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# Aggemose

## An Inland Site from the Early Kongemose Culture on Langeland

by OLE GRØN and SØREN A. SØRENSEN

### INTRODUCTION

The site Aggemose on Langeland represents a small and typologically pure inland unit from the Kongemose Culture. A recent compilation and analysis of the Kongemose material of southern Scandinavia (Sørensen in press) has made it obvious that the site, both with regard to its geographical and chronological position, elucidates important aspects of the development and extension of this culture in southern Scandinavia. Furthermore, the site seems to represent a change from the organizational pattern found in the Maglemosian dwellings to a quite different pattern found in those of the Kongemose and Ertebølle Culture (Grøn 1989; 1995; in press).

### TOPOGRAPHY

The Aggemose basin measures approximately 800 m north-south and 450 m east-west. The surface is 9.5 m above sea level and the distance to the sea is 2.2 km. Today the basin contains a bog with rather degraded (humified) peat. During the period of habitation it contained a lake with a water level 30-35 m above the contemporaneous sea level and 4-5 km from the large river or narrow brackish sound to the east (Jelgersma 1979; Wienberg Rasmussen 1975:126). Thus we are dealing with a true inland site.

The site is located close to the tip of what was, at the time of habitation, an approximately 50 m long and 10-15 m broad sandy spit jutting out ESE into the Aggemose basin from its western shore. Judging from the topography, access to the open water must have been gained to the NNE, where the shore lay only approximately 3 m away (Fig. 1).

### THE SITE

The culture layer apparently became damaged by ploughing in 1974, and in 1975 Kongemose material was found on the site by Flemming Rieck. Later that year it was excavated by Langelands Museum under the direction of Jørgen Holm (1). The 30 cm thick layer of plough soil was sieved, square metre by square metre, through a sieve with a 1 cm mesh, and the finds were registered accordingly. The transitional zone between the plough soil and the underlying yellowish/brownish sand was excavated by trowelling, and here the exact three-dimensional position of each find was registered.

Three square-metre fields were excavated 15 m to the south, 15 m to the north and 13 m to the east of the site, respectively. In each of these fields a 30 cm thick layer of humified peat containing a few small and uncharacteristic pieces of worked flint was observed, but apparently anaerobic conditions, which promote the preservation of organic waste, did not prevail.

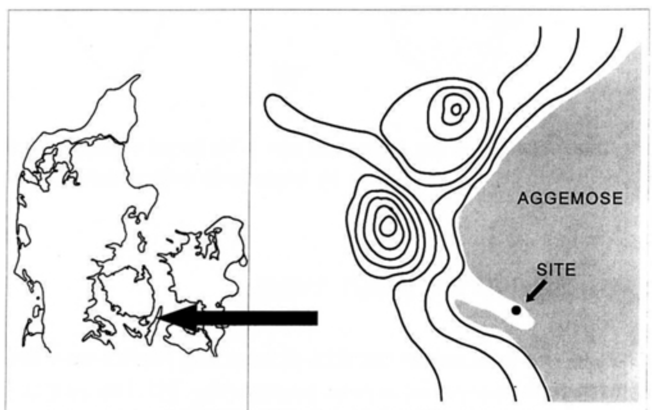



Fig. 1. The topography of the Aggemose site.

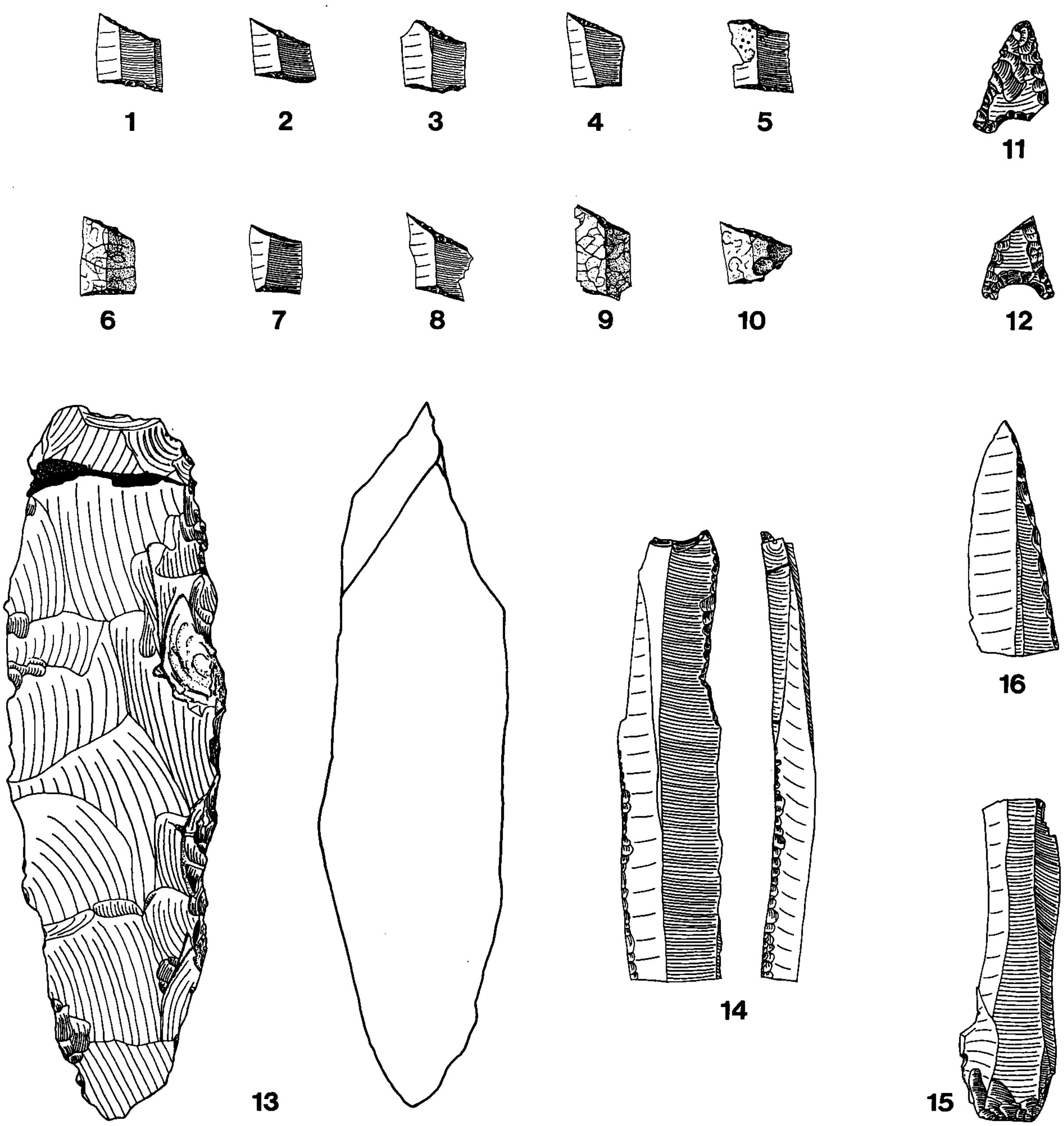



Fig. 2. Artefacts from the Aggemose site: 1-10, broad trapezes; 11-12, Late Neolithic arrow-heads; 13, the core axe with the resharpening flake in position; 14-15, burins; 16, blade-knife with straight retouched back. 2:3.

## DATING AND ARTEFACT TYPES

Due to the technique used in producing blades and the similarity between its arrows points (Fig. 2,1-10) and the oblique transverse arrow points from the Kongemose/Ertebølle transition, the flint material from Aggemose was originally assigned to the later part of the Kongemose Culture. Subsequently, the distinction of the earliest phase of the Kongemose Culture, the Blak phase, made it possible to determine all 10 classifiable arrows in the material as broad trapezes belonging to this phase (Sørensen in press).

Excavations in recent years at the submerged site, Blak II, in Roskilde Fiord have produced a typologically pure and sufficiently large flint material to enable definition of the Blak phase. The most significant elements of this phase are broad trapezes, which on the basis of several characteristic traits can be distinguished from oblique transverse arrow points. The most important trait is that the rear of the point (an unretouched part of the blade from which it was made) is broader. The broad trapezes appear in three morphological versions, which in terms of chronology appear contemporaneously (Fig. 3).

Whereas other sites with broad trapezes contain all three types (Fischer 1989:2; L. Larsson 1978:75; Sørensen in press), only types 2 and 3 are present in the Aggemose material. The broad trapezes appear in southern Scandinavia at approximately 6,000 b.c. (conventional dating) together with triangular microliths in the final Maglemosian phase (L. Larsson 1978:138,144). Here, the latter show a clear dominance. Scalene triangular microliths are still present in the Blak phase, but in extremely restricted amounts relative to the broad trapezes as can be seen at Blak II, for instance (Sørensen in press).

Fig. 4 shows measurements of the broad trapezes from the Aggemose site, Blak II and the Blak phase of Musholm Bay, together with the rhombic arrow-heads from the Villingebæk phase of Blak I. A significant coincidence between the points from the three former sites is obvious. Compared to the other known sites from the Blak phase, only a very restricted spectrum of artefacts other than the broad trapezes are present in the Aggemose material. These artifacts are also few in number.

The material comprises one large core axe and one edge-resharpening flake (Fig. 2,13). The resharpening flake, which was excavated from the main concentration, fits the axe which was found on the surface in 1975.

Burins appear in three variants, represented by only one item each: an angle burin on a break (Fig. 2,15), an angle burin on a transverse retouch (Fig. 2,14) and a fragment of a dihedral burin. The two former ones are produced from large blades of good quality whereas the third one is from a somewhat smaller blade. Blade burins on a break as well as on a transverse retouch are common throughout the Kongemose Culture, but always with the former type dominating.

One intact blade knife and fragments belonging to three others were found (Fig. 2,16), with the distal ends

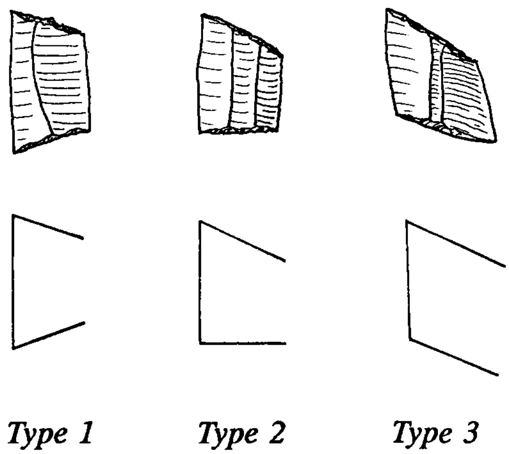



Fig. 3. On all sites from the Blak phase, apart from the Aggemose site, three morphologically different types of broad trapezes are found. They appear to have been in use simultaneously.

retouched from one side into an acute angle relative to the longitudinal axis. They represent a type common in all phases of the Kongemose Culture. Three knives made from flakes with the back partly or totally retouched were also present in the material. These are of little value for dating purposes. Unworked blades showing heavy wear and retouch from use were relatively common at the Aggemose site, as was the case at the Blak II site.

Immediately before this paper went to press, it was discovered that a large number of the blades showed clear microwear traces. A preliminary analysis was carried out by Ole Grøn with a reflected light microscope, type Zeiss Technival 2, at magnifications between x12.5 and x250. Polarized light was used. The pieces are marked using only their artefact numbers, and thus the analyst had no information about their position within the excavated area during the analysis. In spite of the fact that some of the surfaces were not ideal for observation, and thus some types of polish may have been overlooked, at least 46% (149 pieces) of the blades ($\Sigma$=323) showed clear polished facets from cutting some hard material running longitudinally on both edges, or in a few cases only on one edge. From a sample of 100 flakes only 5% (the most blade-like ones) had similar traces of wear. Generally the polish was only observable when the microscope was oriented directly against the edge, whereas the sides of the blades showed nothing. All of the 7 morphologically defined knives with retouch showed similar polish along the edge. Helle Juel Jensen of the University of Aarhus has kindly inspected four blades with this type of wear. She was not able to categorize the type of polish with certainty, but the polish on the blades brought to mind that obtained when cutting hard wood/bone/antler. The three burins were apparently made from blades with a possible hard wood polish on both edges. They are thus to be regarded as tools produced from other worn out tools, rather than as "multi tools". Only the two angle burins show (possible hard wood/bone/antler) polish along their "burin-edges', the one at its "point" the other on its two sides (Brinch Petersen & Juel Jensen 1985:43). The core axe and the resharpening flake both have extremely developed (possible wood) polish on the steeper side of the edge. The trapezes showed no traces of use.

Due to the bad preservation of the surfaces of the lithic material it is not possible to carry the analyses any further.

The big-blade-technique, which can be traced back to the later Maglemose Culture (K. Andersen *et al.* 1982; Henriksen 1976; L. Larsson 1978), is a dominating feature of the earliest phase of the Kongemose Culture. The Aggemose material contains numerous large blades reaching 16 cm in length, but at the same time smaller, rather narrow blades were produced. It is characteristic that the broad trapezes were always produced from blades of the latter type whereas the ordinary blade implements generally were made from large blades. This is consistent with the fact that blades showing micro-polish on their edges were on average 18 mm broad, whereas the corresponding value for those with no observable traces was only 14.5 mm.

A fragment of a polished axe and two Late Neolithic arrow points (Fig. 2,11-12) clearly do not belong with the remaining part of the material. In the densely populated landscape of Neolithic Langeland (Skaarup

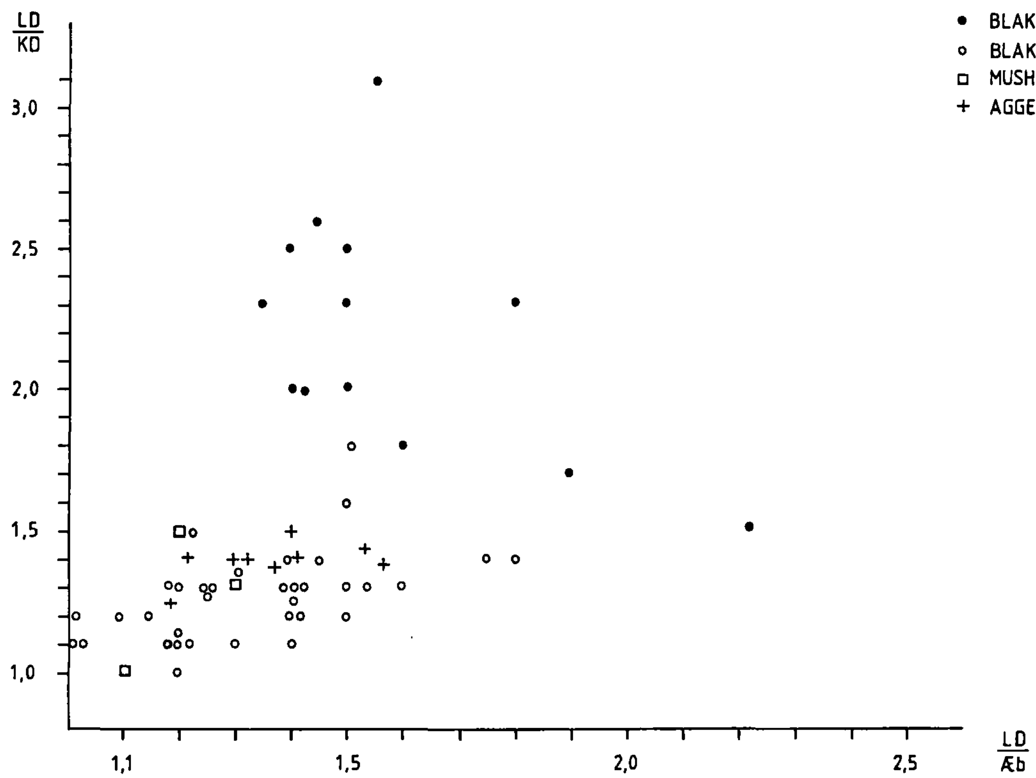



Fig. 4. The diagram compares measurings of 1) the broad trapezes from three danish locations: Blak II, Aggemose and Musholm Bay, and 2) the rhombic arrow-heads from Blak I, a small find from the Villingebæk phase of the Kongemose Culture. It is obvious that the two types separate into two groups. LD = longest diagonal, KD = shortest diagonal. The measurements are made after P. Vang Petersens system for classification of rhombic and transverse arrow-heads (Petersen 1984).

1985:341-396), a high concentration of such stray-finds can be expected around the former lakes.

In the light of the character of the Aggemose material it is obvious that a typological dating must almost exclusively be based on the arrow points. These indisputably place the site in the Blak phase, a dating that is not contradicted by other finds from the site. The exact time interval represented by the phase is not known yet. With some caution it can be said to begin at 6,000-5,700 b.c. (conventional), whereas its end can be fixed with certainty at approximately 5,400-5,300 b.c. As a consequence the start of the Villingebæk phase, traditionally dated to 5,500 b.c. (Vang Petersen 1984:10), must lie somewhat later.

## STRUCTURAL REMAINS, DISTRIBUTION PATTERNS AND SPATIAL ORGANIZATION

Apart from its chronological and geographical importance, the Aggemose site takes up a central position as a link between the Maglemosian pattern of dwelling organization and that of the Kongemose and Ertebølle Culture (Grøn in press, b). This section deals firstly with the preserved structural remains and subsequently analyzes the distribution of lithic waste and artefacts in relation to these structures to obtain information about the organization of the site.

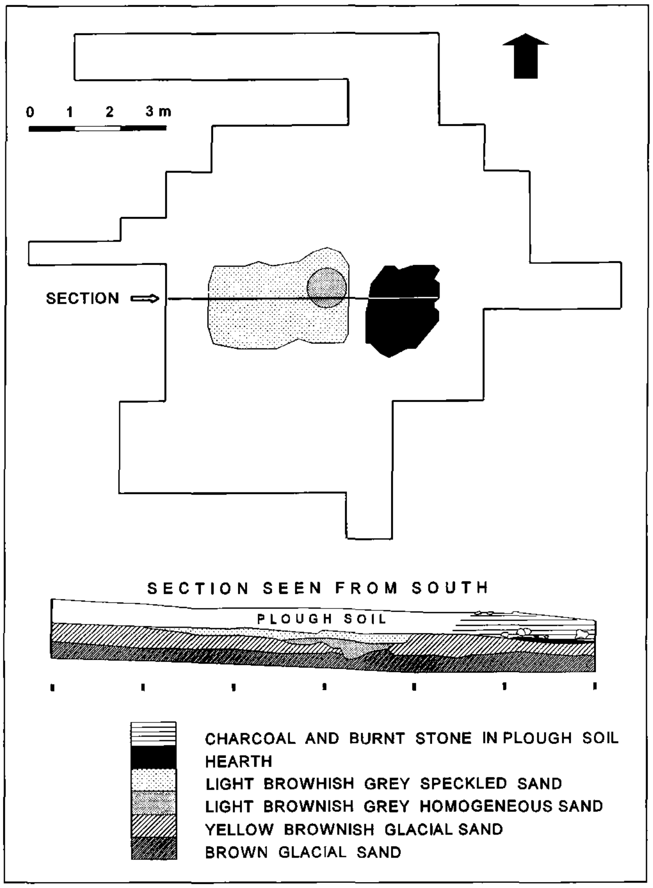



Fig. 5. Aggemose. Plan of features (above) and section (below).

### *The culture layer and the "pit"*

During the excavation in 1975 it was observed that the majority of finds in the brown sandy topsoil derived from stripes of fine light grey sand, which had recently been ploughed up into it. Patches of this grey sand were also found in the transitional zone between the plough soil and the underlying glacial sand, heavily speckled by brownish top soil resulting from animal activity, and also here containing lithic waste and artefacts.

One larger coherent patch, measuring approximately 2 m N-S by 3 m E-W and with an irregularly rectangular shape, was found to be linked to the top of a 10 cm deep, flat bottomed pit, containing brownish light grey sand, speckled with brown topsoil brought down by burrowing animals. The pit contained some worked flint. In its eastern part, the excavator observed a further small round pit, approximately 90 cm in diameter and 20 cm deep. The latter contained brownish light grey "unspeckled" sand and a large number of small pieces of lithic waste, of which at least 50% was damaged by fire.

The only difference in the content of the "upper" and the "lower" pit is that the sand in the former is described as "speckled" with brown topsoil resulting from animal activity, whereas that from the lower is described as "unspeckled". The separation of the two structures thus seems exclusively based on the presence of later animal activity within a restricted vertical zone. The excavator describes the "lower" pit as a "pit in the pit', but does not express directly whether he regards it as a separate structure or not.

The section recorded during the excavation shows that the "speckled" light brownish sand forms a 5 cm thick zone above the top of the "lower" pit (Fig. 5). Thus the brownish light grey "unspeckled" sand is to be seen not so much as specifically the content of the latter, but as a lower part of the fill of one large shallow pit, the upper part of which has been affected by intense animal activity. Equally intense animal activity was not observed in the glacial sand below the plough soil, in the area adjacent to the pit.

The high concentration of phosphate (2) restricted to the pit-zone (Fig. 6,F), indicates the presence of a large amount of organic matter in antiquity. This may have been the reason for increased animal activity within a restricted vertical zone. On the basis of these considerations, the "upper" and the "lower" pits are interpreted as one.

The brownish light grey sand in the pit and in the transitional zone below the plough soil, most likely represents a culture layer of restricted extent. Since ploughing of the 30 cm thick, sandy top soil can only have reduced the top level of the sandy land spit, and no geological processes are likely to have increased it, the pit must originally have been at least 40 cm deep at its centre.

The very restricted horizontal distribution of the lithic material (Figs. 6-8), indicates that earlier ploughing has dispersed the little concentration to only a very limited degree. Had the main part of the material been deposited directly on the prehistoric vegetation surface, one should expect it to be much more dispersed. It probably lay protected in a shallow pit, at least 40 cm deep, represented by the lenticular, brownish light grey sand layer (e.g. Grøn 1990:82; Strömberg 1976:16; 1986).

### *The hearth*

Already in 1974, before the excavation, the hearth was observable on the surface as a dark patch of ash-rich soil associated with a large number of fire-cracked and blackened stones. During the excavation it was found to lie to the east of the main find concentration and to measure approximately 2 by 1.5 m (N-S and E-W, respectively). It had been almost totally disturbed by ploughing, and accordingly it was not possible to make observations on the organisation of the many burnt stones. Only a 5-6 cm thick layer of charcoal at its centre, directly superimposed on the underlying yellow brownish glacial sand, was left undisturbed by the plough. There is no direct evidence of the dating of the hearth, but according to its position (see below) it is not unlikely that it is contemporaneous with the other Mesolithic finds.

### *The distributions of lithic material and phosphate*

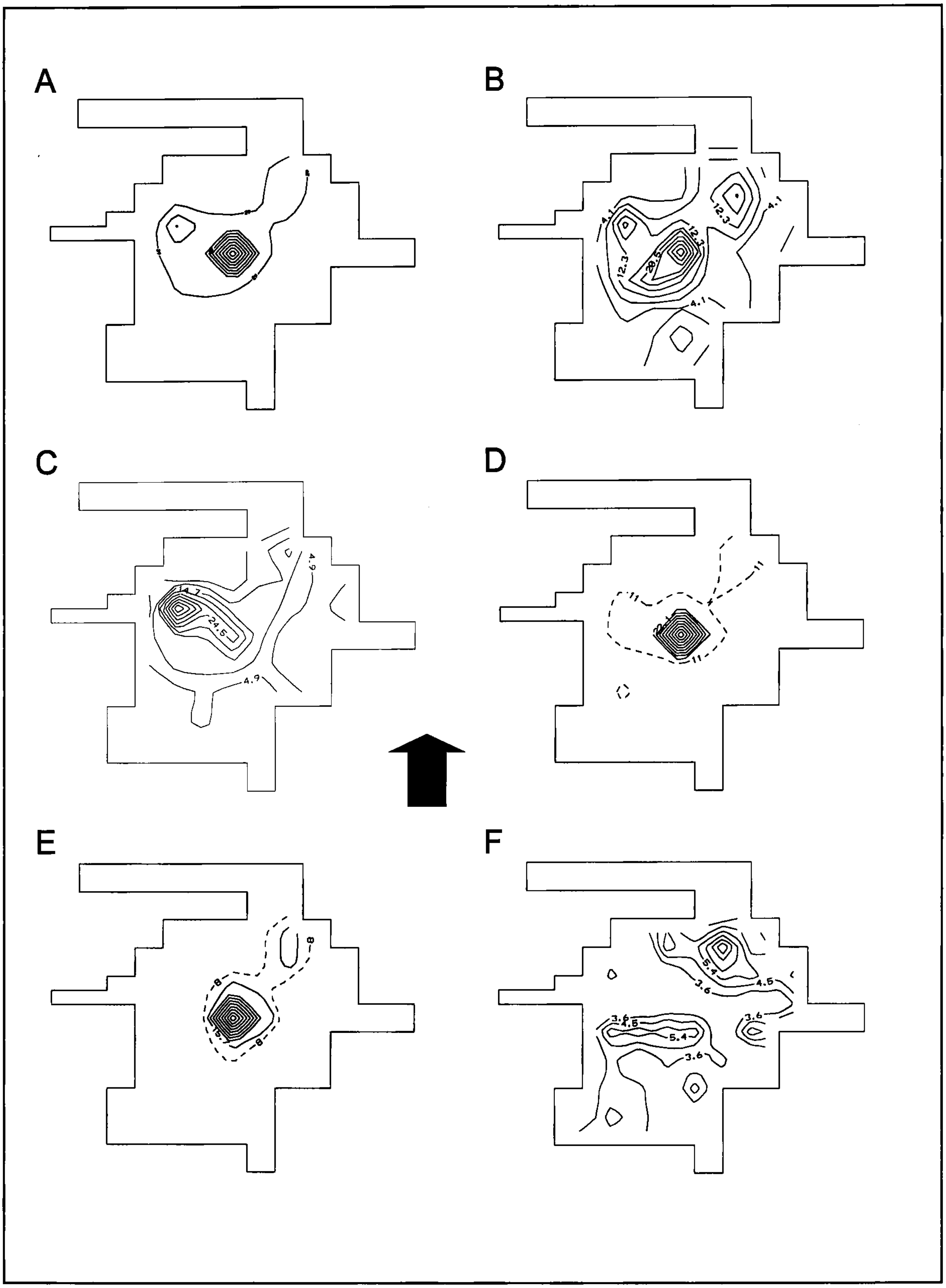
The different typologically defined artefact types appear only in restricted numbers, so the plans of their distribution must be treated with some caution. There are however some clear trends which are likely to be representative.

