic and Late Bronze Age sites.

Prehistoric cereals can be separated into "hulled" and "naked" forms. Naked barley and bread wheat belong to the naked forms, that are threshed spontaneously. In the hulled forms, the caryopsis remains enclosed in the glumes, and is very hard to thresh properly. One way to facilitate threshing is to use parching. This procedure is considered to be one of the factors explaining why cereals, as well as complete ears, are often found carbonized in prehistoric sites. As the naked forms are very well represented in the material from Brogård, the carbonized grains are probably not a result from parching.

On the basis of the cereal record from a prehistoric site in the Netherlands, Buurman (1979, 1987) suggested

	Hulled barley	Naked barley	Barley in general	Emmer	Einkorn	Spelt	Emmer or spelt	Chess
Landskrona	1	1	1	–	1	–	–	–
Reng: Sohög	1	–	–	–	–	–	–	–
Löddesborg	1	–	–	–	–	–	–	–
Norrvidinge	–	8	1	16	3	7	6	8
Halmstad: Kårarp	–	2	–	–	–	–	–	–
Sum	**3**	**11**	**2**	**16**	**4**	**7**	**6**	**8**

Table 7: Imprints of cereal grains in pottery dated to the Early Bronze Age from Sweden (according to Hjelmquist 1979).

	Naked barley	Hulled barley	Barley in general	Emmer	Einkorn	Emmer or spelt	Bread wheat	Spelt	Oat	Millet	Chess
Skåne											
Barsebäck	16	5	–	–	1	–	2	–	1	1	1
Gråmanstorp	10	2	2	–	–	–	–	–	–	–	1
Skivarp	8	16	–	–	–	–	–	–	–	–	6
Hötofta	13	23	2	5	–	2	3	–	1	–	3
Bromölla	42	51	23	8	4	4	1	32	5	8	6
Hagestad area	1	7	–	2	–	–	3	–	2	–	–
Other in Skåne	26	13	–	2	1	–	1	–	3	–	2
Blekinge	–	–	–	–	–	–	–	–	–	–	4
Småland	1	–	–	–	–	–	–	–	–	–	–
Halland	3	1	–	–	–	–	–	–	9	–	–
Bohuslän	1	–	–	–	–	–	–	–	–	–	–
Gotland	1	–	–	–	–	–	–	–	–	–	–
Södermanland											
Hallunda	12	14	5	10	2	5	1(+1)	5	3	–	2
Uppland	2	–	–	–	–	–	–	–	–	1	–
Sum	136	132	32	27	8	11	11(+1)	37	24	10	24
%	**30**	**29**	**7**	**6**	**2**	**2**	**2**	**8**	**5**	**2**	**5**

Table 8: Imprints of cereal grains in pottery dated to the Late Bronze Age from Sweden (according to Hjelmquist 1979).

that hulled and naked barley were cultivated in separate fields. This assumption relies on known characteristics distinguishing naked from hulled cereals. Under good circumstances the naked forms give better yields than the hulled forms that, in addition, require more complicated threshing procedures. Moreover, the hulled forms are less sensitive to moisture, infections and insect pests (Hillman 1981). Because the material from Brogård includes different forms of cereals, it may represent several harvests. However, the limited material studied at Brogård does not allow any further conclusion on farming techniques, or field distribution. Deeper insight into these questions requires the study of a larger and more representative material.

It is often stated in the literature on prehistoric farming, that cultivation during the Neolithic and Early Bronze Age was limited with respect to material and work. It is assumed that, during these periods, the surroundings of the settlements were used extensively, and that crop rotation, fallow fields, and a high diversity of cereals, did not occur before Late Bronze Age (e.g. Olsson 1991 and Emanuelsson 1988).

Because the material from Brogård shows similarities with earlier findings from Late Bronze Age sites, the established view on farming during the Early Bronze Age may be questioned. The development of agriculture during prehistoric times has largely been studied in the light of pollen analysis. This method often has the major disadvantage of providing information primarily on the *regional* vegetation development, but not allowing for any detailed information on specific land-use and farming practices. Pollen diagrams covering the Late Bronze Age period in southern Scandinavia reveal an opening up of the landscape, and an increase in grazing and farming during that period (Berglund et al. 1991). Minor variations in farming activities cannot be detected by this method. Theoretically, small areas may have been affected by an agricultural "reorganization" already during earlier periods. The material from Brogård may indicate an early development from a relatively simple agricultural system during Neolithic times to a more complex farming system already during the Early Bronze Age, a shift that was considered until now to occur during the Late Bronze Age. Further examination of Early Bronze Age seed material may lead to reconsiderations of this theory.

In conclusion it is important to emphasize that the information presented in this paper was brought to light by a rescue excavation. In Sweden it is rare that resources are spent on detailed macrofossil analyses in connection with rescue investigations. The results from Brogård clearly show that this method can add important knowledge to the traditional archaeological material.

Acknowledgements

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