Since the majority of the items is registered only in terms of a particular square metre field, their location in the centre of the square gives a maximum inaccuracy of 0.7 m (the greatest distance from the centre to a corner in a square). Any other position would give even greater inaccuracies. Accordingly, a certain blurring of the original distributions must be expected, no matter how they are expressed graphically. This explains why complementary distributions separated by a wall may look as if they overlap each other by as much as 1 metre.

The "lithic waste" (Fig. 6,A) can traditionally be separated into blades, flakes and irregular pieces. Within the main concentration these three sub-categories behave differently. The blades (Fig. 6,B) appear in both an eastern and a western concentration, the flakes (Fig. 6,C) have a concentration in the east and the irregular pieces (Fig. 6,D) are found in a western one. This probably reflects the different handling of the two first categories: Many blades are used as artefacts whereas the majority of the flakes are not. The concentration of irregular pieces coincides with the concentration of burnt flint (Fig. 6,E) and owes its existence to the many irregular fire-shattered pieces. Together, these distributions make up a large coherent central concentration. The central concentration is linked to a smaller north-eastern concentration by a narrow band which has a similar location for each find category (Fig. 6,B-E). The latter probably represents an opening in some kind of physical barrier, for example a wall or a screen.

The distribution of phosphate (Figs. 6,F and 8,D),

Fig. 6. Distributions of: A, total of lithic waste, equidistance 29.0, *max=290*; B, blades and blade fragments, equidistance 4.1, *max=41*; C, flakes, equidistance 4.9, *max=49*; D, irregular pieces, equidistance 22.1, *max=111*, hatched line for level=11.0; E, burnt flint, equidistance 15.7, *max=157*, hatched line for level=8; F, phosphate, equidistance 0.9, minimum level represented=3.6, *max=8.1*.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4.1
C
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4.9
D
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E
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F
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3.6
4.5
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4.5
5.4
3.6

which should mainly reflect the distribution of bone and antler on the original settlement surface, shows a significant concentration in the southernmost part of the main concentration, and another accumulation with even higher values coinciding with the small north-eastern concentration area.

The broad trapezes (Fig. 7,A) are represented by six pieces found in a "crescent" of six adjacent squares inside the southern part of the main concentration. Four pieces were found in the proposed waste layer and four had an apparently random distribution in the southern and eastern part of the excavated area.

The burin spalls and burins (Figs. 8,A and 8,B, respectively) each appear inside the main concentration with no more than 1 and 2 pieces per square metre, respectively. Together (Fig. 7,B), they appear within the main concentration with a maximum of 3 pieces per square metre in its north-eastern part. Intact and fragmented blades with edge polish (Fig. 7,D) cluster both within the main concentration and the small north-eastern concentration.

Collectively, the lithic material and organic waste constitute a main western concentration comprising the lenticular culture layer, within which blades, flakes, irregular pieces and burnt flint show different distributions. On the basis of the different distributions the main concentration is estimated to represent an approximately rectangular structure, measuring 3.5 by 3.5 m (Fig. 8,C and the shaded squares in Figs. 6-8). Through some kind of physical "corridor" this main concentration is connected to a small north-eastern concentration, where all of the find categories appear with nearly identical distributions. The "corridor-effect" may very well be due to the presence of an entrance, whereas the latter concentration probably represents a small accumulation of waste immediately outside the latter.

The idea that the main concentration, with the lenticular culture layer, represents a dwelling area with an entrance in its eastern side, is partly supported by the distribution of the retouched knives (Fig. 7,C). They show a distribution complementary to the main concentration. According to the micro-polish on their edges, they appear to have had functions identical to those of the blades with polish which clearly cluster inside the main concentration (Fig. 7,D). The retouched knives may represent external activities and the unretouched pieces internal ones.

The *intact* blades show an extremely interesting feature. Those with no registered polish (Fig. 7,E) are clearly concentrated in the north-western part of the main concentration, whereas those with polish (Fig. 7,F) are clearly concentrated in its south-westernmost part, on the southern border of the "pit". These concentrations may represent an area of production or storage of fresh blades suited for cutting, and a collection of worn blades, respectively. Whereas the intact blades with polish only coincide within the main concentration, the fragmented blades with polish also show a clear concentration in the proposed small external waste area. Possibly, a collection of worn but intact blades was kept in a secondary easily accessible place, whereas broken ones were discarded (Figs. 7,D and 7,F).

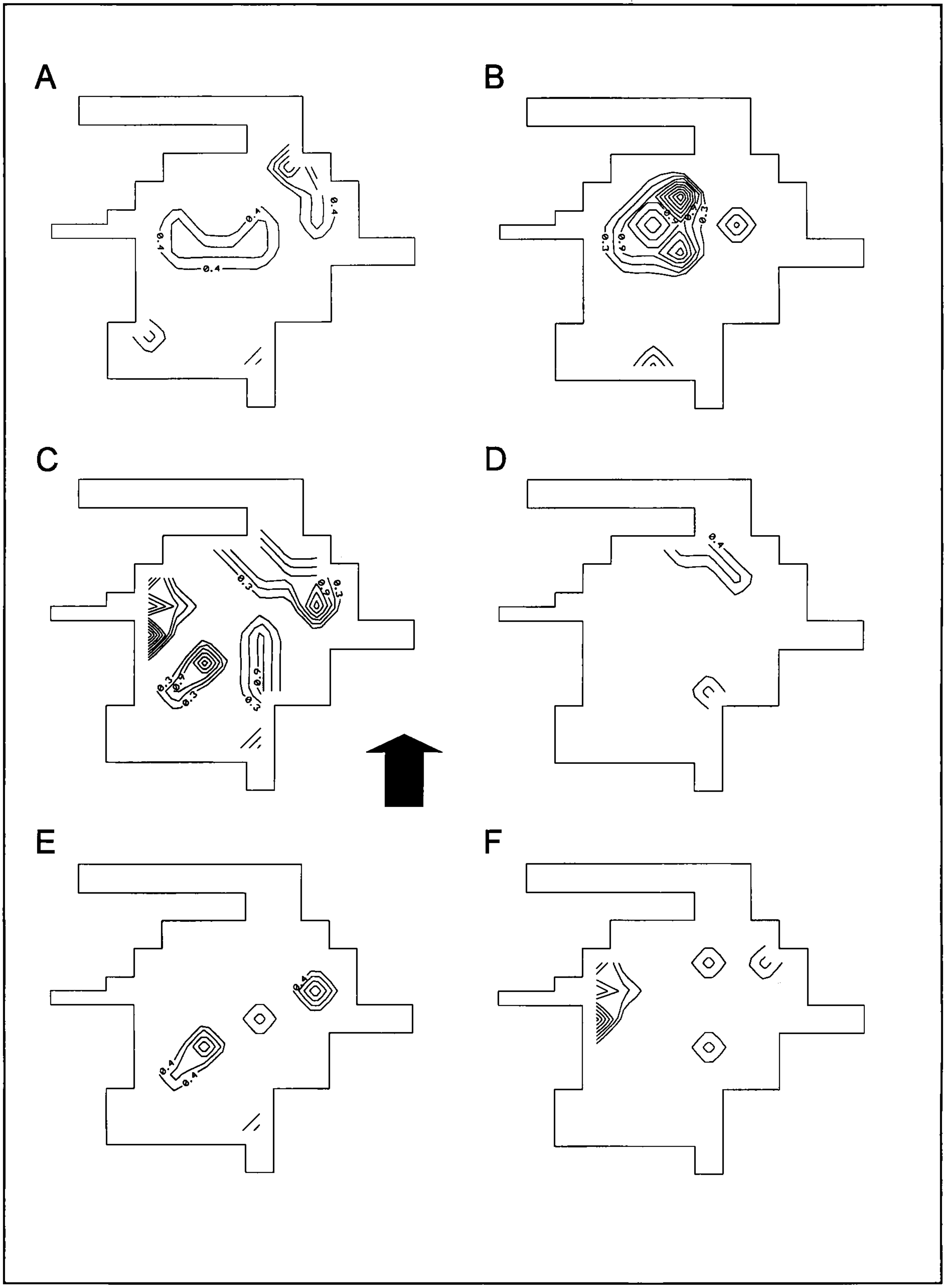
## DISCUSSION. COMPARISON WITH OTHER SITES

It seems likely that the main concentration of waste which comprises the lenticular culture layer, supposed to represent the physical remains of an excavated depression or "pit', represents a dwelling area of approximately 3.5 by 3.5 m.

The concentrations of irregular pieces and burnt flint (Figs. 6,E and 6,D), of phosphate (assumed to represent the bone material) (Fig. 6,F), of broad trapezes (Fig. 7,A) as well as those of the intact and fragmented blades with polish (Figs. 7,D and 7,F) and the lenticular culture layer (Figs. 5 and 8,C) all are restricted to the southern half of the main concentration, i.e. the half furthest from the water.

This fits the general picture we have from other Kongemose and Ertebølle sites: One half of the supposed dwelling area contains only very few artefacts, whereas the other half contains the majority of them. Internal hearths generally seem to be located close to the border

Fig. 7. Distributions of: A, broad trapezes, equidistance 0.4, *max=2*; B, burins and burin spalls together, equidistance 0.4, *max=3*; C, knives with retouched backs, equidistance 0.4, *max=2*; D, blades and blade fragments with micro-polishes on their edges, equidistance 1.2, *max=120*; E, intact blades with no observable micro-polishes on their edges, equidistance 0.9, *max=9*; F, intact blades with micro-polishes on their edges, equidistance 0.7, *max=7*.


A
B
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between these two zones (S.H. Andersen 1975:14-20; Grøn 1995; Grøn in press; L. Larsson 1975:13,15,19; 1978:197-198; M. Larsson 1987:26-30; Simonsen 1952: 202-203).

In the small, round dugout dwelling Hylteberga no.9, which has a diametre of 3 m, a depth of 0.75 m and probably belongs to the Kongemose Culture, a flooring made up of thick rods of hazelwood was observed which covered one half of the dwelling space (L. Larsson 1975:15,19). On this basis, the southern half of the main concentration at Aggemose may be interpreted either as a dwelling zone adjacent to a northern platform – or as a zone with another type of flooring than the northern one. According to the distribution of burnt flint the hearth was located in the northeastern part of the southern zone, close to the northern zone, see Fig. 6,E.

At Hylteberga no.9 an entrance tunnel could be seen connected to the dwelling pit on the southern side, where the "platform" and the adjacent zone met (L. Larsson 1975:15). This situation corresponds nicely with the position of an entrance proposed for the Aggemose site: On the border between the two zones (Grøn in press).

The eastern hearth structure containing ashes and burnt stones may according to this interpretation, belong to another period, but judging from its position it is likely to be an external hearth, a phenomenon which seems to be rather common in the dwellings of the Kongemose and Ertebølle Cultures (Grøn in press).

The restricted number of artefacts found at the site seems to indicate that it was only inhabited for a short period. In most of the Maglemosian cases studied (Grøn 1995:10,39-41), it was obvious that only smaller objects such as microliths had avoided collection during cleaning of the dwelling floors, their distributions thus reflecting the original activity patterns. The fact that large items, such as the knives at Aggemose, have retained rather significant distribution patterns within, and immediately around, the main concentration must indicate that the site was used for so short a period, that no cleaning of the surface had taken place.

## THE AGGEMOSE SITE AND THE SETTLEMENT PATTERN OF THE KONGEMOSE CULTURE IN SOUTHERN SCANDINAVIA

The sites of the Kongemose Culture have hitherto been known mainly from northern Zealand and Scania. Material of Kongemose character has been found at a number of large mixed sites in the remaining part of southern Scandinavia (S.H. Andersen 1971; Mathiassen 1937:94-97; 1948:146-148; Schwabedissen 1944). Only in a few cases has unmixed material from the latest phase of the Kongemose Culture been found to the west of the Great Belt (S.H. Andersen 1970). With the find of the Aggemose site, the first known representative of the early Kongemose Culture in this area, there is no reason to assume that the development here differed from that east of the Great Belt, in spite of the lack of "classical" Kongemose sites of the Villingebæk phase outside Zealand and Scania. The lack of classical sites may very well be a consequence of the fact that these were generally coast-bound and therefore are found today at some depth in the sea in the southern and south-western Danish area.

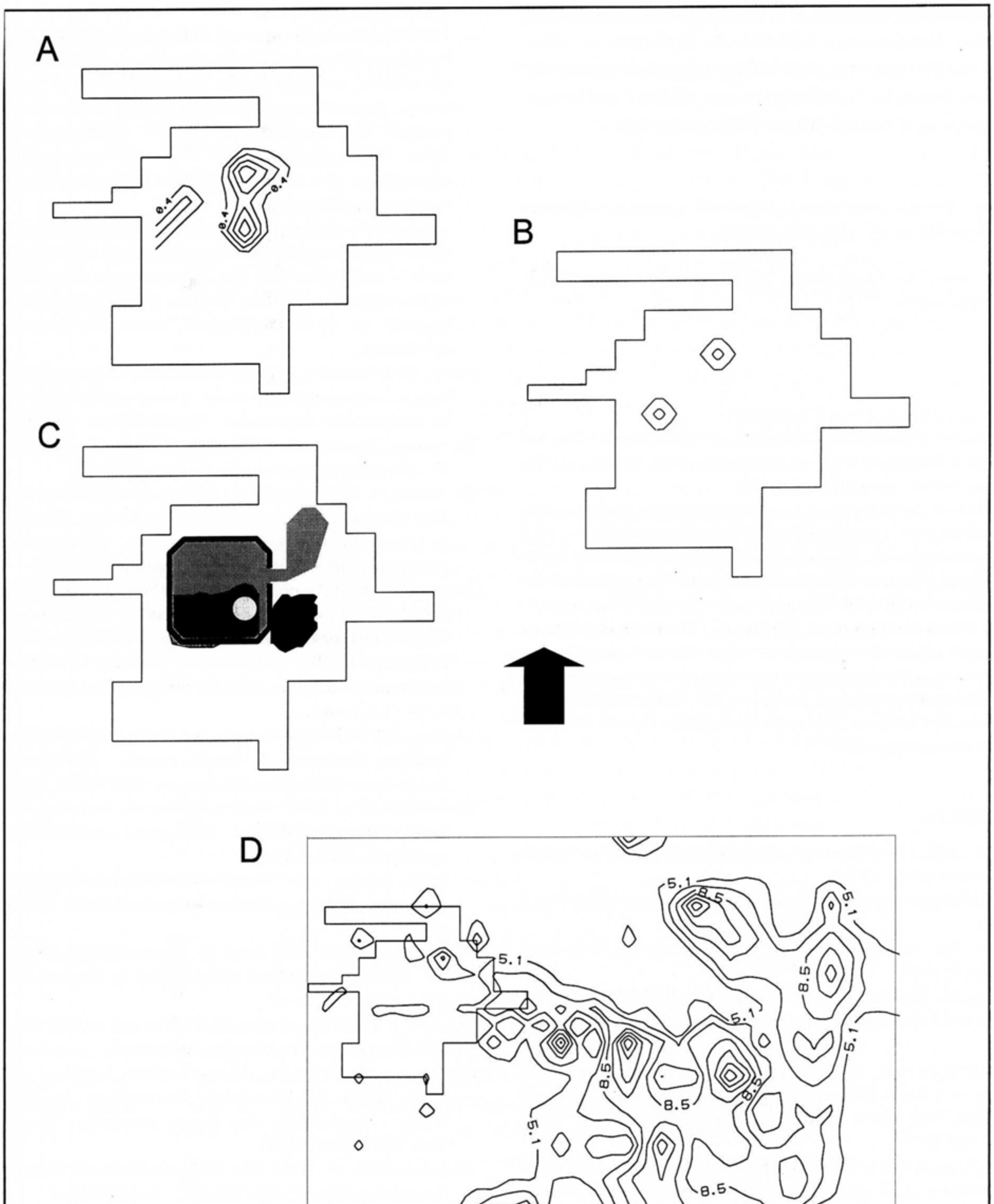
The fact that the Aggemose site seems to represent an inland site used only for a short period, fits the picture we have of a massive coastal settlement, with inland resources being exploited from small extraction camps. From this point of view it is regrettable that there are no faunal remains from the site which can give a direct indication of the economical activities carried out here and of the season(s) during which the site was used.

The group that inhabited the site must have been very limited in size. On the basis of surveys carried out around the site it is to be regarded as very unlikely that other similar habitation units are located on the same shore within a distance of 40-50 m.

## CONCLUSION

The Aggemose site provides us with the first example from Denmark of a link between what must be regarded

Fig. 8. Distributions of: A, burin spalls, equidistance 0.4, *max=2*; B, burins, equidistance 0.4, *max=1*; D, phosphate on and around the site, equidistance 1.7, *max=17*. C is a model of the organisation of the proposed dwelling on the site, with a northern platform, a deeper flooring to the south, with an inner hearth, the entrance and an external hearth possibly contemporaneous with the dwelling.


A
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8.5

as the structural remains of a dwelling and finds dating from the Kongemose Culture. It indicates a clear change in the pattern of dwelling organization at the transition from the final Maglemose Culture to the early Kongemose Culture (Grøn 1995; in press).

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## NOTES

(English text revised by David Robinson)

1. Langelands Museum, Rudkøbing, file no. 8609. Jørgen Holm, the excavator, is thanked for good discussions of the material and his positive help in our publication of it.
2. Niels Hartmann carried out a spot-test phosphate analysis on the site and his report is included in the excavation records. For each point of analysis the phosphate content was analyzed 40, 50, 60 and 70 cm below the top of the plough soil. On the basis of the colouring developed by the reaction, each sample was given a value from 0 (nothing) to 5 (maximum). The interpolated plans are based on the average of these values in each point. In the central parts analysis was made in each corner of a square meter net. Outside the excavated area up to 6 m to the north, 25 m to the east and 6-14 m to the south of it, in the corners of 2 by 2 meter squares (Fig. 8,D).

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# *Lollikhuse*

## - a Dwelling Site under a Kitchen Midden

by SØREN A. SØRENSEN

### INTRODUCTION

Despite almost 150 years of research into settlements from the Ertebølle Culture, our knowledge of dwellings from this period is still extremely limited.

Dwellings are an important facet in settlement analyses, which have achieved prominence, particularly in recent years. The reason that so much importance is attached to dwellings is that they are seen as the controlling constructional element in a settlement, about which all other structures and activities are organised. Similarly, attempts have been made, using dwellings as a starting point, to estimate the size of groups and male/female ratios (Grøn 1987). These are the most important reasons for intensifying the search for dwellings. Attempts have been made to demonstrate the locations of dwellings using the distribution of artefacts and the occurrence of hearths, not only in new excavations, but also in excavations carried out in the past (Brinch Petersen 1972; Blankholm 1985; Grøn 1987). Other researchers have pointed out that these distribution patterns do not necessarily reflect "indoor" activities, but could equally well be the result of activities out of doors (Bokelman 1986:150; Stapert 1994).

The work described above has exclusively been applied to sites of the Maglemose Culture, but the approach can equally well be applied to the Kongemose and Ertebølle Cultures. We probably need to recognise that in the absence of any traces of the constructional elements of the dwellings, then it is only possible to demonstrate the possible presence of a dwelling through the position of hearths and the distribution of the finds. An element such as "wall effect" has been introduced into the discussion. However an abrupt end to the find concentration need not necessarily be the result of a wall, but, as pointed out by Bokelman (1986), could also be the result of knapping flint besides a fallen tree trunk or whilst sitting by a windbreak.

In research into dwellings in recent years there has been a clear tendency to present a "standard dwelling" which satisfies certain requirements made by the analytical methods used. This "standard dwelling" is all-important when accepting or rejecting other finds interpreted as dwellings. The unfortunate side of the matter is that nearly all the archaeologists involved in dwelling research, operate with different "standard dwellings" and it is therefore seldom that they accept each others dwellings (Blankholm 1989; Bokelman 1986; Grøn 1987; Stapert 1994). A point which it is important to emphasise in this respect is that the various "standard dwellings" do not a priori reflect details of construction, rather the activities which have taken place at the site. When one operates with the term "standard dwellings", or perhaps it would be more correct to talk of "standard patterns", it is in reality a particular and repeated behaviour one is trying to demonstrate. The most common starting point is a hearth, about which several particular activities are thought to have taken place, and which can be compared from site to site. It would be beyond the remit of this article to review all the various methods which have been used to demonstrate dwellings. However there is a general need for tolerance of a certain variation in the appearance of dwellings.

If we look specifically at dwellings and dwelling outlines from the Ertebølle Culture, then there have, over the years, occasionally been published structures which have been interpreted as dwellings; these will be reviewed later in this article. A common feature of the majority of the structures published to date is that they have not won broad acceptance in archaeological circles. In other words we have a clear problem of documentation with regard to the demonstration of Mesolithic dwellings. A step in the right direction in recognising dwellings must be the opening up of much larger areas in excavations and a much more tenacious search for dwellings, whose small postholes do not necessarily leave clear traces. Traces of stakes hammered into the ground can easily be confused with animal burrows if they are not sectioned.

In the following account a recently excavated dwell-

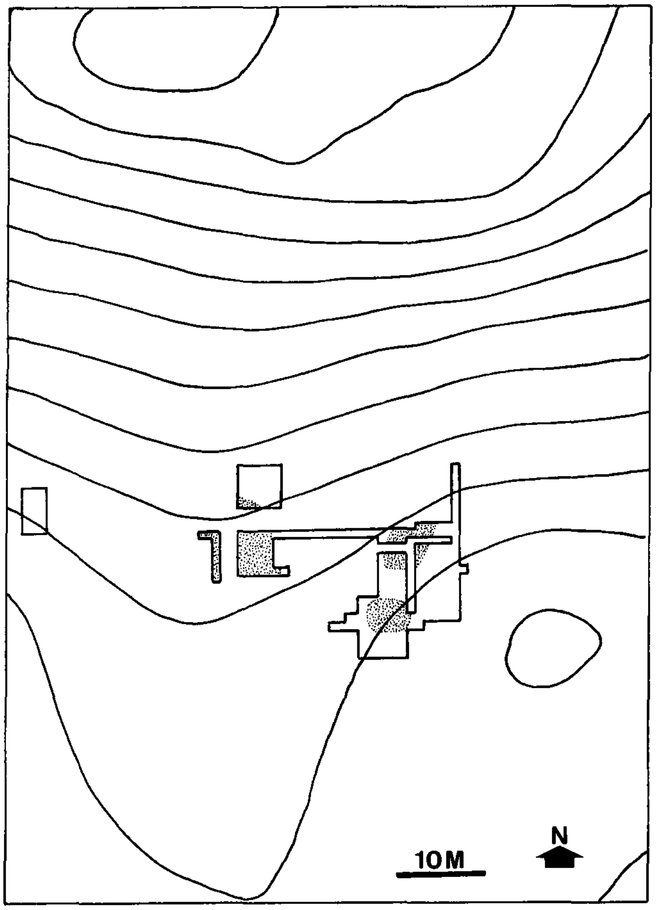



Fig. 1. Map showing the extent of the excavations at the Lollikhuse kitchen midden. The dotted areas signify the three large depressions found at the site. Only the southernmost of these, which is interpreted as the remains of a dwelling with a sunken floor, has been fully excavated.

ing-site under a kitchen midden at Lollikhuse in Hornsherred on Zealand will be described (1). The dwelling site is clearly visible as a complex of several evident structures in the settlement.

The dwelling site is part of a very large Ertebølle settlement, which normally means that there have been numerous repeated settlements at the same locality. There are also clear indications that the occupation of the Lollikhuse kitchen midden extended over a very long period of time, which makes it difficult to analyse the dwelling relative to the adjacent structures. Accordingly, it has not been possible to separate out with certainty the structures on the site which are contemporary with the dwelling site. None of the methods we have at our disposal today is able to demonstrate fully whether various structures are contemporaneous. This is probably one of the most important problems when carrying out settlement analyses on large settlements.

As many presumed dwelling-sites have been recognised with the aid of distribution analyses, the same method will be used on the dwelling-site at Lollikhuse in order to compare the structures demonstrated using this line of evidence.

### *The dwelling site*

Archaeological excavations were carried out at the Lollikhuse settlement in 1989 and 1991. Already in the first season of excavation, three large, very dark areas of fill were observed (fig. 1). None of these areas was excavated in full at the time and it was therefore not possible to interpret them with certainty. It was in order to establish the character of these fills that the excavation was resumed in 1991 (2).

In 1991, the excavation of feature 21 was completed, apart from a small area which lay under a baulk. The feature comprises a shallow pit, 0.2-0.3 m deep, 5.5 m long and 4.0 m wide; it is interpreted as a the remains of a slightly sunken dwelling (fig. 2). The whole of the depression was overlain by a solid 10 – 15 cm thick layer of shells, mostly of oysters. This layer contained artefacts dating from the Late Ertebølle Culture and was deposited when this part of the settlement was transgressed.

The interpretation of the depression as a dwelling-site is based on various lines of evidence – both in the form of evident structures and latent features, which together comprise the structural complex which is the dwelling.

Along the western and southern edges of the depression, several postholes and stakeholes were excavated. These are interpreted as traces of the building's superstructure. It should be mentioned that there possibly also was a row of stakes along the northern side of the depression, which was excavated two years earlier. We cannot be sure of this due to the method of excavation which was employed in the first year of excavation. Fill was excavated layer by layer and where dark areas appeared in the lowest layers these were emptied rather than sectioned. On the excavation plan the edge of the hollow is seen therefore with an unusually lobed appearance. This can presumably be interpreted as being the result of a row of stakes which stood on the northern side of the dwelling.

The reason for a distinction having been made between postholes and stakeholes is that there is very great variation in the dimensions of the holes which were registered along the edge of the depression, and that the postholes had been dug whilst the stakeholes were the result of stakes having been hammered into the ground. Postholes were found only at the western end of the dwelling. They were 0.3 – 0.5 m in diameter and 0.2 – 0.3 m deep. Two of them were lined with stones. In contrast, the stakeholes were only between 0.1 and 0.2 m in diameter and between 0.1 and 0.2 m deep (fig. 3).

Another piece of evidence which supports the interpretation of the feature as a dwelling site is that in the western end of the depression there is a round stone-paved hearth. The hearth measures 0.8 – 0.9 m in diameter and is constructed as a flat cobbled area containing various types of stone. A section through the hearth showed that it had been laid over an earlier hearth, presumably of the same type, from where some of the stones had been robbed.

In the northwestern part of the depression there was a patch of grey ash as well as scattered occurrences of fire-shattered stones. There must therefore also have been a kind of hearth here, although of type other than that described above. An important difference between the two hearths is that there were large amounts of charcoal around the first, whereas the second was characterised by grey ash and almost no charcoal.

The fact that there were two phases represented in the stone-paved hearth, indicates re-use of the dwelling, in connection with which it was necessary to renew the hearth. It is not however possible to determined to what

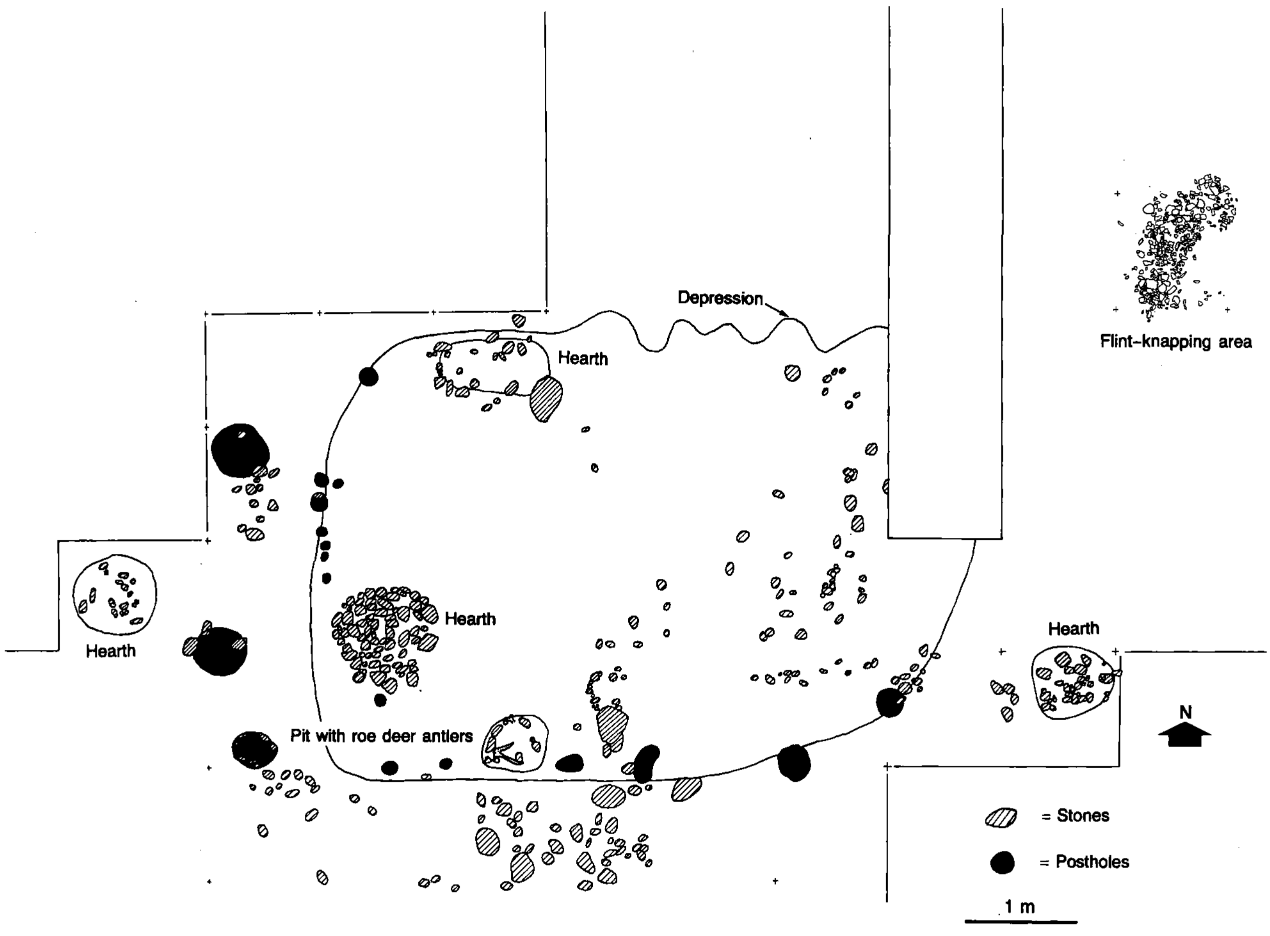



Fig. 2. Feature 21, the dwelling site. The depression measures c. 5.5 x 4 m and is surrounded by stake- and postholes. In the western part of the depression there is a round, stone-paved hearth which had been renewed. North of this lies a patch of grey ash containing a single fire-shattered stone. On the southern edge of the depression there is small pit edged with stones, in which a roe-deer antler was found.

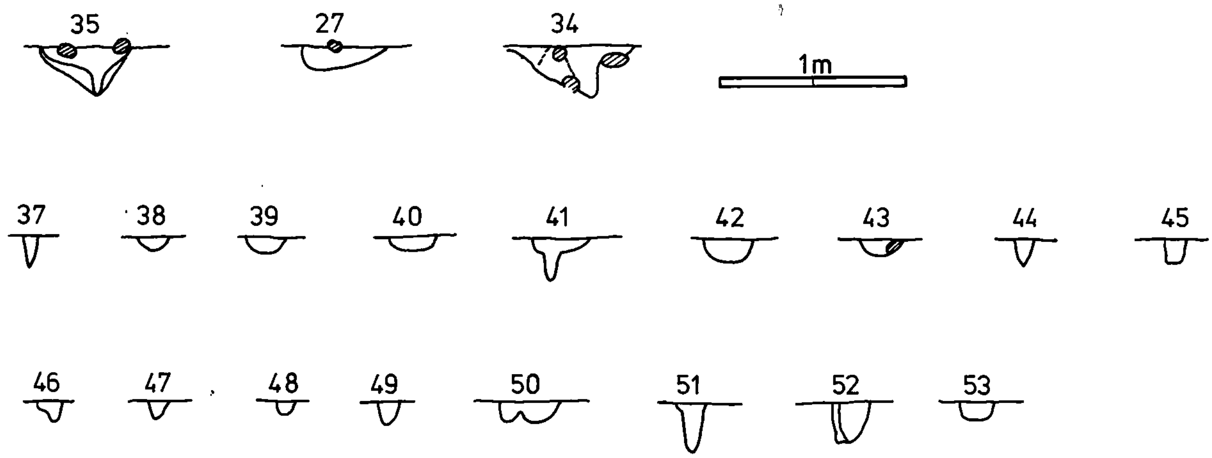



Fig. 3. Sections through the stake- and postholes found around the dwelling.

extent the northern hearth was in use at the same time as the stone-paved hearths.

A last piece of evidence, which supports the interpretation of the feature as a dwelling-site is the size and shape of the depression itself (fig. 2). Its virtual rectangular shape and its size (ca. 22m$^2$) corresponds to the general picture we have of Mesolithic dwellings (Newell 1981:272 ff.). Many of the structures which have been previously interpreted as dwellings have turned out to be the result of the root net of a fallen tree (Newell 1981:235 ff.). The carefully constructed stone-paved hearth in the Lollikhuse dwelling shows quite categorically that this is not the case here.

The length of the depression was, as mentioned above, 5.5 m, but the dwelling as a whole has had a length of ca. 6 m, as there were three postholes lying approximately 0.5 m west of the edge of the depression.

As is evident from the excavation plan (fig. 2), there were also two hearths outside the dwelling. It is possible that these are not proper hearths but piles of discarded limestone "cooking stones". Both features consist of fire-bleached and shattered limestone flags, several of which could be refitted. It is possible that flat pieces of limestone such as these were used as a kind of pan over the hearth. A similar stone, bearing charred food remains, has been found at another Ertebølle site. This stone was however not of limestone but another kind of rock. It was found at the Ertebølle site of Agernæs in northern Funen (Anders Jæger, pers. comm.).

Some few metres to the northeast of the dwelling there was a flint knapping site, where the product was almost exclusively transverse arrowheads. It is not however possible to establish whether the activity here was contemporary with the dwelling. Meanwhile, there is very close typological agreement between the arrowheads found in the dwelling and those from the flint-working site.

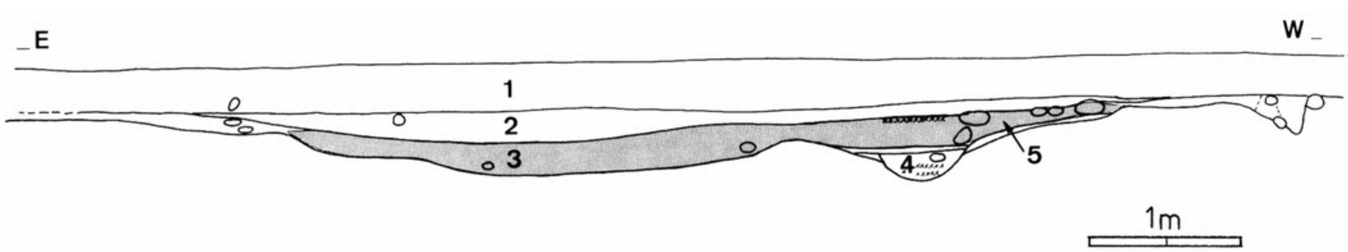



Fig. 4. Section east-west through the dwelling (east to the left and west to the right). 1: plough soil, 2: shell layer – mostly oysters, 3: fill, reddish-brown, in some places greyish due to the presence of ash, 4: pit with very light-coloured fill consisting mostly of sub-soil, older than the fill in the dwelling, 5: stone-paved hearth.

*The depression and its fill*

Most of the hollow was overlain by a compact layer of shells, of which the great majority was of oysters. This layer is a transgression layer, presumably deposited at the Littorina maximum which falls in the Ålekistbro phase. Between the shells there were occasional bones and tools of Late Ertebølle type as well as quantities of undatable flint debitage.

After removal of the shell layer the dark fill of the dwelling site stood out clearly against the sandy clay sub-soil. The fill had a characteristic reddish-brown colour and its content of marine shells was very modest. In some places the reddish-brown colour changed to a more ash grey colour, but these grey patches were of a more local nature. The whole fill contained artefacts from the Early Ertebølle Culture. It was not possible to discern any stratigraphy in the fill either on the basis of artefact typology or in the transverse section which was dug across the depression. An actual floor layer could thus not be identified. We meet a similar problem in the much later pithouses from the Viking Age.

In the transverse section it was however possible to register a deeper depression under the fill in the western end of the hollow close to the stone-paved hearth. This was filled with material of the same colour as the surrounding sub-soil (fig. 4). It was only its modest content of shells, in addition to a couple of bone fragments and a couple of charcoal stripes which distinguished this pit from the sub-soil. Its function is unknown but it was clearly back-filled before the dwelling came into use, as the fill is very light in colour and almost devoid of cultural remains.

On the southern side of the dwelling another feature was investigated, which on the basis of its appearance and stratigraphical observations must be contemporary with the dwelling. It consisted of a circle of stones 0.4 – 0.5 m in diameter (fig. 5). The stones were of a very modest size, up to 0.15 m in diameter. Within the stone circle in its southern part, lay a roe-deer antler. Complete roe-deer antlers are far from common at the settlement; in addition to the one mentioned above only one further intact example was found. The latter was also found within the dwelling site, in its central part at the base of the depression.

Two of the stones in the stone circle attracted attention by virtue of their red colour – they were both made up of very decomposed sandstone. The stone circle

Fig. 5. Pit edged with stones and containing a roe-deer antler, found at the edge of the dwelling and interpreted as a sacrificial pit.

touched a ca. 0.1 m deep pit with a dark brown fill quite rich in charcoal, particularly at the base which in places had a reddish hue due to the heat. The fill also contained a few small fragments of bone.

At several points in the fill of the dwelling site there were patches of red ochre, particularly near the bottom of the depression. The majority lay in the eastern half.

Finally it should be mentioned that there were two large stones, 0.3 – 0.4 m in diameter, in the depression. These lay opposite each other about 2 m from the western end of the hollow and suggest perhaps that the dwelling had some form of internal division.

The material which had been removed in the course of creating the depression, comprising very sandy clay sub-soil, had been placed to the north and west of the hollow. Particularly to the north of the dwelling, a large heap of excavated sub-soil could clearly be seen. Taking the level of the sub-soil in and around the dwelling site showed how deposition of the excavated material had led to the formation of a small mound to the north (fig. 6). As it was not possible to detect any buried topsoil or culture layer under the excavated material, the area must apparently have been severely eroded when the dwelling was built. Within the excavated clay sub-soil there were however often clumps and pockets of culture layer which made observation difficult in this area. This was possibly a contributory factor in the row of stakeholes along the northern edge not being registered during the first season of excavation.

*Dating of the dwelling*

The dating of the dwelling is based exclusively on a typological dating of the artefacts which were found in the depression which was part of the dwelling. The most important of these are the transverse arrowheads which were found in the fill. These points are unequivocal indicators of a date in the Early Ertebølle Culture. This is further supported by the absence of flake axes in the dwelling. In the shell layer overlying the dwelling a few flake axes were found, but there were none in the fill itself. Apart from the morphology of the transverse arrowheads, there are no reliable diagnostic artefact types for the Early Ertebølle Culture on Zealand (Vang Petersen 1984 p. 11), and is therefore important for the dating of the dwelling that all types characteristic of the Late Ertebølle Culture are absent from the fill.

*Interpretation of the structures*

As is already apparent from the above, the depression is interpreted as the remains of a sunken dwelling site. In the following however I will attempt a synthesis of the individual observations regarding the features in and around the depression.

It is the depression itself, which measures ca. 5.5 x 4.0 m, which defines the limits of the dwelling. Around the depression there was a series of small stakes and a few larger posts. The larger posts lie ca. 0.5 m from the western end of the depression and it is presumed that these posts met in a "fork" ca. 2 – 3 m over the floor of the dwelling. From this fork, a long sloping ridgepole extended down along the dwelling's long axis. The stakes were hammered in and attached to the sloping ridgepole.

A construction such as this means that the western end of the dwelling was significantly higher than the eastern end, where the ridgepole is presumed to have ended at ground level. If we look at the features which are present in the dwelling we can see that it is in the western end of the dwelling that the hearths are located. At both the points where hearths are registered, the depression is not so deep as elsewhere in the dwelling. If we maintain the theory that different activities took place in the eastern and western ends of the dwelling, it is interesting that the only division between the eastern and western ends consists of two large stones. It is thus possible that there was an internal division in the dwelling consisting perhaps of a screen of hides or some other similar material. In the outer room there were hearths, whereas in the inner room there were presumably sleeping quarters. It is possible that other activities took place here such as the repairing of flint tools,

The pit with stones around its circumference, and containing the roe deer antler, can be interpreted as a small offer pit, placed in the outer room close to the stone-paved hearth. It is not possible to give a more practical explanation from the pit for which there is no close Danish parallel.

This is not the first time that large hollows on Mesolithic settlements have been interpreted as dwelling sites (L. Larsson 1974, 1985). These interpretations are often met with a certain amount of scepticism from other researchers. It also appears as rather an impractical construction which would concentrate damp and cold. We know however from Maglemosian dwelling sites, built in wetland areas, that people knew how to insulate themselves against the worst of the cold and the damp by constructing floor layers of bark (Andersen *et al.* 1982; Sørensen 1988:60). A corresponding construction, perhaps consisting of thin branches, grass and bark could have made the sunken dwellings significantly more attractive to live in. A construction such as this would also explain why both hearths are slightly raised above the level of the rest of the dwelling floor. It would not have been very sensible to built the hearths on a floor consisting of easily-ignited inflammable organic material.

The patches of red ochre, which were present in the fill can possibly be interpreted as traces of pelts smeared and coloured with this substance. This explanation has previously been proposed in connection with occurrences of ochre in Mesolithic graves (Brinch Petersen 1990:24). Seen in connection with the above, one could imagine that the basal layer of branches, bark and grass was covered by skins. With a construction such as suggested here, the sunken floor would not have made the dwelling damp and clammy, on the contrary it would have been dry and warm.

In discussions of Mesolithic dwellings, arguments have been presented for and against interpreting flint concentrations as being indications of a dwelling site. It is possible that both adherents and opponents of this theory are correct, in that there could be two different types of house floor construction which behave differently with regard to the occurrence of flint on the dwelling floor. It is a logical to conclude that large quantities of flint on the floor would be very inconvenient, if activities in the dwelling took place directly on top of the sharp-edged fragments. However, if the floor consisted of a thick layer of twigs, bark and grass, then small flint pieces would just disappear between the twigs. With other types of floor construction, on the other hand, it is more likely that as much flint as possible was collected and removed from the floor. One important point should however be remembered and that is that flint concentrations reflect functions and activity areas or possibly deposits, and only on those occasions when the activities took place in the dwelling will they also reveal its location. In the absence of traces of any kind of construction, flint concentrations can therefore just as easily reflect outdoor activity areas.

If we look at the occurrence of flint in the remains of the dwelling investigated here, it is characteristic that there are large quantities of flint within the area delimited by the outline of the dwelling; this flint is however almost exclusively in the form of very small pieces. Tools have apparently been produced occasionally or repaired in the dwelling, as revealed by the presence in the fill of several edge flakes, an unfinished tooth bead and debitage from the production of transverse points. It is in particular the finding of two Krukowski microburins and a number of unfinished arrowheads which suggest that production took place within the dwelling itself.

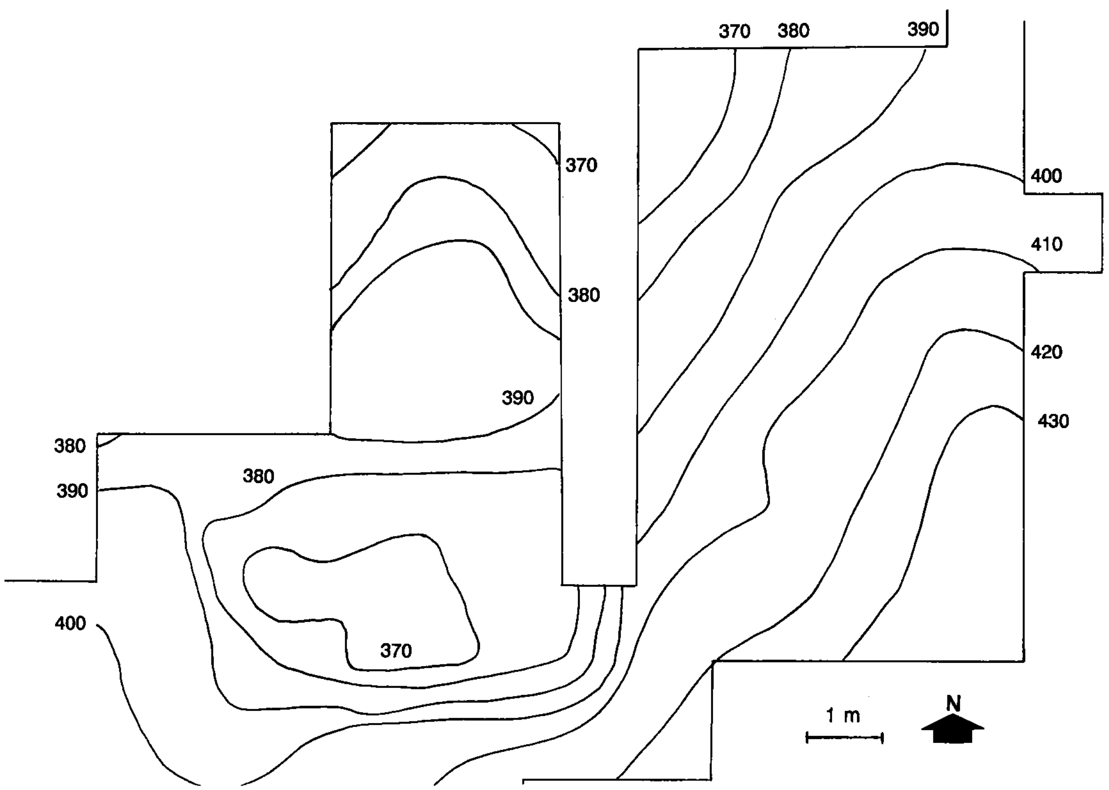



Fig. 6. Levelling of the sub-soil surface after removal of the culture layer and the fill of the depression. The depression stands out clearly, and it can also be seen that part of the excavated sub-soil was deposited just to the north of it. The heights are given in centimetres above sea level.

The analysis and refitting of the flint fragments has not as yet been completed and it is possible that these investigations will provide some interesting new information. The fact that the dwelling is constructed around a depression in which the find-bearing deposits are much thicker than those outside it is important when considering that the concentration of flint per square metre in the area of the dwelling is significantly greater than that of the near surroundings. It is therefore of particular interest whether there is a difference between the types that are found in the dwelling and those found around it.

### *The dwelling as a latent feature*

If we ignore the evidence from the constructional traces which delimit the dwelling and carry out an analysis of the distribution of the artefacts, the dwelling also stands out very clearly. The distributions of fire-shattered stone and flint waste both reveal the presence of the dwelling through marked high values (fig. 7 & 8). This however is hardly surprising as the sunken floor means that the find-bearing layer is much thicker in the immediate area of the dwelling. It is however interesting to note the distribution of fire-shattered stones on the site; the greatest concentrations do not coincide with the stone-paved hearths lie, as one would expect. The situation is almost the reverse, with very few fire-shattered stones around the hearths. This situation is seen most clearly with regard to the two stone-paved hearths lying on the eastern limits of the excavation (fig. 8). However, even the stone-paved hearth inside the dwelling lies on the edge of the concentration of fire-shattered stone. The situation is different with regard to the cooking/hearth pits, which were registered at various points on the site. These structures lie where the concentration of heat damaged flint is greatest. The interpretation of these observations must wait, but it is interesting in connection with the reconstruction of the location of the hearths in the settlement, that not all hearths mark their presence with high concentrations of fire-damaged flint.

With regard to the tools, it is burins and waste from their production in particular, which are more abundant in the dwelling than elsewhere on the site. They also form a concentration slightly to the north of the dwelling site described here, where there was an eroded depression which could possible be the remains of yet another dwelling. An overall picture of the activity areas is obtained by plotting the distribution of axe sharpening flakes, burin waste and Krukowski microburins on the same figure. All these are waste products from the sharpening or production of flint tools and they are of a size such that they often remain at the place where they were produced. Figure 9 shows the distribution of the waste products and on the figure the dwelling appears as two separate concentrations, possibly corresponding to the room division suggested earlier. It must however be concluded that without the depressions, postholes and hearths, it would have been very difficult to separate the dwelling's activity areas from the corresponding activity areas present elsewhere on the site. Only the concentrations of waste flakes and fire-damaged flint reveal the outline of the dwelling very clearly. This situation should not however be considered as being of decisive importance in the interpretation of the feature as the remains of a dwelling, as quantitative analyses will always be influenced by the thickness of the find-bearing layer, which is of course greater in the area of the depression. As there does not appear to have been deposited much fire-damaged flint around the stone-paved hearths, the high concentrations of these in the dwelling can possibly be explained in terms of the dwelling having been burned down. This would also explain why the fill is ash-grey in colour in certain parts.

### *Parallels to the dwelling*

It is obvious to look for parallels to the Lollikhuse dwelling in the very extensive evidence from the Ertebølle Period which has been accumulated during the last 150 years. A literature search does not however throw up many possible counterparts to the Lollikhuse dwelling. A total of seven localities, where features have been interpreted as the remains of dwellings with sunken floors, are mentioned:

1. *Vegger* on the Limfjord (Simonsen 1952). On a sloping stretch of coast it could be seen that the slope had been dug into and an area ca. 5.5 x 2 metre partly levelled (P. Simonsen 1952:202). On the presumed floor level there were several stone-lined hearths. In a later expansion the levelled area was extended to 6 x 2.5 metres and in this phase there was only a single hearth associated with the floor level. No evidence was found of posts or stakes in connection with the feature and it

Fig. 7, right. Distribution of flint debitage in and around the hut. The large concentration to the northeast of the dwelling comes from a flint knapping workshop. The interval between the lines is 100.

Fig. 8, below, left. Distribution of fire-shattered stone in and around the dwelling. The outline of the dwelling is clearly seen from the distribution pattern, but it is interesting to note that there is no specific concentration of fire-shattered stones around the stone-paved hearths. In order to illustrate this better, two stone-paved hearths lying outside the dwelling are marked with circles. The greatest concentrations of fire-shattered flint occur in places where cooking pits or sunken hearths were registered. The interval between the lines is 10.

Fig. 9, below, right. Distribution of axe sharpening flakes, burin waste and Krukowski microburins. The concentrations reveal various activity areas at the site where flint tools have been produced, repaired and used. The flint-knapping workshop, the centre of which is shown completely black, shows very high values for Krukowski microburins, as it was almost exclusively transverse points which were produced here. In the dwelling two distinct activity areas can be seen. These possibly indicate that the dwelling was divided up into two rooms, a conclusion supported by the location of the hearths and of two large stones on the edge of the depression. The interval between the lines is 1.

Fig. 7.

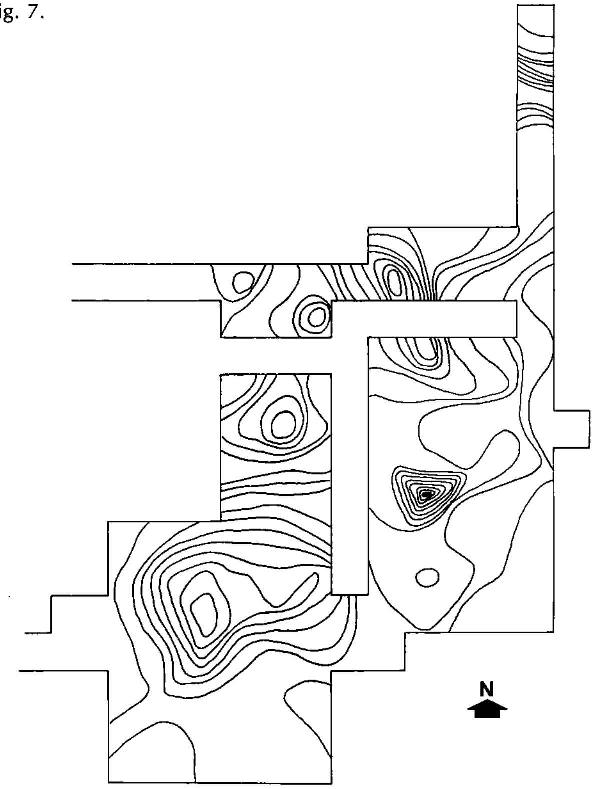



Fig. 8.

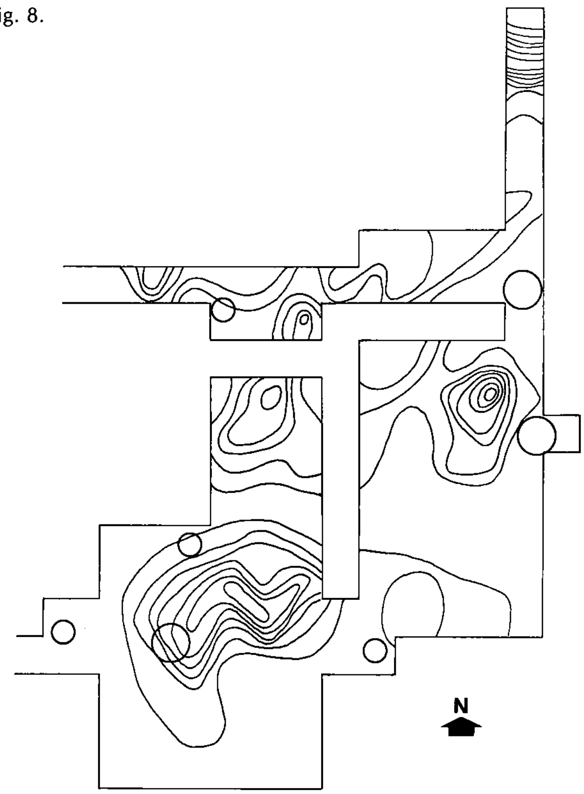
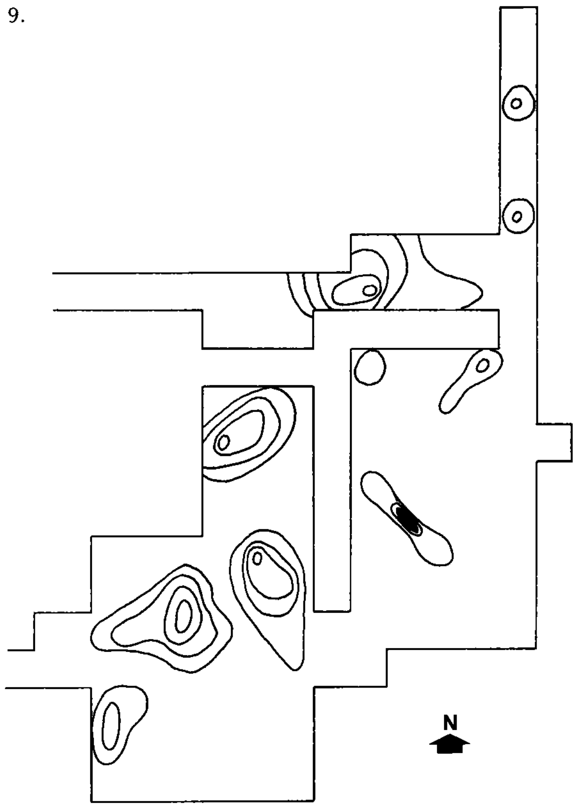



Fig. 9.



has never won acceptance as the remains of a dwelling, although it was unambiguously interpreted as such by the excavator (Simonsen 1952:199).

This is not a direct parallel to the dwelling site at Lollikhuse, and a number of factors, including the lack of posts and the pronounced slope of the floor level (3) does not seem consistent with an interpretation of the feature as a dwelling. On the other hand the locality at Vegger cannot be completely dismissed, as postholes could possibly have been overlooked.

2. *Vængesø*, Helgenæs, is another locality where excavation of a coastal slope in order to create a level surface has been observed (S.H. Andersen 1975). Apart from a large elongated hearth along one side of the terrace (4), no traces of constructions were demonstrated in connection with the levelled area (S.H. Andersen 1975:15). Mention is however made of the fact that the concentration of finds was greatest in the levelled area.

According to the excavator, the hearth's eccentric location on the levelled area is evidence against the interpretation of the terrace as a dwelling site, despite the fact that he refers to the site at Vegger where the same observation was made (S.H. Andersen *op. cit.*). We also see an eccentrically located hearth at Lollikhuse, so this detail should not be used negatively in an evaluation of the Vængesø terrace as a dwelling site. However as the excavator himself quite rightly concludes, it is not possible to establish with certainty whether there has been a dwelling on the surface of the terrace as any evidence of a construction is lacking.

3. *The Ertebølle site* (*locus classicus*) has also been mentioned in connection with traces of dwellings with sunken floors (Simonsen 1952:222 ff.), but in this case re-excavation of the site was able to discount the presumed feature (S.H. Andersen & E. Johansen 1987:48).

4. *Strandegård*, which contains remains from both the Ertebølle and Funnel Beaker Cultures is yet another site from where the remains of a dwelling with a sunken floor dating from the Ertebølle Culture have been published (H.C. Broholm & J.P. Rasmussen 1931:265 ff.). The fact the feature described is the remains of an Early Neolithic long barrow seems beyond reasonable doubt today.

5. The best parallels to the Lollikhuse dwelling are to be found in Scania. At the settlement site of *Skateholm I*, a very large slightly sunken feature (anlæg 10) has been investigated and interpreted as the remains of a sunken dwelling (L.Larsson 1985). The depression has a depth of between 0.2 and 0.3 m and it measures no less than 10.7 x 6.5 m (L. Larsson 1985:199). At the base of the sunken area 23, features are registered which are interpreted as postholes (L. Larsson 1985:200), as well as an eccentrically-located hearth in the southwestern corner of the sunken area (L. Larsson 1985:291). A more centrally-located hearth was shown by radiocarbon dating to date from the Late Bronze Age and can therefore be ignored.

6. A feature described as the remains of a sunken dwelling is also known from the Kongemose settlement of *Saxtorp 11:9* in Scania (L. Larsson 1974). The depression here measured 5 x 4 m and the depth varied from 0.1 – 0.4 m (L. Larsson 1974:6). At the base of the depression there were four features which are interpreted as postholes, as well as an area in the western part of the depression with burnt stone and charcoal, interpreted as the remains of a hearth (L. Larsson 1974:7 ff.).

7. At the site of *Bredasten* in Scania we find a seventh structure interpreted as a dwelling from the Ertebølle Culture. It might be considered here even though the construction, consisting of a circular ditch and some postholes, is somewhat different from the Lollikhuse dwelling. Despite the fact that the floor is not actually sunken, this hut structure may be related with the structures mentioned above. The Bredasten structure measures 6 x 6 m. The circular ditch is 0.5 – 1.0 m wide and 0.1 – 0.4 m deep. Faint traces of charcoal in the centre are interpreted as the remains of a hearth (M. Larsson 1986).

It has not been possible to find absolute parallels for the Lollikhuse dwelling, but it appears to have some features in common with the sites in Scania, notably a slightly sunken floor and a non-central hearth, usually on the western edge of the sunken area. One feature which clearly distinguishes Lollikhuse from the two Scanian dwelling sites is that in the former the postholes in the construction are located around the margin of the dwelling whereas in the latter they are located in the dwelling itself.

An obvious question is why have we not found more features of this kind, given the numerous excavations which have taken place on our Ertebølle sites? An important factor to be considered, is that in the majority of Mesolithic excavations large areas have not been exposed and without these it is almost impossible to demonstrate the presence of a dwelling site. Another explanation is that there were probably several dwelling types in existence contemporaneously in Ertebølle times. This situation is known from a series of ethnographic parallels in hunter-gatherer societies, for example in Greenland, where there is a very marked difference between winter and summer dwellings. The dwellings with sunken floors need only represent one of the dwelling types which were in use in the Ertebølle Culture.

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## NOTES

1. The kitchen midden lies in Selsø parish, parish register no. 77, Hornsherred, Frederiksborg county.
2. The excavation in 1991 concentrated on two of the large areas of dark fill, feature 9 and structure 21. Feature 9 is by far the largest of the features investigated and as yet it has not been excavated in full. Accordingly its absolute size and function is not yet known.
3. On the section drawing on p. 206, fig. 6 it is evident that the "floor level" slopes no less than 0.5 m over a distance of only 2 m, which must be seen as rather excessive if the structure is to be interpreted as a hut.
4. The hearth measured no less than 4.8 x 1.5 m.

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# *Small Mammals from Danish Mesolithic Sites*

by KIM AARIS-SØRENSEN and TINE NORD ANDREASEN

## INTRODUCTION

Bones of small mammals (Insectivora and Rodentia) have often been dealt with briefly or even neglected in archaeozoological studies of faunal remains from Danish Mesolithic sites. This may be due partly to the moderate number of specimens usually recovered at each site, and partly to the fossorial habits exhibited by most of the species. The latter circumstance often casts doubt on whether the small mammal bones share with the rest of the bone assemblage a contemporaneous origin in the deposits.

Modern excavation techniques, applied at Mesolithic sites for the last twenty years, have included water-screening of selected samples or even of the entire deposit. This procedure has substantially increased the quantities of small mammal bones retrieved, making interpretations of micro-faunal assemblages more urgent. The aim of this paper is to model the pre-burial taphonomic pathway of small mammal bones at Mesolithic sites. This is attempted through a detailed analysis of a large sample from an Ertebølle settlement, combined with an overview of data from 29 other Mesolithic sites in Denmark.

It will be demonstrated that no single process can explain the presence of the rodents and insectivores at the settlements. Several causes are involved and only some of them include human activity.

## MATERIAL

The primary sample used in this study consists of 220 small mammal bones from the Mesolithic settlement of Maglemosegård (Table 1). This settlement is situated on the south coast of the former Vedbæk Fjord, a small Atlantic-Early Subboreal inlet in northeastern Zealand.

The great majority of the bones derive from a large midden accumulated on land, and they date to the older part of the Ertebølle period. The site was excavated in 1975-78 in connection with the interdisciplinary "Vedbæk-project" of which the main participants were the National Museum, the Institute of Prehistoric Archaeology and the Zoological Museum, both at the University of Copenhagen (see e.g. Brinch Petersen *et al.* 1976, 1977, 1979 & 1982).

An overall description of the faunal remains from Maglemosegård and other Vedbæk Fjord settlements has previously been published (Aaris-Sørensen 1980a, 1980b, 1982 & 1988), and the Maglemosegård assemblage has been used in a study of the magnitude of the general taphonomic loss at Mesolithic sites (Aaris-Sørensen 1983). The large number of fishbones and the kind of fishing they represent have also been studied in detail (Enghoff 1983 & 1994). This study, however, is the first description of the small mammals from Maglemosegård.

The analysis of Maglemosegård is supplemented with an overview of 29 other Danish sites. They represent the majority of the most important Mesolithic sites excavated in Denmark during the past hundred years. From an archaeological point of view, several important sites are not represented simply because they lack remains of small mammals.

Table 2 lists the 30 sites with information on the years of excavation, the species identified, the techniques (waterscreening) applied, and references. All samples are curated at the Zoological Museum, University of Copenhagen.

Chronologically, the sites span the Maglemose (with the exception of the earliest phase), Kongemose and Ertebølle cultures, which corresponds to the time period from about 8,000 to 4,000 BC (calendar years). Eight sites (no. 23-30), which mainly date from younger Ertebølle, were also occupied during early Neolithic Funnel Beaker Culture (Fig. 1).

**Table 1**

| Skeletal elements n=220 | *Sorex araneus* | *Sorex sp.* | *Neomys fodiens* | *Erinaceus europ.* | *Sciurus vulgaris* | Muridae/Arvicolidae | *Clethrionomys gl.* | *Arvicola terrest.* | *Microtus agrestis* | *Apodemus sp.* |
|---|---|---|---|---|---|---|---|---|---|---|
| Cranial bones | | | | 2 | | | | | | |
| Maxilla | | | | | | | | | | |
| Mandible | 3 | | 1 | 2 | | 2 | 5 | 4 | 1 | |
| Incisiva upper | | | | | | 4 | 6 | 6 | 3 | 12 |
| Incisiva upper/lower | | | | 2 | | | | 3 | | 4 |
| Incisiva lower | | | | | | 18 | 16 | 4 | 9 | 21 |
| Molars | | | | 3 | | 2 | 22 | 10 | 26 | |
| Scapula | | | | | | | | | | |
| Humerus shaft | | 1 | | 1 | | | | | 1 | |
| Humerus distal | 1 | | | | | 1 | | | | 2 |
| Radius proximal | | | | | | | | 1 | | |
| Radius/ulna shaft | | | | | | | | 1 | | 1 |
| Radius/ulna proximal | | | | | | | | 1 | | |
| Ulna proximal | | | | | | 1 | | | | |
| Carpales | | | | | | | | | | |
| Pelvis | | | | 1 | | | | | | 2 |
| Femur schaft | | | | | | | 1 | | 1 | 3 |
| Tibia proximal | | | | | | | | | | 1 |
| Tibia shaft | | | | | 1 | 1 | | 1 | | 4 |
| Tarsales | | | | 1 | | | | | | |
| Metapodials | | | | | | | | | | |
| Phalanges | | | | | | | | | | |
| Ribs | | | | | | | | | | |
| Vertebrae | | | | | | | | | | |
| Total | 4 | 1 | 1 | 12 | 1 | 29 | 50 | 31 | 41 | 50 |

**Table 2**

| Sites | *Talpa europaea* | *Sorex araneus* | *Neomys fodiens* | *Erinaceus europ.* | *Sciurus vulgaris* | *Clethrionomys gl.* | *Arvicola terrest.* | *Microtus agrestis* | *Apodemus syl./fla.* | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Lundby II 1945 | | | | | X | | | | | |
| 2. Mullerup 1900 | | | | X | X | | | | | |
| 3. Ulkestrup Lyng Ø 1947-51 | | | | | | | (X) | | | |
| 4. Sværdborg I 1917-44 | | | | X | X | | (X) | | | |
| 5. Holmegård I 1922-23 | | | | X | | | | | | |
| 6. Stationsvej, Vedbæk 1985 | | | | X | | | X | | | S |
| 7. Maglemosegårds Vænge 1976 | X | X | | X | X | X | X | X | X | S |
| 8. Henriksholm-Bøgebakken 1975 | | | | | X | X | | | | S |
| 9. Lystrup Enge 1983-94 | | | X | | | X | X | | | S |
| 10. Norslund 1958-63 | | | | | X | | | | | |
| 11. Sønderholm 1979 | | | | X | | | (X) | | | S |
| 12. Godsted 1903-04 | | | | X | | | (X) | | | |
| 13. Præstelyngen 1963-72 | | | | X | | | (X) | | | |
| 14. Vejleby 1910 | | | | | | | (X) | (X) | | |
| 15. Norsminde 1972-87 | | | | | | | X | | | |
| 16. Nederst 1989-92 | | | | | | X | (X) | X | X | (S) |
| 17. Bjørnsholm 1985-91 | (X) | | | | X | | (X) | | (X) | S |
| 18. Ertebølle 1893-97 | | | | X | X | X | (X) | | (X) | |
| 19. Mejlgård 1888 | | | | | X | | (X) | | | |
| 20. Salpetermosen 1957-61 | | | | X | X | | (X) | | X | |
| 21. Maglemosegård 1976-78 | | X | X | X | X | X | X | X | X | S |
| 22. Nivå 1912-14 | | | | X | | | (X) | | | |
| 23. Dyrholmen 1923-32 & 37-39 | | | | | X | | | | | |
| 24. Neverkær 1944 | | | | X | | | | | | |
| 25. Klintesø 1897 | | | | X | X | | (X) | | | |
| 26. Kassemose 1908 | | | | X | | | (X) | | | |
| 27. Maglelyng 1952 | | | | X | | | | | | |
| 28. Nøddekonge 1983-85 | | | | X | X | | X | | X | (S) |
| 29. Vejkonge 1983-85 | | | | X | X | | X | | | |
| 30. Åkonge 1983-85 | | | | X | X | | X | | X | (S) |

Table 1. The distribution of species and skeletal elements in the Maglemosegård assemblage. In identification of the many incisors a distinction has been made based on the fact that arvicolid incisors have a triangular cross section in contrast to the more rectangular in the murid group. The arvicolid sample has furthermore been seperated according to size differences.

Table 2. Small mammals from 30 Danish Mesolithic sites.
1. Lundby II, Rosenlund *det.* (Rosenlund 1980). 2. Mullerup, Winge *det.* (Winge 1904). 3. Ulkestrup Lyng Ø, Richter *det.* (Richter 1982). 4. Sværdborg I, Winge *et* Aaris-Sørensen *det.* (Winge 1919; Aaris-Sørensen 1976). 5. Holmegård I, Winge *det.* (Winge 1924). 6. Stationsvej, Vedbæk, Møhl *det.* (unpubl.). 7. Maglemosegårds Vænge, Aaris-Sørensen *det.* 8. Henriksholm-Bøgebakken, Aaris-Sørensen *det.* 9. Lystrup Enge, Ljungar *det.* (Ljungar in print.). 10. Norslund, Møhl *det.* (Møhl 1966). 11. Sønderholm, Aaris-Sørensen *det.* (Jønsson & Pedersen 1983). 12. Godsted, Winge *det.* (Winge 1905). 13. Præstelyngen, Noe-Nygaard *det.* (Noe-Nygaard 1969). 14 Vejleby, Winge *det.* (Winge 1912). 15. Norsminde, Møhl *et* Rowley-Conwy *det.* (Andersen 1989). 16. Nederst, Aaris-Sørensen *det.* 17. Bjørnsholm, Bratlund *det.* (Bratlund 1991). 18. Ertebølle, Winge *det.* (Winge 1900). 19. Mejlgård, Winge *det.* (Winge 1888). 20. Salpetermosen, Møhl *det.* (unpubl.). 21. Maglemosegård, Aaris-Sørensen *et* Andreasen *det.* 22. Nivå, Winge *det.* (Degerbøl 1926). 23. Dyrholmen, Degerbøl *et* Møhl *det.* (Degerbøl 1942). 24. Neverkær, Aaris-Sørensen *det.* 25. Klintesø, Winge *det.* (Winge 1900). 26. Kassemose, Winge *det.* (Winge 1910). 27. Maglelyng, Møhl *det.* (unpubl.). 28. Nøddekonge, Gotfredsen *det.* (Gotfredsen 1990). 29. Vejkonge, Gotfredsen *det.* (Gotfredsen 1990). 30. Åkonge, Gotfredsen *det.* (Gotfredsen 1990).
X: species recorded, (X): recent intruder, S: sieving applied, (S): sieving applied on selected samples.

## RESULTS

### *Number of bones and species*

Not surprisingly, the settlements excavated before 1975 generally yielded only a few species of small mammals (Table 2). Waterscreening had not yet become rutine procedure, and the species recovered were consequently the largest of the small: the hedgehog (*Erinaceus europaeus*), the red squirrel (*Sciurus vulgaris*) and the water vole (*Arvicola terrestris*). Of course, sieving is a necessary but not sufficient prerequisite for recovering large quantities of small mammal bones. Small mammal remains may have been absent or sparse from the beginning, and even if abundant the preservation may have been poor, and the excavated area may be too small. Thus, even modern excavations (e.g. no. 6 & 11) may yield only a few micro-mammalian species.

The general increase in number of species is accompanied by a greater increase in the number of bones recovered. This pattern is not evident from Table 1, but can be illustrated by a comparison between two sites. The excavations chosen for this comparison are of the same order of size and both have a calcareous midden with well preserved bones as a main element. From the famous Ertebølle site, where 314 m$^2$ were excavated in 1893-97, Winge (1900) reports 5 different species of small mammals represented by 17 bones. In contrast, the 1975-78 excavations of 480 m$^2$ at Maglemosegård, where sieving was employed, yielded 220 small mammal bones representing eight species (Table 1).

In the Maglemosegård assemblage the majority of recovered skeletal elements are incisors and molars. This pattern is typical for both natural as well as anthropogenic deposits because tooth enamel is the most resistant to destruction of any part of the skeleton.

The 220 bones of small mammals are a relatively large quantity, but seen in retrospect they must be considered as only a fraction of the preserved bones. Micromammalian bones were found only in about 15 % of the square meters excavated. This is due to the relatively coarse mesh size of 3 mm used in the field. From an archaeological point of view, 3 mm can be considered as a fine mesh and from a paleozoological point of view it is better than no sieving at all, but ideal studies of small mammals require a finer mesh size (1 mm). This point was confirmed by applying a 1 mm sieve in 10 different squares on Maglemosegård, which considerably increased the quantities of small bones and teeth that were recovered. Using a fine sieve is of course very time consuming, and impossible to carry through as a normal procedure of a large excavation, but small representative samples must be fine-sieved.

Studies of other small faunal remains also require fine-sieving. For example, in a study of fish bones from the kitchen-midden at Bjørnsholm, Enghoff (1991) monitored bone loss from 2-3 mm mesh sieving by later using 0.6 mm mesh sieve in the laboratory. The results show that the fine-sieving is essential for any qualitative and quantitative assessments of the Mesolithic fishing carried out from the site.

### *Burrowers*

Brackets around a record in Table 2 indicate that the author responsible for the identification considers the age of the specimen dubious. For example two of the five species mentioned above from Ertebølle are described by Winge (1900:88) as the results of recent intruders.

It is of course a general problem to interpret the remains of many rodents and insectivores because of their fossorial habits. Nevertheless, it is usually possible through a sequence of observations to identify the recent intruders. The water vole (*Arvicola terrestris*) may be a good example. The burrows of this species are often encountered during archaeological excavations, and Winge (1904b:222) wrote about the problem many years ago (in translation):"All the bones of water vole found in the middens are found so complete and often still articulated or so close to burrows, that it is most likely that they belong to animals which have dug themselves into the middens after these were deposited."

If we add to those observations the colour or patina of the bones, a distinction between recent and fossil material should be possible. Bones found in Mesolithic deposits usually have a uniform colour or patina, often light to dark brownish, whereas bones of later intruders will be whitish or light yellow. And, continuing to use the water vole as an example, recent specimens will still exhibit the characteristic yellow-orange enamel colour of the incisors.

Finally, in problematical cases of special interpretive importance, an AMS C-14 dating of the bone itself may solve the problem.

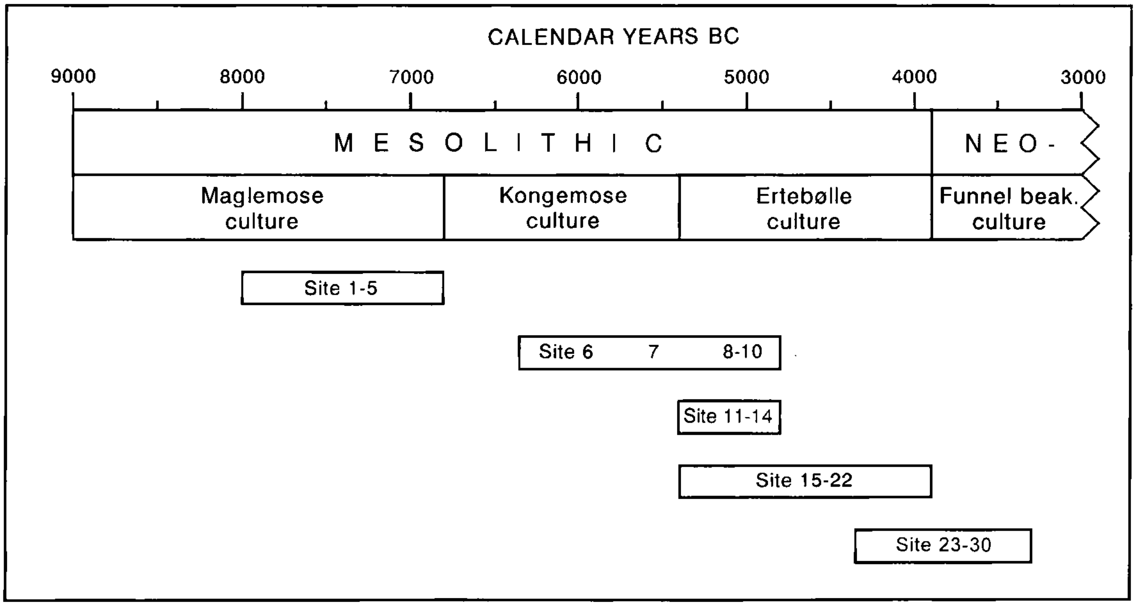


Fig. 1. Chronological distribution of the 30 sites investigated.

*Hunting and man made biotopes*

During the excavation of Maglemosegård recent burrows of the water vole were encountered frequently, along with light coloured, complete bones of the species. However, dark coloured, fragmented bones of the water vole, and seven other small mammals as well, were found in undisturbed midden layers among thousands of other vertebrate bones. This pattern holds for other settlements as well (Table 2), and the question is how these remains found their way into the middens.

There is little doubt that Mesolithic people sometimes took small mammals, for example red squirrel, in addition to their primary, larger fur-bearing prey such as beaver (*Castor fiber*), the pine marten *(Martes martes)*, the otter *(Lutra lutra)* and the wild cat *(Felis silvestris)*. The red squirrel is represented in half of the sites investigated and at least one mandible from Vejkonge (no. 29) (Gotfredsen 1990:61) shows clear cut marks. The red squirrel was probably hunted especially for its long, silky winter coat. It is possible that the water vole and the mole ( *Talpa europaea*) were also trapped because of their fur. The water vole stays warm and dry by a short, dense undercoat below a longer outer fur, and the mole has a silky, velvety fur. Both could have provided furs that were useful for special purposes.

The hedgehog is found in 70 % of the sites, and cut marks on some of the bones clearly indicate that the animals were deliberately procured. Gotfredsen (1990) has analysed the bones from Åkonge (no. 30) and found 34 fragments from at least 4 hedgehogs. Cut marks can be seen on a mandible, in the temporal region of a skull and on a tibia (Fig. 2, 3, & 4).

Practically all meat on a hedgehog is concentrated in the big dorsal muscle which lies just below the skin and enables the animal to curl up and to erect the spines. The meat has been considered edible and even tasty up to modern times, and fat built up in the autumn before hibernation can be melted down and used for various purposes. Besides meat and fat, there can be little doubt that the sharp 2-3 cm long spines were also utilized by Mesolithic people.

Today the hedgehog thrives in the cultural landscape around farms, along edges of a wood and hedgerows, and in gardens and parks. Moreover there seems to be a special bond between the hedgehog and man, which, for example, prompts people to move hedgehogs from one place to another to prevent local extinctions. On a larger scale, the northernmost distribution of the species in Norway, Sweden and Finland is heavily influenced by mans intentional introductions (Kristiansson 1981).

We may therefore consider the Mesolithic settlement area as a man-made biotope that was favorable for the

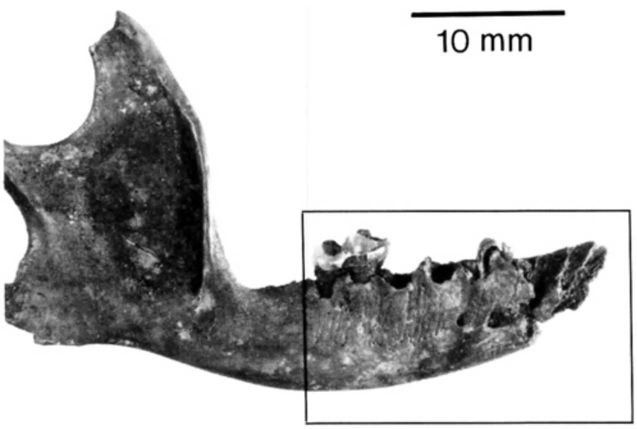


Fig. 2a. Mandible of a hedgehog (*Erinaceus europaeus*) from the site Åkonge with cut marks. (Foto: Geert Brovad).

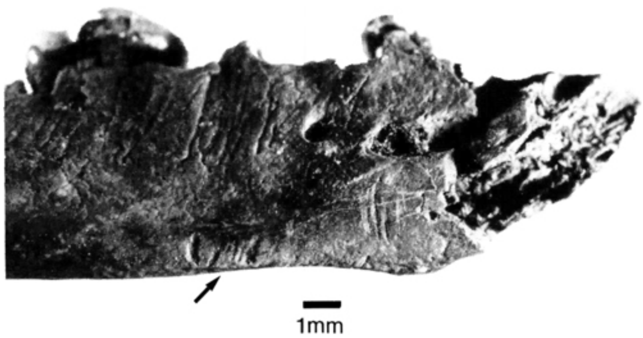


Fig. 2b. Enlargement of the mandible from Åkonge showing clear cut marks. (Foto: Geert Brovad).

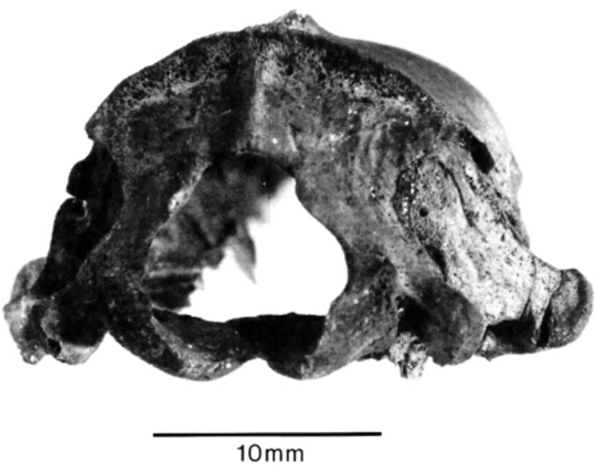


Fig. 3. Skull of hedgehog (*Erinaceus europaeus*) from Åkonge showing cut marks in the right temporal region. (Foto: Geert Brovad).

hedgehog. The settlement and associated human activity opened up the forest and made it an excellent area for foraging hedgehogs. The price they had to pay for this was the occasional exploitation by man. On the other hand, investigations in Sweden suggest that Mesolithic and Neolithic people actually helped the hedgehog expand its distribution.

On the island of Orust in Bohuslän, Leif Jonsson has recently found the oldest known remains of hedgehog in western Sweden. They were found on a Mesolithic site dated to 7,000 BP (in conventional C-14 years) corresponding to the Middle Atlantic. The straits separating Orust from the mainland were so wide at that time, that introduction by man seems the only possibility for the hedgehog to have invaded the island (Jonsson pers. comm.).

By going through the bone assemblages from Mesolithic and Neolithic sites on the island of Gotland, Lindqvist & Possnert (in print) have shown that the hedgehog is absent from Mesolithic and Early Neolithic sites, but suddenly turns up at Middle Neolithic Pitted Ware sites (including five hedgehog mandibles found in a grave on the chest of a young girl!). Gotland has been isolated since the deglaciation of the area and the hedgehog must have been introduced by man in the Middle Neolithic.

### *Pellet and scat remains*

Predators other than humans may add to the accumulation of small mammalian bones in the kitchen-middens. Bones may be deposited in pellets of diurnal raptors or owls or in scats of carnivores, especially the dog. These predators may find their prey in the surrounding country or in the settlement area itself. Like the hedgehog, other small mammals may have been attracted by the open man-made biotope. The bank vole (*Clethrionomys glareolus*), for example, prefers young forest with a dense undergrowth, while the field vole (*Microtus agrestis*) is most common around glades. The scats of dogs were most likely dropped on the settlement while it was still inhabited, whereas the pellets may have accumulated during periods when the site was abandoned by the people as a part of their seasonal migration.

Winge (1900:85) made a short note on what he believed to be dog scats from the kitchen-midden of Ertebølle. The scats were found between the shells in the

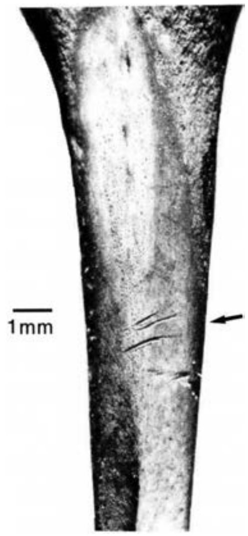


Fig. 4. Tibia diaphyse of hedgehog (*Erinaceus europaeus)* from Åkonge with cut marks. (Foto: Geert Brovad).


Fig. 5. Incisor from a mandible of a bank vole *(Clethrionomys glareolus)* found in dog scat at Ertebølle. The tip of the incisor shows heavy etching of the enamel characteristic for digestion.

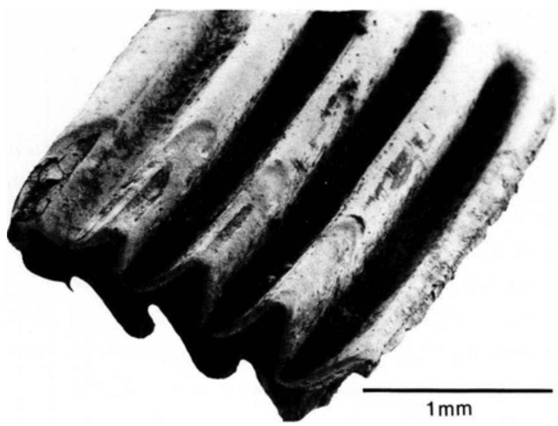


Fig. 6. Molar of vole showing enamel penetration characteristic of light digestion by owls.

midden as "collapsed lumps of chewed and corroded bone fragments of fishes, birds and mammals." One of the fragments can still be identified by a label in Winge's handwriting. It is a piece of a mandible of a bank vole including a molar and an incisor. The mandible, which has now fallen into several pieces, and the teeth show clear signs of corrosion typical of digestion. The tip of the incisor is shown on a SEM (scanning electron microscope) micrograph in Fig. 5, revealing heavy etching of the enamel, which is characteristic of digestion. Thus, Winge's interpretation of these "collapsed lumps of chewed and corroded bones" as scats from carnivores is reasonable, and the dog is the most likely species.

Recently Andrews (1990) has published a comprehensive and detailed study of small mammal taphonomy based on descriptions of present day small mammal faunas. How do we identify faunal remains as being prey assemblages accumulated by predators? Of course pellets or scats themselves may occasionally be preserved, but usually one will have to answer the question by analysing the species composition and size distribution of the prey animals found, and the types of modifications seen on their bones.

Analyses of the small mammal bones from Maglemosegård have been tried following the directions of Andrews (op.cit.). The sample, however, turned out to be too small and too heavily impacted by later depositional agencies to provide a basis for reliable calculations of skeletal element proportions or breakage patterns. Nevertheless, "the corrosive effects of digestion on bones and teeth in the predators stomach are not duplicated by any other alteration process" (Andrews 1990:64) and clear signs of digestion can be seen on several murid-arvicolid teeth in the Maglemosegård assemblage. Incisors, for example, show light digestion characterized by a slight wavy outline of the enamel surface, recession of the enamel along its contact with the dentine, penetration of the enamel surface and splitting of the dentine (Fig. 7).

Molars of voles also show light digestion, with the enamel penetrated along the salient angles of the teeth – sometimes limited to near the occlusal surface, indicating that the teeth were still in the jaw when exposed to digestion (Fig. 6).

The light to moderate digestion of the Maglemosegård teeth is typical for some owls, suggesting that the bones were accumulated on the site in regurgitated pellets. Several owl species may have contributed, including the barn owl *(Tyto alba)*, the short-eared owl *(Asio flammeus)* and the long-eared owl *(Asio otus)*.

## CONCLUSION

Small mammal bones found on Mesolithic sites are important for paleoenvironmental reconstructions and add to the cultural and faunal history of the region.

Waterscreening, which has been a routine procedure in excavations of Mesolithic sites in Denmark since about 1975, has increased the number of species and the number of bones retrieved. The sieves used, however, are usually too coarse (c. 3 mm) to catch all the remains of small mammals or other small-sized vertebrates. Fine-sieving ( 1 mm mesh) should be applied to selected samples or columns as a supplement.

Sorting out recent intruders from those species originally belonging to the deposit is a problem – but the problem is not insoluble. Colour, patina and the degree of fragmentation often reveal the recent intruders, and in problematical or crucial cases an AMS C-14 date can resolve the question.

The accumulation of small mammal bones on the Danish Mesolithic sites is partly a result of human activity. Hunting, trapping and gathering for furs, meat and fat (e.g. *Sciurus vulgaris* and *Erinaceus europaeus*) are evident from clear cut marks on the bones. Bones of the majority of the smaller rodents and shrews probably reached sites in scats of carnivores, especially the dog, and pellets of diurnal raptors and owls. This is confirmed by analyses of incisors and molars of voles from the sites of Ertebølle and Maglemosegård. The teeth show corrosion and etching of the enamel and splitting of the dentine characteristic of digestion. Heavy digestion is seen on an incisor of *Clethrionomys glareolus* from

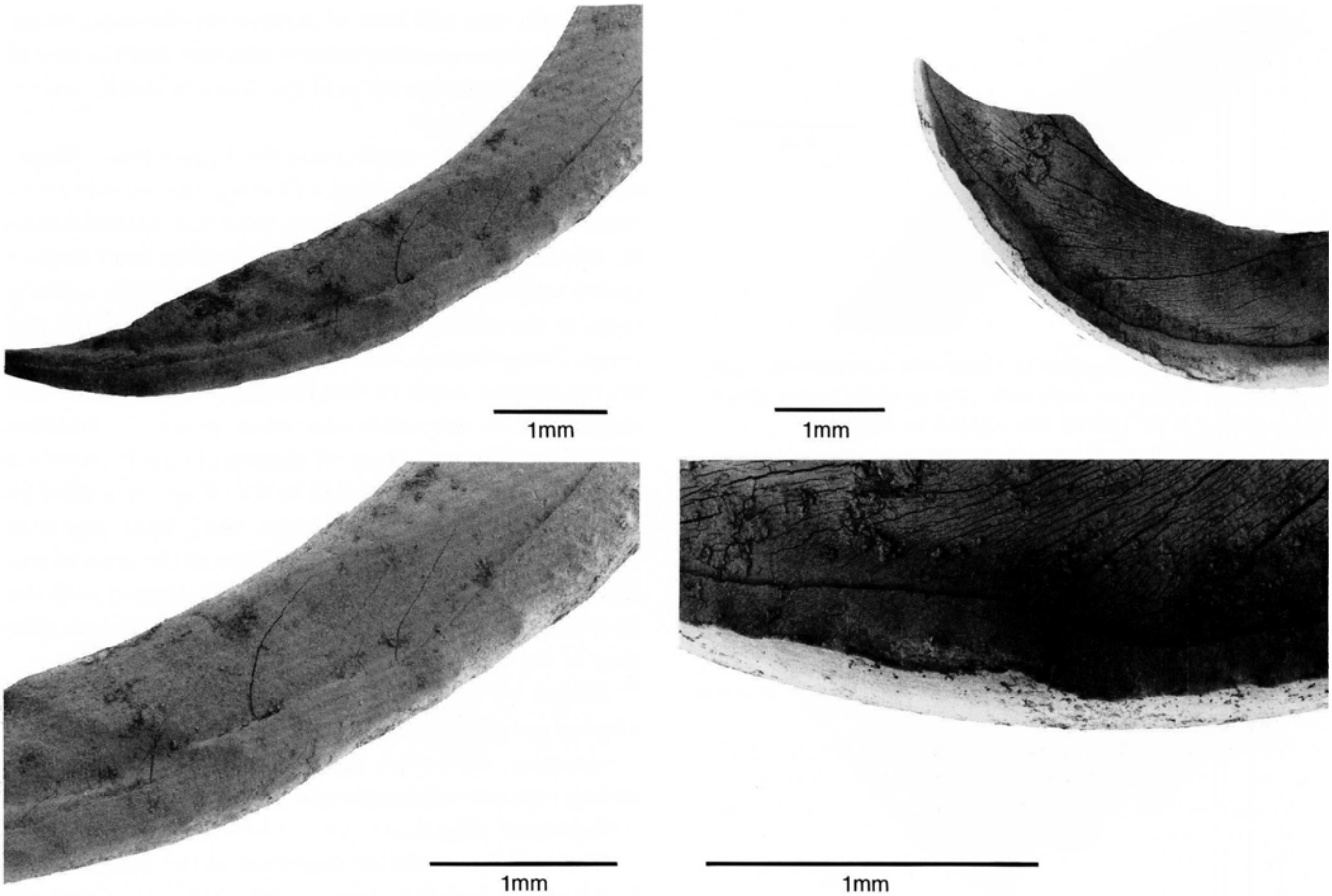


Fig. 7. Two incisors showing light digestion of enamel and dentine typical for teeth found in pellets of e.g. barn owl *(Tyto alba)*, the short-eared owl *(Asio flammeus)* and the long-eared owl *(Asio otus)*.

lumps of corroded and chewed bone fragments that were interpreted as dog scats. Light to moderate digestion is seen on several incisors and molars of voles that have been interpreted as originating from owl pellets.

Waterscreening alone prevents us from observing the distribution pattern of bones in the deposit. The sieving should therefore be supplemented with careful observations while trowelling down level by level in order to locate any *in situ* scats and pellets.

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# *Prehistoric Settlement and Landscape Development in the Sandhill Belt of Southern Thy*

by DAVID LIVERSAGE and DAVID ROBINSON

## INTRODUCTION

Along most of the east coast of the North Sea, and not least in Denmark, runs a wide belt of blown sand. In some places this is being eaten away by erosion as the breakers cut into the low sandy cliffs. The present article is about investigations carried out since 1965 along a 14 kilometre stretch of coast immediately north of the western opening to the Limfjord, from Fladesø in the south to Stenbjerg in the north in the part of Denmark known as Thy (fig. 1). Along this stretch of coast prehistoric settlements regularly come to light in the course of erosion. They appear in the steep sand cliff above the beach, in which a constantly rejuvenated section can be studied. North and south of the study area the deposits now being eroded are not ancient enough to contain prehistoric remains.

In theory it should be possible to find all traces of earlier settlement as they emerge, and thus to obtain a complete cross-section of settlement history. At the same time the environmental evidence for the evolution of the landscape is unusually varied and well preserved. The aim of the present paper is to give a preliminary account of both archaeological and environmental aspects of these investigations, and indicate some of the future potential (1).

## GEOLOGICAL AND GEOGRAPHICAL BACKGROUND

### *Earlier research and the historical sources*

Not a great deal has been published on the geography or recent geology of the study area. The best account is still in many ways Axel Jessen's paper on the Litorina transgression in north Jutland (Jensen 1920). In this some very important points are made. The western end of the Limfjord has never been directly open to the North Sea, for the raised beach deposits in it are of types formed in sheltered water, and the shells from old bottom deposits are thinner walled than those from open coasts. Generally the original west coast of Thy lay further east than the present one, which been moved westwards by the deposition of large quantities of beach and aeolian sand. Jessen saw the first deposition of blown sand as going back to the *Litorina* transgression, and its big extension inland as being a result of the destruction of the forest. These conclusions still stand, but we now know that the destruction of the forest took place much earlier than Jessen thought.

With regard to the western entrance to the Limfjord, Liversage and Robinson (1988) pointed out that the boulder clay areas, that must once have existed west of the present entrance to the Limfjord and kept surf out, are likely to have been fairly extensive because coastal erosion in the region is so severe. This barrier was not so continuous as to hold salt water out altogether, for investigations by K. Strand Petersen (1983, 75) showed that salt water entered the present basin of Nissum Bredning at about the Boreal/Atlantic transition. K. Strand Petersen's most recent work (1994) shows that sheltered waters protected by an undulating landscape resembling the Limfjord with islands and fjords once existed as far as 75 km west of Agger Tange.

There is much scattered literature about the formation of the belt of blown sand, especially historical literature, but not much precise field observation. Two questions have to be addressed and ought to be kept separate. They are the evolution of the coast, and the chronology and causes of dune formation. The opinions expressed tend to be rather conjectural, and the new research described in this article fills something of a lacuna.

Brüel (1918) quotes several interesting unpublished descriptions, but comes too easily to the conclusion that dune formation began as a result of 16th century forest clearance and the removal of marram grass and other dune vegetation for fodder and binding materials.

Somewhat more scholarly, is a paper by Viggo Hansen (1957). Here the beginning of dune formation is placed in the Iron Age, following an undocumented assertion that Bronze Age pottery had been found at an unspecified place in northern Jutland in "*martørv*" or primary sandy peat under the blown sand. Hence he generalizes that the blown sand as a whole was deposited after the Bronze Age. He sees a second phase of dune formation in late and post-Medieval times, and writes "it is now reasonably well established that abuse of the dune vegetation was the primary cause of the late Medieval period of dune formation, which lasted until about 1750". This paper often gives the impression that we know more than we really do. It must be the source of the statement by H. Kuhlman in "Danmarks Natur" (1975) that the coastal dune belt originated in the Iron Age.

The actual historical sources from the 15th – 19th centuries are more interesting. Some of them relate to the history of dune formation, others to the question of possible now vanished land masses west of the Limfjord. They show that even as late as the 19th century the remains of a boulder clay area survived west of Agger and Fladesø. An account by Andresen in 1861, quoted by Jessen (1920), reports that a continuous morainic cliff ran from Agger to the northern end of Lodbjerg parish, interrupted only for a couple of hundred metres at Aalum. The gap had opened to a kilometre by Jessen's day (Jessen 1920), and there is now no sign at all of any boulder clay west of Fladesø lake. Further evidence of a now-vanished morainic area is an account by A. Østerbøll (1878), that the villages of Agger and Vester Aalum had originally been "on the mount" (described by Andresen as stony clay – *rullestensler*) but had by then been moved to lower land further east. Østerbøll also writes that the bones of a "wild ox" were found in "martorv", and as bones only survive here in contact with till, this also shows that there was till where none survives today.

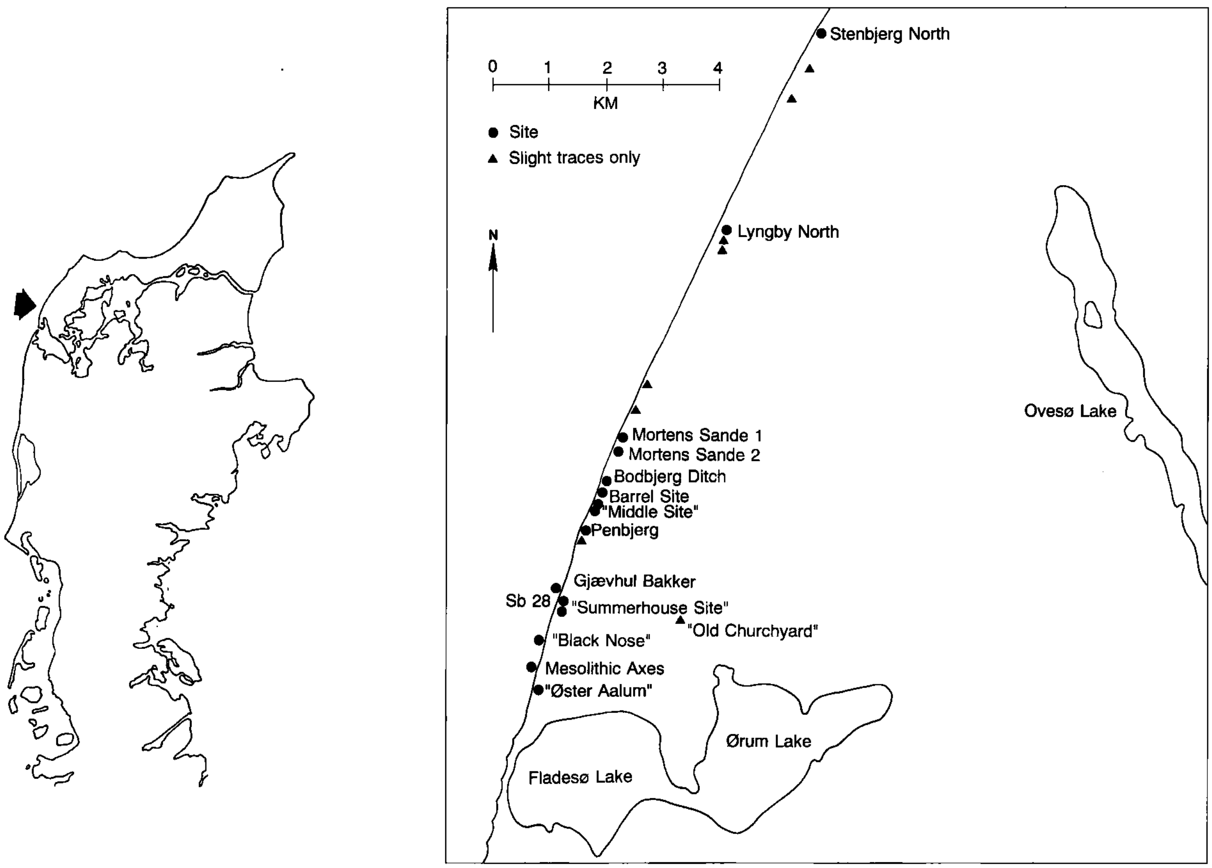


Fig. 1. Map of the area, showing the present extent of the dune belt and the position of the sites along the coast.

An interesting, but more speculative point concerning these land masses is the statement by Pontoppidan (1761) that the inhabitants of Agger spoke a dialect different from that of other people in Thy. It is tempting to see this as evidence that "the mount" which survived west of Agger and Fladesø was the remnant of an area that originally was large enough to have dialect of its own, which still survived in the 18th century.

The historical sources on dune formation are summarized by Hansen (1957) and concern the extension of the dune belt into agricultural land, which could be a disaster for those affected. They begin with a clerical petition from the 15th century and give the impression that sand blowing was at its worst in the 16th-17th centuries and became less of a problem in the 18th. This last point is disputed by Fuglsand. He admitted that the petitions from clerics ceased by about 1750, but thought it was only at the end of the century, when organized measures were taken to anchor the sand with vegetation, that there was any real improvement (Fuglsand 1949).

The dunes are now of course anchored and watched, and natural sand blowing is not allowed. It would help us to know whether this is really necessary, if we could establish whether the dunes started being anchored in the 18th century spontaneously, or only when organized measures were taken to plant them with marram grass (*Ammophila arenaria*). Unfortunately the historical sources are not precise on this point and tend to be partial. Similarly we would like to know whether the problem starts being mentioned in the late Middle Ages because a real deterioration took place, or only because of increasing literacy and the hope of receiving a little help from central government. The fact is we do not know whether there from time immemorial have always been alternating periods of dune advance and dune stability, or whether the sort of conditions that prevailed before artificial measures were applied to restrict sand blowing have always been typical, only becoming more severe as the size of the dune belt increased. It is therefore not possible to judge whether the measures do more than prevent the natural rejuvenation of the landscape through the formation of new dunes close behind the coast, where the existing ones are now disappearing into the sea.

Contemporary observers have always favoured anthropic explanations. Sand blowing was attributed to cutting firewood, using marram grass, etc., and royal decrees were promulgated to protect the local environment from the kinds of use it no doubt had been subject to for millennia. In the demographic perspective, the theory of anthropic degradation is not particularly likely. The 15th-17th century, when sand blowing appears

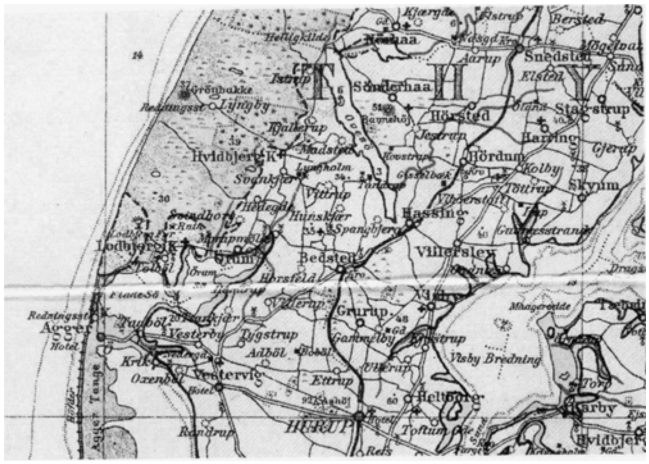


Fig. 2. Axel Jessen's map of the maximum extension of the sea in our area.


Fig. 3. The withdrawal of the coast since c.1790. The present coastline superimposed on Videnskabernes Selskab's map.

Fig. 4. Typical view of the cliff in the area of study, showing the alternation between organic layers and blown sand.

to have been at its worst, was generally a time of low population, when the pressure by the local people on the dune vegetation can be expected to have been less than either earlier, before the Black Death, or later, as populations rose in the 18th century.

### *New field observations and deductions*

Modern and historical work is thus restricted and sometimes directly misleading. More can be learned from the field evidence. This includes present surface indications, the stratigraphy visible in the erosion cliff, borings (for wells) shown on the basis data maps issued by the Danish Geological Survey and further information in the archives of the Geological Survey.

Fig. 2 reproduces A. Jessen's estimate of the course of the shoreline at the Litorina maximum, and though it cannot be accurate, it gives a good impression. Two islands are seen north of Fladesø, and north of them the coastline ran some 5-6 km east of the present coast, with Ovesø lake as an arm of the sea, as is confirmed by a modern sediment core taken from the lake bed for pollen analysis (Andersen et al. 1991).

Naturally no map can be reconstructed of the areas that must have been eroded away west of the present coastline, but there is reason to think the differences from the present situation were much more dramatic than suggested by Jessen's map (for example Strand Petersen's new work (Petersen 1994). Some idea of what can be expected can be obtained from the rate of coastal erosion, which can be accurately determined for the past two centuries and projected backwards.

The earliest cartographically correct survey is Videnskabernes Selskab's map, surveyed in the 1790's. The original hand-drawn version of this survey was drawn at the same scale of 1:20,000 that was in use until the 1970's for normal map cover, and as church steeples were used as trigonometric points, accurate comparison is simple. Unfortunately the present coastline first appears on the new 1:25,000 maps, but the problem of transferring the present coast to the 1:20,000 maps was solved through the kindness of the Danish Ordnance Survey, so that it could be superimposed on Videnskabernes Selskabs map, using the churches to link them together. The result is shown in fig. 3, where however the printed version of the old map has been substituted for the hand-drawn original, which is not suitable for reproduction on so small a scale.

It was found that at Agger the coast has retreated 1200 metres in two centuries. The amount of retreat decreases northwards, and near the site of Lyngby North (fig.1) was only about 250 m. Agger Bar itself has been moved up to 2 kilometres eastwards, and now bends inwards as two horns, when in 1790 it passed across in a straight line from Thy to the nearest part of the mainland.

The speed of retreat agrees well enough with modern observations. For instance at the site of Mortens Sande 2 the coast withdrew 16 metres in 1983-1992, giving an average of a little over 2 metres a year. With this evidence before us it is not difficult to appreciate that the west coast of Jutland can have been retreating at a rate of 2-3 kilometres every thousand years, and could have retreated 12-18 km since the Neolithic, and considerably more since the sea reached its present level in early Atlantic times. There can be no problem in accepting the existence of large land masses west of Agger, which sheltered the original western end of the Limfjord from heavy surf, giving a pattern of land and sea radically different from that which we find today.

We may now turn to the other factor in the development of the present landscape – the formation of the dune belt.

The original bays east of the present coastline must have begun to fill immediately with sand derived from the erosion of the more exposed parts of the original coast. Beach deposits of sand with water-worn stones up to the size of a fist have been observed below the blown sand in the cliff and must be part of the original bay filling, and there is certainly also stone-free beach sand.

Higher up in the profile there is wind-blown sand everywhere. The highest dunes rise to over 40 m above sea level. Up to about 12 m the blown sand is interbedded with numerous organic layers, which show as dark brown horizons in the cliff above the beach. These are old surfaces, often with remains of the original vegetation surviving on them. An impression of the situation is given by fig. 4. In some places they are associated with remains of human settlements, of which about 23 have been found since 1965 (fig. 1). Some very minor finds of pottery or flint are not shown on this map. In many places old surfaces are absent owing to "blowouts", where wind erosion has cut through the layers described above almost to present beach level. The largest blowout is about a kilometre wide. Many of the blowouts are recent, but they have been completely refilled with blown sand, which can rise in them to high dunes. If the old surfaces give the impression of running for long distances, this is something of an optical illusion because so much of the scarp in reality is covered by talus and sandslips. It is impossible to clean a long enough section to see how the blown sand is really built up, but it seems that most of the individual turf lines only run a few hundred metres before ending in blown sand. It should be pointed out that the sand belt is a cumulative phenomenon. Sand is added, but not removed. Originally only quite modest amounts of blown sand were present, but the amount has been steadily increasing. It is clear that the larger the dune belt and the more sand it contains, the more dramatic will be the effect if the dunes become active and invade the land behind them. Each invasion could be expected to be more extreme than the one before.

## ARCHAEOLOGICAL SITES

As well as helping to date the blown sand, the archaeological sites produce valuable closed assemblages of artifacts. These closed finds are particularly well segregated and stratigraphical sequences occur. As only a selection of the material has been published so far, the opportunity can be taken to sum up the results of 28 years' archaeological fieldwork. The location of the sites is shown in fig. 1. The emphasis has changed during these 28 years gradually from obtaining closed finds to illuminate the development of material equipment, to examining the relation between the sites and their environment.

### *Mesolithic*

The only certain evidence pointing to the Mesolithic was the discovery by the Hirsch family in 1971-76 of 9 core axes, some incomplete, at the point marked "mesolithic site" in fig. 1. The site cannot have been a normal settlement, as there were no other tools and very little chipping waste.

## *Funnel Beaker Culture*

There are three sites from the Funnel Beaker Culture, all on the till under the blown sand, and therefore older than the beginning of dune formation along the present coast. The pottery at all three sites was from the late EN or the beginning of the MN.

At the first site (fig. 1 "Black Nose") there were two small pits and a little pottery. The second site (fig. 1, sb.28) lay by a depression in the moraine which there were deposits from a pond that existed before the blown sand was deposited. A column of peat was taken from it and preserved for possible future study. A pit in the till not far away, which contained animal bones only, may have been from this settlement. The old surface under the dunes was compressed and exceedingly hard, making all excavation very difficult.

Much the most important of the three Funnel Beaker sites was Penbjerg. Thanks to the perseverance of Harald Holm a valuable assemblage of artifacts of pottery, flint and amber was found. The flint was described by Liversage and Singh (1985), and some of the amber by Hirsch and Liversage (1987).

Only TRB settlements from around the EN/MN transition have been found. If there was settlement from other phases of the culture, it has yet to emerge. At the beginning of the Middle Neolithic deposition of blown sand had not begun, or at least had not yet reached the line of the present coast.

## *Single Grave Culture/Late Neolithic /Earliest Bronze Age*

The settlement remains from these periods were much more substantial, and the population must have increased. The earliest material is from the Ground Grave period, when the Single Grave Culture first appeared north of the Limfjord, and thereafter there are so many sites that we may assume that the blown sand area was being more or less continuously exploited as part of the subsistence strategy of the inhabitants, a conclusion supported by the pollen diagram from Gjævhul Lake (fig. 8). The occupation layers now had blown sand below them as well as above them, showing that dune formation had begun, but the sand layers were still thin, and out of them rose morainic hills, crowned by barrows, some of which still emerge through the dunes today. Some information and photographs from this settlement phase has been given earlier (Liversage 1989).

Single Grave Culture. This was represented at Mortens Sande 2, the only Stone Age site that was excavated extensively enough for comprehensible structures to be uncovered. It has been fully published (Liversage 1988). There were traces of three of four consecutive structures. Each had one substantial post and a double rows of stakes. Though regarded as shelters of some kind, it is hard to be specific about their original appearance. The site produced a good closed assemblage of pottery and flint, as well as remains from amber working.

Mortens Sande 2 was a stratified site with overlapping strata from the Single Grave and Bell Beaker cultures. More Single Grave settlements certainly exist, for isolated Single Grave potsherds have appeared at two other locations along the coast.

The next developmental stage is represented by layers with Bell Beaker pottery, sometimes associated with flat-flaked tanged and barbed arrowheads and/or flint dagger fragments. Four distinct Bell Beaker strata have been found (fig. 1). They are Mortens Sande 1, the upper layer at Mortens Sande 2, the lower of two occupation layers at Bodbjerg Ditch, and the lower of two layers at the Barrel Site. There are also faint signs of Bell Beaker settlement at the Viking site of Øster Aalum. There must have been structures at some of these sites, as pits and stakeholes have been observed, but only small areas could be excavated, and nothing definite can be said about the structures.

There were also occupation layers with pottery with degenerate or residual Bell Beaker traits. There are three occurrences of this kind, all small. They are the upper layer at the Barrel Site, Middle Site A, and the lower of two layers at Gjævhul Bakke.

The final site in this series (the upper layer at Gjævhul Bakker) produced coarse thick pottery from period I of the Bronze Age. Part of a type VI flint dagger was found on the surface at this site, and may be supposed to be derived from this layer.

All these Single Grave/Late Neolithic sites were rather alike. They comprised spreads of charcoal, flint implements, chipping waste, and pottery, and usually amber (Hirsch & Liversage 1987). Stake structures would certainly have been found if the sites could have been excavated in the same way as Mortens Sande 2. Their size can be roughly estimated from their extension along the cliff, which suggests a typical diametre seldom or never exceeding 10 m. The flimsiness of the structures, the small extent of the occupied area, and the limited amount of finds all suggest that these sites were temporary camps rather than permanent settlements. It seems likely that they were inhabited seasonally by herdsmen, whose permanent settlements lay elsewhere, but who exploited the dune belt for grazing, probably on a seasonal basis. The permanent settlements were no doubt similar to some of those excavated by the Thy-project on higher land east of Ovesø lake, and could even be the same settlements. It was never possible to recover the total material of a site, and it is clear that a great deal has been lost to the sea. Nevertheless the excavations give quite a good idea of the range of pottery that was in use in different phases and how it developed from phase to phase, and this is supported by stratigraphical evidence. At some sites polished flint was present. Amber was extensively worked. At Mortens Sande 2 the complete flint chipping inventory of a Single Grave community was recovered, and found to be so unusual that it supports the theory that these people lacked experience and skill in dealing with flint (Liversage 1988).

### *Early Bronze Age (period II onwards)*

Period I in the upper layer at Gjævhul Bakker belongs to the Single Grave/Late Neolithic cycle. The next in chronological order must be Lyngby North (see fig. 1). It was a difficult site to date, because the pottery was atypical and rather sparse. The pottery must in all events be later than the coarse pottery from the upper layer at Gjævhul Bakke, while the presence of a little flat-flaked flint shows that the settlement can hardly be later than the early Bronze Age. The finds included a glass bead, which though found on the surface is most unlikely to be intrusive.

### *Late Bronze Age*

Basically there are two types of site. The first are sparse scatters of sherds and flint accompanied by a little charcoal. The second have abundant finds, especially of pottery, and numerous postholes are found. These were much larger than any from the Late Neolithic, and certainly represent year-around settlements lasting decades.

The three rich LBA sites were in chronological order the Middle Site B and C (which may be from the same settlement), Stenbjerg North, and Bodbjerg Ditch (fig. 1). There were indications that settlement activities had been spread over quite a large area. Thus at the Middle Site there were two middens, so far as we can judge from the pottery both of about of the same age, lying about 100 m apart, and at Bodbjerg Ditch apparently similar pottery was found in a blowout some scores of metres from the main discovery. The midden deposits were characteristically about or in one place over a metre thick, and consisted of streaky blown sand variously coloured by ash, in which there was much pottery, fire-shattered stones ("potboilers"), and food debris in the form of carbonized plant remains and decomposed ruminant teeth representing the cattle, and sheep or goats eaten by the inhabitants. Adjacent to one of the middens at the Middle Site was an area with numerous, often fairly large postholes. Many were cut into one another, showing that the buildings had been rebuilt or repaired at the same location, which indicates that the settlement must have been in use for a substantial time.

The third major Bronze Age site was Stenbjerg North. Here there were the remains of a house, which will be described on p.52.

On the basis of the pottery, and to some extent supported by radiocarbon dates, the Middle Site can be dated to period IV, Stenbjerg North to period V, and Bodbjerg Ditch to period VI of the Bronze Age. They provide closed assemblages showing the full range of pottery in local use at these stages. Chipped flint is still present, and if anybody wants a pure and uncontaminated sample showing how flint was treated in the LBA, it is available here. Amber was no longer being worked and there is no indication that it was used.

A particularly important feature of the Late Bronze Age settlement is that old plough soils start appearing. They are recognizable first as homogeneous greyish strata 10-20 cm thick. The identification is confirmed if the criss-cross grooves caused by ploughing with the ard can be found at the transition to the underlying deposit. The plough layers will be considered below p.51.

The sparse type of Bronze Age occurrences have been harder to study. Several occurrences were found in the early years of the project, but no sites of this kind have been found recently. It is quite likely that they were diffuse artifact scatters associated with plough layers, and most of them were found in the northern two thirds of the research area, on what was at the time a level plain some metres above sea level. Together they suggest a considerable amount of Late Bronze Age settlement, but they are very difficult to study.

### *Iron Age*

A site from the middle of the Pre-Roman Iron Age at a point now far out in the breakers is indicated by a box of sherds at the National Museum from an unspecified place in the sand dunes in Lodbjerg parish.

Only one Iron Age settlement has been found since 1965. It is the "Summerhouse Site", which has been thoroughly studied and published by an international team (Liversage *et al.* 1987). Primarily it was a ploughsoil with ard marks. This was bounded on the south by a broad, very low bank of wind-blown sand. A narrower bank running through the ploughed area had signs of cultivation underneath it, showing it did not date from the earliest use of the field. Pottery, flint, and charcoal indicate settlement, and a sunken clay layer must be interpreted as a house floor. It was cut by ard marks showing that there had been cultivation after demolition of the building. The interesting botanical and pedological studies will be discussed in the next section. The pottery dated the site to an early part of the Pre-Roman Iron Age. In 1992 it was found that the field had entirely disappeared into the sea.

### *Later settlement*

After the early Pre-Roman Iron Age there seems to be a gap in settlement, so that the late Pre-Roman, Roman, and Post-Roman periods are unrepresented in the archaeological material.

The youngest site found has been named "Øster Aalum" after the Nørre Aalum shown on old maps and washed away by the sea in the last century. "Øster Aalum" was a Viking Age farming settlement, and was placed at what was then the border between boulder clay and the innermost edge of the blown sand. There was evidence of cultivation on both substrates, and there may have been good agricultural reasons for choosing the situation at the transition between two soil types. Thus Øster Aalum is not really a true dune site, and it can be said that as far as our present evidence goes settlement on the blown sand ended in the Pre-Roman Iron Age and was never revived. The erosion of the coast at Øster Aalum is particularly severe, and over the years postholes, a hearth, various pits including what probably was a pithouse, a palisade or house wall, and a great deal more, have been washed into the North Sea. Features connected with agriculture at this site were a cultivation layer, a field bank, and some small trenches, which were probably field drains. As well as a little Viking pottery the site has produced archaeobotanical material, and there are faint traces of earlier settlement from pre-Roman and Bell Beaker times.

### *Summary*

At all these sites only a small fraction of the finds could be salvaged, but the material is interesting and its validity as closed finds is ensured by the thick separating layers of blown sand. The assemblages add usefully to our knowledge of the development of material equipment. Among other things they provide good evidence of technology of chipped flint over a long period, and provide the best opportunity we have for examining the character of the flint work in Late Bronze Age and Pre-Roman Iron Age times. In several cases direct superposition of cultural layers provides stratigraphical sequences of a type that rarely occurs before the stratified Iron Age settlements.

## THE ENVIRONMENTAL EVIDENCE

### *Introduction*

At the outset, the first priority of this project was the archaeology of the finds and structures which emerged from the eroding dunes. After a while it was realised that there was also a very significant natural archive preserved in the layers which the sea was relentlessly exposing. Over the boulder clay and under the dunes there are buried mineral soils capped by organically-rich vegetation layers, and peat and gyttja deposits accumulated under the wetter conditions found in small hollows, ponds and lakes, similar to those seen today on the flats behind the dunes. In some areas the dunes were stable sufficiently long for vegetation cover to establish and soils to develop before another layer of blown sand was deposited. In some places, gleying, podsolisation and iron pan formation in the layers of blown sand, led to local waterlogging. These processes were aided by a general rise in the watertable linked to the rise in the ground surface as successive layers of blown sand were deposited, and even well-drained deposits eventually became waterlogged. As a consequence, peat and gyttja deposits can be found in the blown sand high above the glacial till. Due to the waterlogging and the protective effect of the sand, many of these deposits contained well-preserved carbonized and uncarbonized organic material in the form of pollen, seeds, fruits and other plant remains, insect remains and occasionally bones.

The vast majority of the deposits found in the erosion cliffs are natural and devoid of artifacts. In a small number of cases the deposits have either been modified by being on the fringes of human settlements or have been directly created by human activity. Analyses of the botany, pedology, geology and micromorphology of natural, semi-natural and man-made deposits can give us a great deal of information about the local natural environment and the development of the landscape, and the part which successive human populations played in this process.

## *The analyses*

The first palynological evidence came in 1972. A sample from an organic layer below the Bell Beaker occupation layer at Mortens Sande I was described by Svend Jørgensen of the National Museum as very humified organic material, containing fungal hyphae, charcoal dust and fine eolian sand, in a felted fibrous mass of woody and herbaceous root and stem fragments. Archaeological finds were absent from the layer, which must represent the pre-occupation environment. Despite the pollen being sparse and poorly preserved, Svend Jørgensen produced a pollen count (Table 1). The pre-occupation environment at Mortens Sande I was probably sheltered scrubby woodland, comprising oak *(Quercus)*, birch *(Betula)* and alder *(Alnus)*, and the influence of nearby dune and coastal vegetation can be clearly seen. Direct palynological evidence of human activity is minimal, although the openness of the woodland and the abundance of herb pollen (particularly grass, *Poaceae*) is indirect evidence of human influence. Heather pollen shows the heath formation had already begun locally in the area at this time, possibly both in the woodland and on the dunes.

The next step forward came in 1979, when an international team, comprising an archaeologist, a palynologist, two soil scientists and an archaeobotanist became involved in investigations at a Pre-Roman Iron Age locality – the "Summerhouse Site" (Liversage *et al.* 1987). The investigation included a section through the remains of cultivated fields, field banks, a house floor and uncultivated areas. Pollen and plant macrofossil analyses were carried out on plough soils and peat and gyttja deposits in the uncultivated areas immediately adjacent to the fields. The pedology and soil micromorphology

Table 1. Pollen analysis from Mortens Sande 1 – Svend Jørgensen 1971.

| Pollen Type | Count | % total pollen + spores |
|---|---|---|
| Trees | | |
| Fagus (Beech) | 1 | 0.4 |
| Quercus (Oak) | 32 | 12.8 |
| Fraxinus (Ash) | 2 | 0.8 |
| Tilia (Lime) | 3 | 1.2 |
| Ulmus (Elm) | 2 | 0.8 |
| Pinus (Pine) | 15 | 6.0 |
| Betula (Birch) | 43 | 17.2 |
| Alnus (Alder) | 15 | 6.0 |
| Shrubs | | |
| Salix (Willow) | 16 | 6.4 |
| Corylus (Hazel) | 26 | 10.4 |
| Dwarf Shrubs | | |
| Ericaceae | 7 | 2.8 |
| Herbs | | |
| Poaceae (Grasses) | 62 | 24.8 |
| Cyperaceae (Sedges) | 2 | 0.8 |
| Galium (Bedstraw) | 2 | 0.8 |
| Liguliflorae (Composites) | 5 | 2.0 |
| Tubuliforae (Composites) | 1 | 0.4 |
| Melampyrum (Cow-Wheat) | 2 | 0.8 |
| Plantago maritima (Sea Plantain) | 3 | 1.2 |
| Plantago coronopus (Buck's-horn Plantain) | 2 | 0.8 |
| Potentilla (Tormentil etc.) | 2 | 0.8 |
| Scrophulariaceae (Figwort Family) | 1 | 0.4 |
| Vicia (Vetch) | 1 | 0.4 |
| Elymus (Lyme grass) | 1 | 0.4 |
| Ferns and mosses | | |
| Polypodium (Polypody) | 3 | 1.2 |
| Pteridium (Bracken) | 2 | 0.8 |
| Dryopteris (Buckler fern etc.) | 2 | 0.8 |
| Sphagnum (Bog Moss) | 2 | 0.8 |
| Total pollen and spores | 253 | |

of the various deposits including the remains of a house floor were also investigated. The botanical and stratigraphical analyses from the small pond north of the field are particularly useful in reconstructing events at the site, as the deposits consist primarily of gyttja formed under water, thus avoiding many of the interpretative problems associated with soil pollen analyses (Moore et al 1991, p.22). The analyses show that prior to the area coming under cultivation, the dominant vegetation was heather *(Calluna vulgaris)* heathland, with local wetland vegetation in the pond. Heather produces very large amounts of pollen, which tends to swamp the evidence for other vegetation types in the pollen spectra. Nevertheless, it is clear from the presence of various agricultural indicator species (albeit in relatively small amounts) that agriculture was being practised in the vicinity, prior to cultivation at this particular location. When cultivation and settlement commenced in the immediate vicinity, drastic changes occurred in the pollen spectra. These are partly due to the removal of the source of the heather pollen, but also very real changes in the vegetation are apparent. The pollen and plant macrofossil analyses reveal the presence of distinct vegetation types linked to the cultivated fields, the pond, and possibly the field bank or hedge associated with the fields. Some of the spectra from the plough soils are clearly a mixture of residual heather pollen and pollen of cereals, arable weeds, grasses and sedges *(Cyperaceae)* from the time of the settlement. The seeds found in the plough soil were mostly of common arable weeds. In the pond deposits there is, in addition to pollen and seeds from the local aquatic and wetland vegetation, clear evidence of nearby cultivation in the form of both pollen and seeds of arable weeds and ruderals. We can also see that the bank of the pond became disturbed and polluted (nutrient enriched) as a consequence of the proximity of the settlement. The pond also contains traces of the vegetation likely to have been growing on the rather more stable environment of the field boundary. Outside the cultivated area there seems also to have been a change from heather heathland to rough pasture, with an accompanying rise in the pollen of grasses and sedges. It is however difficult to see the scale of this change – the relative increase in sedge and grass pollen in the later samples may be more due to the removal of the source of some of the dominant heather pollen rather than a dramatic increase in grasses and sedges.

The archaeological investigations showed that the plough soil contained abundant charcoal and pottery fragments, suggesting that the manure used on the fields had contained domestic refuse. The manuring of the soil and the fact that the house floor had been damaged by later ploughing suggested that there had been intensive and repeated cultivation and settlement within a confined area. This interpretation was confirmed by the pedological and soil micromorphological analyses. The overall picture was of small intensively and repeatedly cultivated plots intrinsically bound to the settlement, in a relatively inhospitable mosaic of bogs and heaths – marginal land which was probably used primarily for grazing.

Research at the "Summerhouse Site" established that palaeobotany could make an important contribution to understanding the nature of prehistoric settlement in the blown sand, and inspired by the results, one of the authors (D.L.) spent many evenings of a later field season processing soil samples in order to study the occurrence of seeds in different contexts. Some of the samples were later identified by Hans Arne Jensen (Lyngby) and Jan Peter Pals (Amsterdam), and some new samples were taken by Bas van Geel (Amsterdam).

A sample from the "Summerhouse Site" produced a seed of a medicinal plant that is not native to Denmark, the opium poppy *(Papaver somniferum)*. Whether this represents a weed, or intentional cultivation for food, medicinal or narcotic purposes is impossible to determine, but it is in all events a very interesting discovery. A small sample of carbonized cereal grains, that had been blown free by the wind at the EBA site, Lyngby North, were identified by Grethe Jørgensen as 6-rowed barley *(Hordeum vulgare)* – whether naked or hulled cannot be determined owing to the state of preservation.

During excavation of the Viking site, "Øster Aalum", in 1983 a pit house was excavated, which quite obviously contained very large numbers of cereal grains, which were scattered uniformly throughout its sandy fill. These were examined P. Rowley-Conwy (Rowley-Conwy 1990), and were found to be dominated by grains of rye *(Secale cereale)* with small numbers of barley, oat *(Avena)* and wheat *(Triticum)* grains. A few weed seeds and seeds of plants of damp habitats were also recorded. Rowley-Conwy interpreted the material as a by-product of crop processing, so-called "tailings", i.e. small grains and weed seeds which have been separated from the main crop during processing and cleaning of the grain (Hillman 1981). In the light of other analyses from pit houses however, there is no reason to see the remains as anything other than the charred remains of a locally-grown and harvested crop (Robinson 1993).

A more systematic approach to the question of preserved plant remains was adopted in 1984, when a flotation bucket was used to retrieve plant remains on site at the Bell Beaker "Barrel" site (sb 37) and the Single Grave stratum at Mortens Sande 2. The resulting material was examined by the second author of this paper (D.R.). The analyses from Mortens Sande 2 were published by Robinson and Kempfner (1988) and those from the Barrel Site are to be found in Robinson (1992). The samples from Mortens Sande 2 came from a layer dated by Ground Grave pottery. Only carbonized remains were preserved, and they were dominated by cereal grains, of which the overwhelming majority were of naked barley, although a few grains of hulled barley, emmer *(Triticum dicoccum)* and oats were also recorded. Some naked barley grains still had fragments of the enclosing lemma and palea adhering to their surface. This shows that the grains were not fully ripe when harvested. It also seems likely that the barley had been harvested, stored and brought to the site as hand-plucked ears. This conclusion is based on the fact that fragments of barley rachis (the segments which make up the spine of the ear) were present, while seeds of arable weeds were exceedingly rare. Both these traits are consistent with the ears having been hand-plucked. The few other plant remains which were encountered were ruderals, which grow on disturbed nutrient-rich soils, and plants of moist shady woodland and heath.

The Barrel Site comprised a layer rich in organic material and an overlying more sandy deposit. Both contained the same Bell Beaker pottery. A thicker layer of blown sand separated the Bell-Beaker layers from an overlying Late Neolithic occupation. Several samples were analysed from the lower and upper parts of the Bell Beaker deposit, and one from the Late Neolithic layer – all contained both carbonized and uncarbonized remains.

All the Bell Beaker layers at the Barrel Site contained carbonized cereal grains. Naked barley dominated the spectrum but there were also grains of emmer and a single grain of hulled barley. In keeping with other Neolithic finds, arable weed seeds were rare, with the exception of fat hen (Chenopodium album) which was very common. Fat hen probably grew as a ruderal on the nutrient rich soil around the site, rather than as an arable weed. The seed content of the organically rich basal deposit is much more diverse than that of the other layers. Its composition is consistent with moist scrub woodland and grazed common. The sample from the higher Late-Neolithic layer contained no remains of crop plants but there were remains of plants which typically grow in scrub woodland, on grazed common and in wetland areas.

At various times, massive peat and gyttja deposits have been exposed by coastal erosion at Gjævhul, and in 1982 a sample column was collected by Bas van Geel. In 1987, preliminary pollen analysis of the deposit was begun by DR and two samples were radiocarbon dated, one from the top and one from the bottom. The resulting "skeleton" pollen diagram and a description of the stratigraphy of the deposits is presented in fig. 5. Although still at a preliminary stage, the pollen diagram is presented here because it contains valuable information and it is unlikely that resources will be available in the foreseeable future to enable its completion.

The lower 40 cm of the deposit consists of very humified and degraded wood peat, which formed over boulder clay under terrestrial conditions some time just prior to the beginning of the 4th Millennium BC, radiocarbon dated to 5050 ± 90 bp, calibrated 3960 – 3790 BC (K-4849) (Stuiver & Pearson 1993). Some quite large pieces of charcoal were apparent in the upper part of the wood peat. At 41 cm there is then a very sharp transition to gyttja (i.e. a deposit formed under water), which then made up the remaining 2.1 metres of the deposits. The transition from peat to gyttja has not yet been radiocarbon dated and this is something which obviously should be done (see later). The sand content of the gyttja varies considerably up the profile and a number of thin sand layers and lenses are obvious in the deposits, notably at the transition from peat to gyttja. The top of the gyttja is radiocarbon dated to 2720 ± 70 bp, calibrated ± 1 standard deviation: 920 – 820 BC (K-4850) (Stuiver & Pearson 1993). As the top of the deposit appeared to have been eroded, this may be earlier than the actual cessation of sedimentation in the lake.

Analysis of the basal wood peat revealed that pollen was either absent or very scarce and degraded, which suggests that the deposit had been subjected to periodic drying out and considerable bioturbation by the soil fauna. Only two pollen samples from the wood peat could be counted satisfactorily, luckily one of them comes from the level of the radiocarbon date. This analysis confirms that the deposits are terrestrial in origin and that in the early Neolithic there was woodland at the site, probably alder carr, with hazel *(Corylus)* and possibly pine *(Pinus)* in the vicinity. The smaller amounts of pollen of other tree species may have originated from long distance transport. Grass and sedge pollen is present only in modest amounts, heather pollen is absent, and very few herb species are recorded. Spores of ferns *(Filicales)* and adder's tongue *(Ophioglossum)* are well represented, which is consistent with there having been woodland at the site.

A sample from the uppermost 5mm of the wood peat shows the continued dominance of alder woodland with ferns, but the influence of the overlying aquatic deposits is clearly seen. At the transition to gyttja the pollen spectrum changes dramatically before remaining more or less constant for the remaining 2.1 metres of the deposits. The pollen is generally much better preserved and the spectra are characterized by very low tree pollen values, with the exception of hazel-type (which also includes bog myrtle *(Myrica gale)* pollen), and high values for grass, sedges and heather. Cereal-type pollen is present in the majority of samples and anthropogenic indicators such as ribwort plantain *(Planta-*

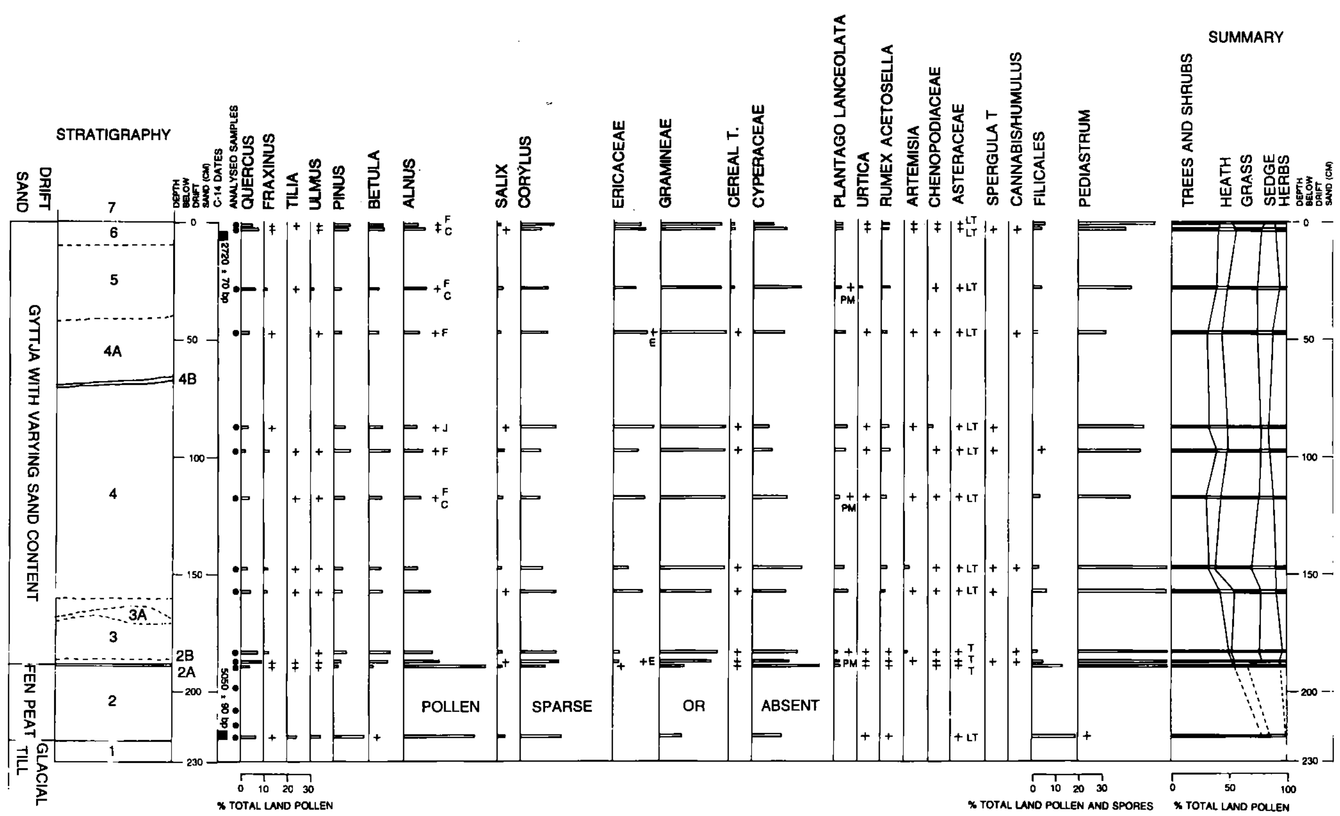


Fig. 5. Preliminary pollen diagram from "Gjævhul Sø" – peat and lake deposits from the Neolithic and Bronze Age, buried under drift sand. Only the most abundant or most important taxa are shown; other pollen and spore taxa were recorded at lower frequencies, but have been omitted for reasons of space.
Key: + = values of less than 1% of total land pollen; F = Fagus; C = Carpinus; J = Juglans; E = Empetrum; PM = Plantago media/major; L = Liguliflorae; T = Tubuliflorae.
Pollen sum (total land pollen): between 213 and 628 (average 457).
Stratigraphy: 1 = glacial till; 2 = degraded fen peat; 2A = fine sand; 2B = mixture of fen peat and gyttja; 3 = gyttja with a moderate to high sand content; 3A = gyttja with very high sand content; 4 = gyttja with low sand content but with occasional stripes and lenses of fine sand; 4A = gyttja with low sand content; 4B = fine sand; 5 = gyttja with moderate to high sand content; 6 = weathered/degraded gyttja; 7 = drift sand.
Radiocarbon dates: TOP: K-4850 = 2720 ± 70 bp (920 – 820 BC corrected ± 1 standard deviation (Stuiver & Pearson 1993)).
BOTTOM: K-4849 = 5050 ± 90 bp (3960 – 3790 BC corrected ± 1 standard deviation (Stuiver & Pearson 1993))

*go lanceolata)*, nettle *(Urtica dioica)*, sheep's sorrel *(Rumex acetosella)* and mugwort *(Artemisia)* are also well represented. Fern values decrease and the very large numbers of colonies of the green alga *Pediastrum* confirm that the sediments formed under aquatic conditions. We do not know as yet when or why the area became inundated, neither do we know the length of time which the gyttja deposits represent. A radiocarbon date from the peat/gyttja boundary would be helpful in this respect. It is however unlikely that two metres of gyttja could have accumulated in under 1000 years. The pollen diagram from the gyttja covers therefore a very long period of time, perhaps the whole of the later Neolithic and Bronze Age, during which there was an apparently open and agriculturally-dominated landscape. The openness of the landscape corresponds very well with the picture we get from the Hassing Huse Mose pollen diagram (Andersen et al. 1991; Andersen 1992; 1995 (this volume)), although the high values of pine pollen seen in the Hassing Huse diagram at this time are not apparent in the deposits at Gjævhul Sø. We can also see from the Gjævhul diagram that heath formation had not begun locally in the early Neolithic, but occurred later. The first heather pollen appears at the base of the gyttja, after which values increase steeply to a level which is maintained throughout the rest of the diagram. A date from the peat/gyttja transition would again be useful as it would fix the start of the development of heathland in the southern part of the study area.

Collection and analysis of further material from the sand-dune area for botanical analysis in the future will depend very much on available manpower and economic resources. The scientific potential of the area is enormous, particularly now that we are so fortunate in having the regional pollen diagrams from Hassing Huse Mose and Ovesø (Andersen et al 1991, Andersen 1992, Andersen & Rasmussen 1992) to provide a reference framework both for the sites turning up on the coast and those being investigated inland under the auspices of the Thy-Project.

## A SPECIAL QUESTION – OLD CULTIVATION SOILS

One of the unexpected discoveries was that old cultivation layers could be found in the blown sand. Plough layers with ard marks have been identified at five points along the 14 km stretch of coastal cliff, and further deposits have the appearance of old cultivated soils although no ard marks have been found in them. All dated occurrences have been from the LBA or the Pre-Roman Iron Age (apart from the Viking Age plough layer at Øster Aalum, which is not strictly a sandhills site). No signs have yet been found of Neolithic or EBA cultivation. It seemed we had nothing less than a whole buried landscape with the unique opportunities for studying land use and agricultural methods in prehistoric Denmark! Blown sand seems nevertheless a surprising substrate for crop cultivation, but with a little thought it became plain that the inhabitants had not simply gone out and cultivated blown sand, but had chosen places with well developed humic or peaty surface deposits with a solid plant cover, and had almost certainly added organic matter in the form of manure and/or peat. The cultivated areas have the appearance of sandy soils now because the organic fraction has largely broken down as a result of cultivation and the passage of time; the plough soils have reverted to grey powdery sand.

Logically the first question to ask was how big were the cultivated areas and how were they delimited. It turned out however that the boundaries of the cultivated areas could not always be found. In fact it was only at the two youngest sites, Øster Aalum and the Summerhouse Site, that the edge could be determined precisely. At Øster Aalum the ploughsoil ended northwards at a very distinct artificially constructed field bank of sand (southwards it sank to below beach level and was lost to sight). A section through the bank is seen in fig. 6. Unfortunately despite repeated efforts it has not been possible to find this bank again. The plough layer was intersected by or passed over 2-3 narrow ditches, which must have had some purpose in their time, perhaps that of drainage. They appeared to contain a good deal of organic material, the analysis of which is in progress. The furrow marks in the base of the field layer differed from those at other sites along the cliff in including broad, one-directional furrows that are likely to have been made by a mouldboard plough, but criss-cross ard marks were also present (fig. 6). It has not been possible to decide whether the two kinds of marks were of from the same or different ages, for there was limited evidence of Late Neolithic and possibly also of Pre-Roman Iron Age activity at the site.

The situation at the Iron Age Summerhouse Site was somewhat different (Liversage et al. 1987). From its

Fig. 6. Marks of two different ploughing implements at Øster Aalum. In background section through the field bank bounding the cultivated area.

uninviting situation out in the sandhills it was first assumed that it must represent short-term "outfield" cultivation. This is the system in which areas of marginal land are opened up and cropped for a year or two and then allowed to revert to the wild. However from her study of the soil micromorphology M.-A. Courty was able to conclude that cultivation had continued over a substantial period of time. This was supported by various other indications as already described – the ploughed-over house remains, the low banks formed through the gradual deposition of blown soil, the secondary internal bank, the substantial amounts of pottery and flint chips. These all showed that the place had been settled for too long a time to be an "outfield". There was further support from palaeobotanical evidence indicating vegetational changes that were too marked to result from short-term utilization. Finally the strong leaching of the underlying sand was consistent with a long period of cultivation. Thus the archaeological, palaeobotanical and pedological evidence all pointed towards a period of cultivation lasting at least for decades. The limits of the fields at Øster Aalum and the Summerhouse Site were easily found, but this was not the case at the other sites where ard marks were encountered. Homogenized soil with clear ard marks at its base might be discovered, but when followed sideways it would gradually change to an unhomogeneous material with horizontal streaks of dark and light sand, and there would no longer be ard marks, i.e. it lost the character of a cultivated soil, but no clear boundary could be found between the cultivated and the uncultivated. The explanation is certainly bioturbation. At Øster Aalum and the Summerhouse site the ploughsoils had been sealed by new blown sand soon after the sites were abandoned. This is clear because the new natural vegetation hardly managed to re-establish itself on them before they were covered by more blown sand. Being quickly buried had greatly reduced the amount of bioturbation that took place after they were abandoned. Some other plough soils remained uncovered for centuries after cultivation ceased. During this time natural plant growth and burrowing animals eradicated most of the signs that could have identified them as old cultivated soils. Even at Stensbjerg North, where there was evidence of prolonged Late Bronze Age settlement, it was impossible to delimit the cultivated area. The homogenized ploughsoil became gradually streaky in one direction, and had been destroyed in the other by a recent blowout.

In the cultivated soil at Stenbjerg North there were the remains of a post-built house with its floor lying about 30 cm below the surface of the field. The excavation plan is given as fig. 7. The fill in the depression where the building stood was indistinguishable from the surrounding ploughsoil, except that on the very bottom there was a thin, dark, greasy deposit representing dirt on the floor. This floor deposit was cut by a network of ard marks, showing that the ploughman had cultivated down through the depression left when the walls and posts of the house had been cleared away. Fainter traces of ard marks at various levels higher in the fill, made it clear that cultivation continued throughout the filling up process. The section (fig. 8) shows that cultivation continued until the hollow had been completely filled up and the surface passed horizontally across it without the slightest sign of the depression underneath. This can only mean that the site was cultivated for a considerable number of years. As at the Summerhouse site, the story told is of continued cultivation for a period not of a few years, but that has to be counted in decades or generations. Again the "outfield" theory must be ruled out.

When the site was finally abandoned a peaty horizon with woody vegetation formed on the surface of the abandoned field and represents the centuries before the next blown sand arrived. Innumerable water voles dug their burrows with characteristic storage chambers and virtually obliterated the ard marks except down in the deeper hollow where the house had been. Outside the house only a few short lengths of furrow could be distinguished in the confusion of burrows.

The plough layers without ard marks that have been mentioned resembled this plough layer as it survived outside the house enough to suggest that they indeed were ancient cultivated soils that had become virtually unrecognizable through bioturbation.

## LANDSCAPE DEVELOPMENT AND HUMAN SETTLEMENT

In the earliest times there was normal forest development on boulder clay, just as anywhere else in the country. By Atlantic times the rising sea had flooded the low-lying areas that are now the North Sea, and an arm reached into Ovesø. The coastline was very different from the present one, and the boulder clay prominences in the southern part of the present cliff continued as a land mass far to the southwest, partly closing the western Limfjord. The sea was certainly closer north than west of most of our sites. Though the Limfjord was closed to big waves, salt water began to enter it in early Atlantic times. On the boulder clay prominences we find occasional traces of Funnel Beaker settlements. Sv.Th. Andersen's pollen analyses from Hassing Huse Mose and Ovesø Lake show that the effect of the TRB culture on the forest in southern Thy was relatively light

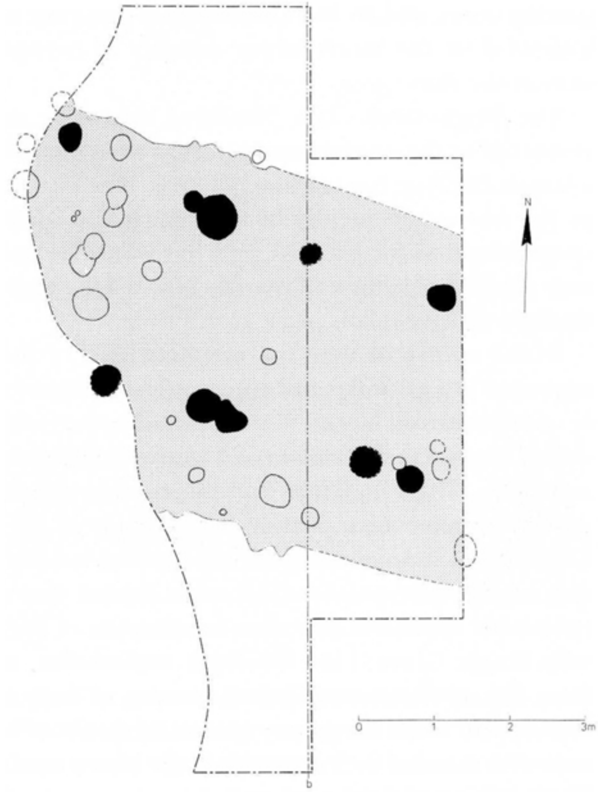


Fig. 7. Plan of a Late Bronze Age sunken dwelling at Stenbjerg North.

(Andersen et al. 1991, Andersen 1992, this volume, Andersen & Rasmussen 1992).

By the time of the Single Grave Culture, blown sand was being deposited over the beach sand that had long been filling up the bay leading to Ovesø. Sv.Th. Andersen's pollen diagrams as well as ours from Gjævhul Sø show that a very marked and sudden deforestation took place at this stage, with the formation of extensive

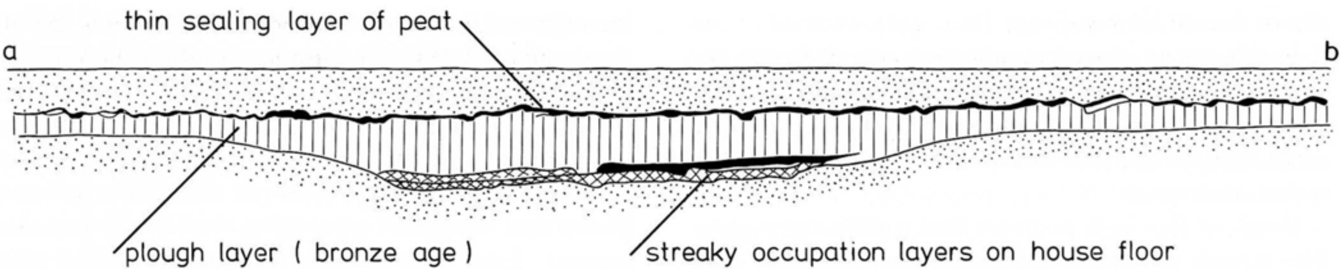


Fig. 8. Section through the sunken dwelling shown in fig. 7.

grazing areas, and an increased human presence is also indicated by the much larger number of occupation sites in the dune area.

The Single Grave/Late Neolithic sites were mainly restricted to the southernmost part of what by then was a largely filled-up bay leading to Ovesø. The beach sand in the bay would readily be caught by the wind and swept inland to form dunes, and this would be particularly marked at a time of marine regression, such as is thought to have taken place at this time.

In the course of time the northern part of the bay aggraded to a great flat and apparently unsettled expanse of marshes and meres, that extended to the northern end of the 14 km section of coast where old deposits are accessible. These marshes and meres are represented now by a metre-thick peat and gyttja layer in the cliff, which stands in something the same stratigraphical relation to the earliest blown sand as the Beaker sites do. It reveals an uninhabitable zone northwards of the area with Single Grave/Late Neolithic settlements, which from the small size and limited amount of finds at the sites appear to be temporary camps, no doubt of herdsmen who minded their livestock in the blown sand area. Their cultivated fields and main homes were no doubt substantial long houses on till soils, like those excavated by the Thy project. The limited pollen analytical evidence from the sandhill area suggests both dune vegetation of willow and heather, and local growth of various trees, including oak. The extensive heaths had not yet developed.

Subsequently sandhills marched across the marshes, leaving sheets of blown sand behind. Climate was not necessarily the cause of this change of regime, for it could have resulted from either the approach of the sea from the west as the shore was eroded back, or of a withdrawal seawards of the coastline through the deposition of expanses of beach sand, which could to be caught by the wind and swept inland. On the other hand climatic causes cannot be ruled out.

In the course of some centuries a new plain was created at a higher and drier level in the northern two thirds of the area of study. This provided an environment suitable for Late Bronze Age farming and year-round settlement.

South of this high plain we find a different regime. The terrain was lower and more irregular, with small dunes on some of which Late Bronze Age settlements were established and existed for some decades during this long period. These were much more substantial settlements than earlier. Some of them had solid buildings whose posts had been renewed at least once before abandonment, and there were deep midden layers containing much pottery.

There is a so far an unexplained discrepancy between the settlement history of the blown sand area and the interior, as shown by Sv.Th. Andersen's pollen diagrams. These suggest a high population density in the Early Bronze Age (increased forest clearance), and a lower one in the Late Bronze Age (limited return of the forest). However along the coast settlement from the Early Bronze Age is scantily represented, but a marked expansion can be detected in the Late Bronze Age.

The pollen diagram from Gjævhul Sø suggests that there was substantial areas of heathland throughout the Bronze Age, and there is heather charcoal at the Late Bronze Age sites. Investigations at the early Pre-Roman Iron Age "Summerhouse Site" indicated that the natural environment into which settlement intruded was a nearly treeless heather moor. It would be interesting to study these natural surfaces so see whether there was evidence of the periodical burning of the heath, which could be expected if it was wished to maintain its quality as grazing land.

A big question is what happened to the dunes after their settlement came to an end in the last centuries B.C. It is very surprising that there are no sites from the period c.100 B.C.- 200 A.D., for this period is signalled in Thy by an unequalled richness and abundance of settlement finds. The inhabitants must have had large numbers of cattle and would surely not have neglected the especial resource area along the coast. A possible explanation is that society at this stage was so well run that the inhabitants could simply mark their cattle and let them loose in the dunes without sending herdsmen to protect them from human or animal predators. If true, evidence of the continued human presence might be indicated by heath management. It is well known that heather heaths will degenerate to much less pastorally useful habitats unless maintained by grazing and regular burning.

Though the earliest Iron Age apparently presented a bare heath, the younger layers in the cliff reveal at a glance that vegetation types other than heath were also present. Even very cursory examination shows that some areas were very wet, as indicated by remains of bog moss, other mosses, gyttja and peat. At other places twigs, or even larger branches appear to represent deciduous thickets such as we rarely find today, because all the inner part of the sands has been planted with conifers. In the absence of archaeological finds there is no way of dating these upper layers except by radiometry. When applied, this has indicated earlier datings that expected. For instance a very pronounced peaty later at a high level in the cliff section, which was expected to represent the last stabilization before the Little Ice Age turned out to be from the Viking period.

So far we have not succeeded in identifying any buried plant layers from the Middle Ages. A possible explanation could be that the dunes were a sandy desert without plant cover at this time, but the question needs further investigation.

It should be mentioned finally that the interpretation of the events we can see is not always so simple as might at first be thought. A simple climatic explanation cannot be assumed when there is evidence of deteriorating conditions, for the approach of the sea resulting from the steady erosion of the coast must everywhere have brought about an inexorable climatic "deterioration", as increasingly coastal regimes moved in over the localities. It is also a question what an increase in the deposition of blown sand really indicates. If a climatic explanation is presumed, would cold, wet and windy conditions as in the "Little Ice Age" most increase dune formation, or would it be warm dry conditions, which weakened the plant cover through drought and allowed the sand to blow about more easily? We should also be careful before assuming a simple causal connection in cases where a period of settlement was immediately followed by renewed sand deposition. The abandonment of some sites was indeed followed rapidly by the deposition of more sand, and it would be easy to argue that the inhabitants had destroyed the anchoring vegetation and precipitated a natural catastrophe. At other sites on the other hand, abandonment was not immediately followed by renewed sand deposition at all but there is no obvious reason for the difference. There is certainly no statistical rule connecting settlement with an immediate subsequent increase of sand deposition. There are indications that the sand came as dunes, that originated at the coast and wandered across the country, as described by Hansen (1957). Their arrival soon after a settlement was abandoned could therefore be purely coincidental. Indeed the ultimate cause of some changes of regime for which a climatic or anthropic cause might be sought, could have been earlier changes of coastal configuration affecting the size of the beach, and thereby the amount of sand available to be blown inland. In all events the causative connections between sand deposition and climatic or human factors are so complex that simple or premature explanations are untenable.

One thing is clear, with its rich archaeology and wonderful preservation of environmental evidence the coastal sandhill area offers a unique possibility for studying in depth the evolution of a landscape and how the human presence played a part in this evolution.

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## NOTE

1. At all stages the work has depended on the participation of two amateur archaeologists, Harald Holm and Professor Peter Hirsch (with family), who between them found and reported to the National Museum most of the archaeological sites. One of the authors (D.L.) then carried out trial excavations recording the stratigraphy and other details.

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# History of Vegetation and Agriculture

## at Hassing Huse Mose, Thy, Northwest Denmark, since the Ice Age

by SVEND TH. ANDERSEN

### INTRODUCTION

Thy is the westernmost part of North Jutland, which is delimited from the Jutland mainland by the Limfjord (Fig. 1). Large areas in the west and north of Thy are covered by wind-blown sands. The central and eastern parts consist mainly of sandy and clayey tills, which rise to 94 m altitude, and Holocene deposits (Pedersen 1989, Fig. 2).

The western Limfjord area was densely inhabited from the time of the Ertebølle Culture (S.H. Andersen 1990) and up through prehistoric and historic times. There are scattered graves and finds from the Early and Middle Neolithic Funnel Beaker Cultures in Thy (Kristensen 1989, Davidsen 1985, Kristiansen 1988) and numerous finds from the Middle Neolithic Single Grave Culture and the Late Neolithic (Glob 1945, Vandkilde 1990). The concentration of Bronze Age finds and graves is one of the densest in Denmark (Baudou 1985, Kristiansen 1985), and there are numerous settlements, graves and finds from the Iron Age (Hedeager 1985, Fonnesbech-Sandberg 1985, Hvass 1985). Dense new settlements appeared again in the Medieval Period (Baudou 1985). Natural woodlands had disappeared from Thy by the last century (Ødum 1968), due to the intensive agriculture.

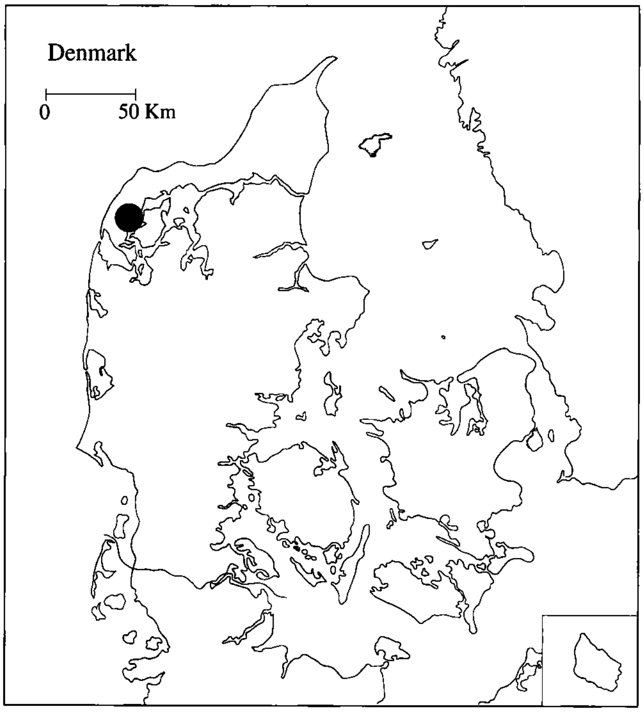


Fig. 1. Map of Denmark with the location of Hassing Huse Mose.

The sand drift in western Thy began already in the Middle Neolithic (Liversage 1987), but the extensive dune areas were not created till after the early 13th century (Hansen 1957). The dune sands were stabilized by planting of marram grass since the late 18th century, and extensive pine plantations were established since about 1885. Small private plantations have appeared in Thy since about 1900.

The climate in Thy is oceanic (15.8° in July, 0.3° in January, Lysgaard 1969). Wind directions are equally distributed in the spring and predominantly westerly in the summer. The average wind velocity is higher than at inland localities (5.9 and 3.6-5.0 m $sec^{-1}$ in the spring, 4.8 and 3.0-4.4 m $sec^{-1}$ in the summer, Frydendal 1971).

Due to the intensive settlement history, it was decided to establish a radiocarbon-dated regional pollen diagram from Thy. 10 localities were examined by B. Odgaard and P. Friis Møller 1985. Of these, only one contained deep non-calcareous deposits suitable for radiocarbon dating: a small swamp named Hassing Huse Mose near Bedsted. Two cores for pollen analysis and radiocarbon dating were extracted 1987 by B. Odgaard and P. Friis Møller. 1991 a core was extracted from the nearby Ove Sø by B. Odgaard and P. Rasmussen. A radiocarbon-dated pollen diagram from Hassing Huse Mose was published by Andersen and Rasmussen (1993). This pollen diagram comprises four mid-Holocene elm declines. The size of a reservoir effect on

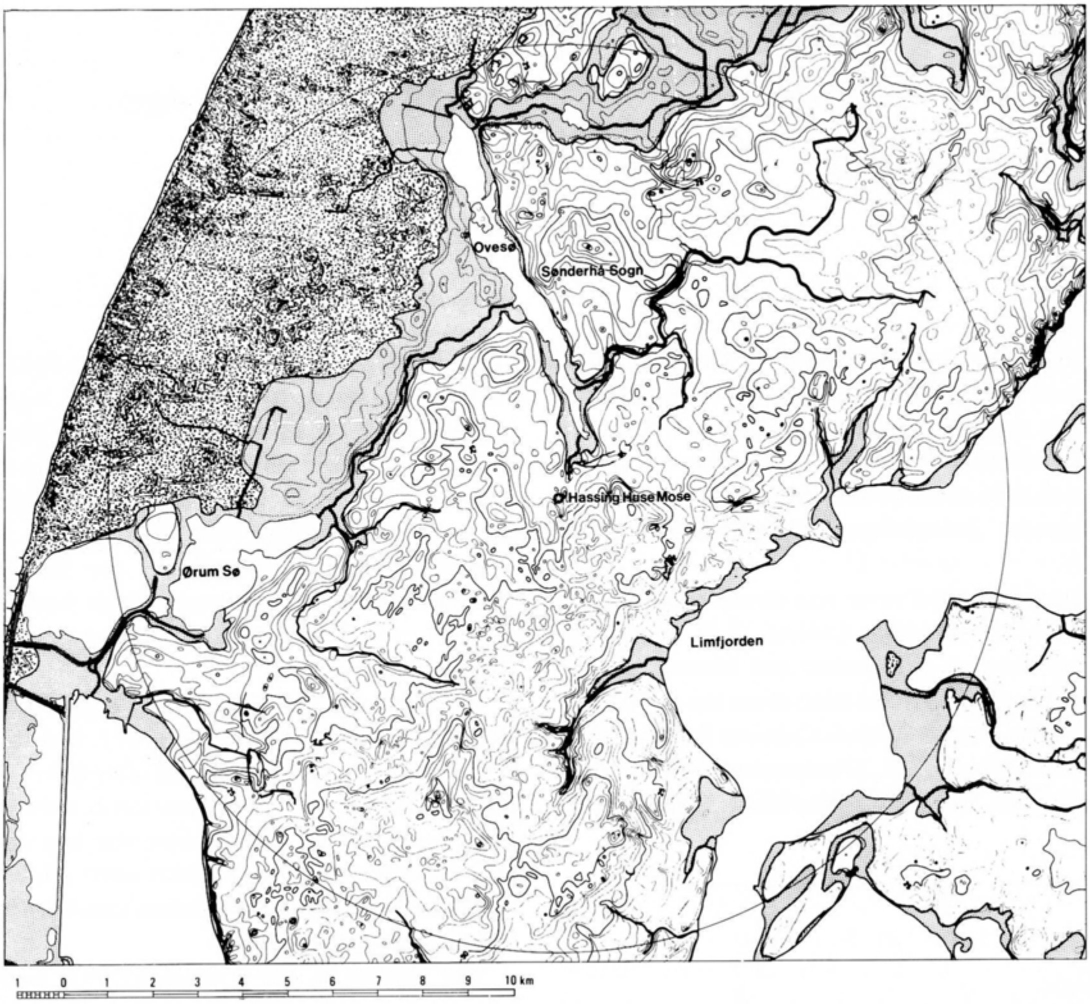


Fig. 2. Map of surface contours in central Thy around Hassing Huse Mose. Coarse dots: Sand dunes. Shaded: Holocene freshwater and marine deposits. The radius of the circle is 10 km. Base map from Danmark 1:100.000. Geodætisk Institut 1982. Reproduced by permission of Kort- og Matrikelstyrelsen no. A.404/85.

the age-determinations of gyttja samples and precise datings were obtained by comparing dates for consecutive samples with the atmospheric calibration curve (wiggle dating), and by dating of the humus and alkali-insoluble fractions of two samples, separately.

## THE SITE

Hassing Huse Mose is located in central Thy (56°49'N, 8°27'E, Fig. 1). It is oval in shape and about 250 x 150 m in size (3.1 ha, Fig. 3). The surface is at 10 m altitude, and the maximum depth of the Holocene deposit is 8.3 m. The site is surrounded by low hills up to 21 m altitude; the sides of the basin are rather steep, and there is no surficial inlet or outlet. The Holocene deposit is 3 m swamp peat above 5 m gyttja. Most of the swamp peat was dug away for fuel industry during World War II, except for two narrow walls, which extend from the west shore to the center of the basin. They had been used for support of narrow-gauged rail tracks. The pits are now water-filled up to near the surface of the peat walls. The area around the site is cultivated intensively.

Cores were extracted at two points on the southern peat wall, series 1 at 96 m, and series 2 at 17 m from the shore. Series 1 is near the centre of the basin.

## METHODS

### *Coring and sampling*

Consecutive cores were extracted from the swamp peat in series 1 with a Russian-type sampler (Aaby and Digerfeldt 1986), 50 cm long and 6.3 cm wide. Three additional cores were obtained with a piston corer of Livingstone type (Aaby and Digerfeldt 1986), 1.3 m long and 10 cm in diameter. The deepest of these cores contained the lowermost part of the swamp peat and the top part of the underlying gyttja. Other cores from the gyttja in series 1 and in series 2 were extracted by the piston corer. Depth levels of the gyttja cores from series 1 deeper that 3.54 m were adjusted by subtraction of 0.16 m (Andersen and Rasmussen 1993). Samples were taken for microfossil analysis (0.5 cm thick) and radiocarbon dating (2 cm slices).

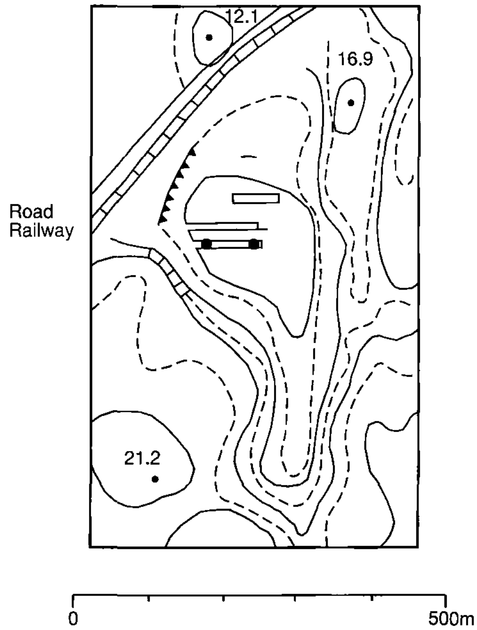


Fig. 3. Topographic map of Hassing Huse Mose and its surroundings. The sections in Hassing Huse Mose are indicated by black circles. Detail of Denmark 1:25.000, Sheet 1116 IV SØ (1964). Reproduced by permission of Kort og Matrikelstyrelsen no. A.404/85.

### *Ash content*

Ash content (% dry weight) was determined by combustion at 550°C.

### *Pollen and charcoal analysis*

The samples were treated for pollen analysis by boiling in 10 % KOH, sieving (peat samples), treatment with HF overnight and acetolysis. The residues were mounted in silicone oil. The numbers of pollen grains and charcoal particles larger than 0.01 mm were counted at 200 or 500 x magnification. English plant names and their equivalents in latin are listed in Table 6.

The diameter of the pore *annulus* was measured on pollen grains of the grass family. Average size (largest and smallest diameter) was measured on grains with annulus diameter larger than 6 μm, and surface-sculpture (scabrate or verrucate) was determined with phase-contrast equipment.

The pollen analyses were performed by H. Krog, B. Stavngaard and S.T. Andersen.

### *Pollen diagrams*

The pollen taxa were grouped in seven categories: Trees, non-tree plants from forest and coppice, wild grasses, plants from open-ground habitats, taxa of ambiguous significance, wet-ground plants and aquatics. Hazel and yew were considered trees. Heather was included in the wet-ground plants because of massive occurrence in the swamp peat.

Pollen percentages were based on the sum of land-plant pollen. Wild grass pollen was included in the land plants because the pollen frequencies follow the frequencies of open-ground plants. The ambiguous and the wet-ground plants had to be excluded, because the pollen from these plants found in the peat may derive from local vegetation. This procedure is not quite satisfactory, because ambiguous and wet-ground plants may also have occurred in land vegetation around the basin. The frequencies of algae (*Pediastrum* and *Botryococcus*) and charcoal particles were related to the land-plant pollen sum. *Algae* were not recorded at 2.95-3.68 m depth, because of massive occurrence, and charcoal was not recorded below 5.74 m depth. Tree pollen percentages corrected for differential pollen productivity were calculated separately (Andersen 1970, 1978). Depth levels from the two sections were correlated by pollen analysis and variations in ash content, and were converted into calendar years based on radiocarbon dates. The pollen diagrams were drawn using the computer program TILIA-GRAPH written by E.C. Grimm, by B.V. Odgaard. Pollen zone borders were determined with the computer program CONISS written by E.C. Grimm (1987). Frequencies for individual taxa within ambiguous, wet-ground plants and aquatics were not drawn.

The pollen sums varied between 500 and 800, in general. Lower pollen sums occurred in the late-glacial samples (300-500, below 8.56 m depth) and in the swamp peat (150-250, at 1.10-1.80 m depth). 2000-3000 pollen grains were counted in the pollen diagram published by Andersen and Rasmussen (1993, at 3.00-5.74 m depth).

### *Rarefaction analysis*

The numbers of pollen taxa recorded in a sample increases with the number of counted pollen grains. Pollen taxon richness was therefore estimated using the computer program RAREPOLL developed by J.M. Line (Birks *et al.* 1986, Birks and Line 1992). The rarefaction program estimates the numbers of pollen taxa (E(T)), which would have been found in all the samples if their pollen sums had been equal to that of the smallest count, and 95% confidence intervals for the estimate. Taxon richness was estimated for the whole section based on the counts of land plant pollen (excluding ambiguous plants, wet ground plants and aquatics, lowest pollen sum 153), and for the gyttja samples separately (below 2.94 m depth). The ambiguous and the wet-ground plants were included in the counts for the gyttja samples. The lowest pollen sum was 484 (the two lowermost samples were excluded because of low pollen sums). A similar pollen sum was used for rarefaction analysis in Andersen and Rasmussen (1993, lowest count 2015 grains).

Pollen diversity and species diversity are generally correlated (Odgaard 1989, 1992a) and are sensitive to vegetation disturbance (discussion in Andersen and Rasmussen 1993).

### *Radiocarbon dating*

Radiocarbon datings were performed at the C-14 Dating Laboratory of the National Museum and the Geological Survey of Denmark, using standard methods (Andersen and Rasmussen 1993). The datings were supervised by H. Tauber, K.L. Rasmussen and U. Rahbek. Coarse and fine fractions (>0.07 and <0.07 mm) were separated by wet sieving and were dated independently in peat samples. Alkali-soluble and -insoluble fractions were dated in one case and average dates were calculated (see below), the dates of gyttja samples are bulk datings. Two dates, at 5.01-5.11 m and 5.94-6.04 m depth, were based on the alkali-soluble humus fraction (Andersen and Rasmussen 1993). Dates at 3.82 and 4.42 m were obtained from Andersen and Rasmussen (1993).

The radiocarbon dates were calibrated into calendar years utilizing the CALIB ver 3.03 $^{14}C$ age calibration program (Stuiver and Reimer 1993), which is based on the atmospheric curves in Linick *et al* 1986, Kromer and Becker 1993, Pearson and Stuiver 1993, Pearson *et al* 1993 and Stuiver and Pearson 1993.

The calibrations were based on moving averages corresponding to the age span of each sample. Midpoints were calculated as the geometric average of the two outer bounds of the calibrated age ± 1 standard deviation in cases where more than one intercept was obtained by the calibration program (cf. Andersen and Rasmussen 1993). A reservoir effect of 120 years was assumed for the gyttja sample ages except for the two humus samples, which were assumed to be of terrestrial origin (Andersen and Rasmussen 1993).

A smoothed depth/age curve for series 1 and 2 in combination was calculated by B.V. Odgaard as a least square spline utilizing the SAS procedure TRANSREG transcribed by B.V. Odgaard. Two dates (at 1.70 m and 2.91 m) were rejected as they were far outside the 2 standard deviation boundaries. The five uppermost dates were used as fixed points. Dates for the following levels were estimated: 0.01 m, AD 1940 (beginning of peat digging), 0.06 m, AD 1900 (reforestation), 8.58 m, 9100 BC (juniper maximum, Fredskild 1979). The dates below 8.58 m were extrapolated assuming a constant deposition rate. The spline curve was used for conversion of depth to calendar years in the pollen diagrams.

## RESULTS

### *Sediments*

The sediments in series 1 and 2 are described in Table 1. Mineral content is indicated by figures for ash content in percentage of dry weight. 90% ash content may correspond approximately to 50% of the volume (An-

| | |
|---|---|
| Series 1 | |
| 0.00-0.01 m | Litter |
| 0.01-0.35 m | Decomposed swamp peat (*Turfa herbacea*[2-3]). Colour reddish-brown. Many fresh rootlets. Ash content 20-50 %. |
| 0.35-1.95 m | Decomposed swamp peat (*Turfa herbacea*[2-3]). Colour reddish-brown. Ash content 10-20 %. |
| 1.95-2.81 m | Somewhat decomposed swamp peat (*Turfa herbacea*[2]). Colour reddish-brown. Ash content 10%. |
| 2.81-2.94 m | Slightly decomposed swamp peat (*Turfa herbacea*[1]). Colour reddish-brown. Ash content 10%. The lower limit was sharp, slightly oblique. |
| 2.94-3.61 m | Fine-detritus gyttja. Colour yellow-brown. Ash content 20-30 %. |
| 3.61-4.50 m | Fine-detritus gyttja. Colour reddish-brown. Ash content 20-35 %. |
| 4.50-7.34 m | Fine-detritus gyttja. Colour reddish-brown. Ash content 15-30 %. |
| 7.34-8.20 m | Fine-detritus gyttja. Colour reddish-brown. Ash content 20-50 %. The lower limit was sharp, some what uneven. |
| 8.20-8.23 m | Clay-gyttja. Colour greenish-grey. Ash content 50- 90 %. |
| 8.23-8.26 m | Clay. Colour greenish-grey. Ash content 95 %. Several small pebbles occurred. |
| Series 2 | |
| 3.40-4.05 m | Gyttja. Colour reddish-brown. Ash content 15-50 %. |
| 4.05-4.23 m | Clay-gyttja. Colour greenish-brown. Ash content 20 -80 %. |
| 4.23-4.55 m | Clay-gyttja. Colour greenish-grey. Ash content 90- 95 %. |

Table 1. Description of sediments. The indices for *Turfa herbacea* indicate humification according to Troels-Smith (1955).

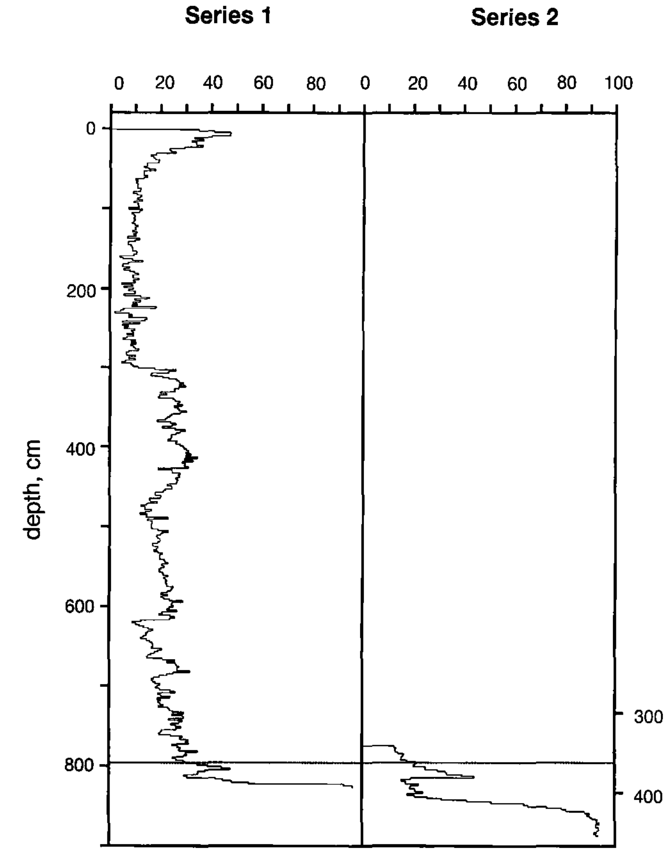


Fig. 4. Curves for ash content (percent of dry weight) in the two sample series from Hassing Huse Mose.

dersen 1984). The transition from gyttja to swamp peat at 2.94 m in series 1 marks the *Verlandung* of the former lake. The *Verlandung* was rather abrupt and was probably caused by a lowering of the water level. The decreased ash content above 8.23 m in series 1 and above 4.23 m in series 2 marks the beginning of the Holocene.

Variations in ash content are shown in detail in Fig. 4. The ash content is likely to be influenced by external factors such as soil and shore erosion and internal conditions such as productivity and decomposition of organic matter. Changes in ash content are, therefore, difficult to interpret.

The high ash content (above 90%) below 8.23 m in series 1 and 4.23 m in series 2 indicates high erosion and low organic productivity in the lake. The abrupt decrease in ash content above these levels (to 30 and 20%) is probably due to stabilization of the vegetation cover and an increase in organic productivity at the beginning of the Holocene. A temporary re-increase of ash content (to 48 and 45%) is evident in both series (at 8.02 and 3.80 m depth). The significance of this event is uncertain. The ash content decreases up through the gyttja series (to around 15%), with some irregularities, and increases again above 4.80 m depth (up to around 35%). Peaks of the ash content at these levels coincide with elm decline phases and may be due to increased erosion in connection with vegetational disturbance (Andersen and Rasmussen, 1993).

The ash content decreases abruptly at the transition to the swamp peat (at 2.94 m depth), and is low (around 10%) up through the peat. The ash content increases from 0.63 m depth up to 48% near the surface.

### *Correlation of section 1 and 2*

The onset of sedimentation of organic matter in a small lake may vary considerably, as the oldest sediments may occur near the leeward side of the basin (Odgaard

| | Depth ser. 1 | Diff. | Depth ser. 2 | Diff. | Diff. ser. 1-2 |
|---|---|---|---|---|---|
| Hazel 70% | 7.96 m | | 3.62 m | | 4.34 m |
| Ash content, peak | 8.02 m | 0.06 m | 3.80 m | 0.18 m | 4.22 m |
| Ash content 90% | 8.22 m | 0.20 m | 4.26 m | 0.46 m | 3.96 m |

Table 2 Correlation of characteristic events in series 1 and series 2.

| | Coarse fraction | | Fine fraction | |
|---|---|---|---|---|
| | y B.P. | st.d. | y B.P. | st.d. |
| Insoluble | 3450 | 125 | 3200 | 85 |
| Soluble | 3470 | 80 | 3220 | 80 |

Table 3. Radiocarbon dates for alkali-insoluble and -soluble fractions of a peat sample (0.97-1.93 m).

1993). Series 1 at the centre of Hassing Huse Mose was, therefore, supplemented with series 2 near the west margin.

The two sections were correlated by pollen analysis and by the variations in ash content. A decrease in herb pollen and a birch and a hazel maximum could be recognized in both series, and the ash curves are closely correlated (Fig. 4). Depth levels for characteristic events are compared in Table 2. The thickness of corresponding sediments are 2-3 times larger in section 2 than in section 1, and the difference in corresponding levels increases from 3.96 to 4.34 m. These differences indicate sediment focusing in the shallow leeward part of the basin in the early Holocene as found also by Odgaard (1993). Pollen spectra and radiocarbon dates from section 2 from level 3.62 m downward were used in the joined diagrams due to the higher time resolution. 4.34 m were added to these depth levels.

*Radiocarbon dating of peat samples*

Radiocarbon dates of peat samples may be younger than expected due to infiltration with humus and penetration of rootlets from above. Alkali-soluble and insoluble fractions were dated separately for one sample (Table 3), and coarse fractions (>0.07 mm) and fine fractions (<0.07 mm) were dated and compared (Table 4). The ages of the soluble and insoluble fractions in Table 3 are identical. Infiltrated humus, therefore, is unlikely to affect the datings. The age difference between coarse and fine fractions is very large (–400 and +1270 years) in two cases (0.15-0.21 m and 2.37-2.41 m). The former sample contained many modern rootlets (Table 1). The young date for the coarse fraction was therefore rejected, and only the fine-fraction date was accepted for this sample. The very old date for the coarse fraction in the other sample (5390 B.P.) must be due to an unknown error. This dating was also rejected, and only the fine-fraction date accepted. The difference between coarse and fine fractions is insignificant

| | Depth | Coarse fraction | | | Fine fraction | | Diff. | Weighted av. | |
|---|---|---|---|---|---|---|---|---|---|
| m | W,g | y B.P | st.d. | W,g | y B.P. | st.d. | y | y B.P. | st.d. |
| 0.15-0.21 | 4.34 | 520[1] | 80 | 27.32 | 960 | 65 | –440 | – | |
| 0.23-0.27 | 3.85 | 1610 | 80 | 12.17 | 1340 | 70 | +270 | 1400 | 70 |
| 0.37-0.51 | 4.35 | 1840 | 65 | 11.58 | 2050 | 75 | –210 | 1990 | 70 |
| 0.51-0.65 | 4.90 | 2760 | 80 | 14.50 | 2770 | 75 | -10 | 2770 | 75 |
| 0.97-1.03 | 12.23 | 3460 | 75 | 27.73 | 3210 | 60 | +250 | 3300 | 65 |
| 1.27-1.31 | 9.27 | 3650 | 80 | 15.86 | 3600 | 80 | +50 | 3620 | 80 |
| 2.33-2.37 | 6.50 | 3990 | 80 | 7.80 | 4030 | 75 | –40 | 4010 | 75 |
| 2.37-2.41 | 8.18 | 5390[1] | 70 | 9.01 | 4120 | 85 | +1270 | - | |
| 2.57-2.61 | 7.24 | 4150 | 80 | 12.75 | 4140 | 85 | +10 | 4140 | 85 |
| 2.89-2.93 | 9.85 | 4240 | 85 | 11.12 | 4030 | 85 | +210 | 4130 | 85 |

[1] date rejected

Table 4. Radiocarbon dates for coarse fractions (>0.07 mm) and fine fractions (<0.07 mm) of peat samples, W = dry weight.

in four other samples, and the coarse fraction is older than the fine fraction in three samples and younger in one sample. It was concluded that penetration of younger rootlets from above affected only the topmost dating. Bulk samples dates were calculated for the other samples, making allowance for differences in weight of the two fractions.

### *Sedimentation rates*

The calibrated radiocarbon dates and three estimated dates were used for computation of the spline curve in Fig. 5. This curve is based on dates from section 2 below 8 m and from section 1 above 8 m depth. The sedimentation rate was low in section 2 at 8.14-8.60 m depth (1970 years/m) and increased at 7.96-8.14 m (870 years/m). The corresponding rates were lower at section 1 (4525 years/m and 2610 years/m) due to sediment focusing at section 2 nearer the west shore. The sedimentation rate increased at 8-3 m depth in section 1 (900 years/m). This figure is similar to the figure calculated for a shorter depth interval by Andersen and Rasmussen (1993, 970 years/m, 3.06-6.41 m). Small variations in sedimentation rate such as those found by Andersen and Rasmussen (1993) may occur. The sedimentation rate increased somewhat at 1.3-3.1 m (730 years/m) and decreased strongly above 1 m depth (5380 years/m at 0.06-0.58 m). This decrease in sedimentation rate (x7.4) is rather similar to the increase in ash content above 0.63 m (x5). Hence, the increase in ash content may be explained by increased decomposition of organic matter.

### *Wild-grass and cereal pollen*

The identification of species in the grass family is difficult. Only one species, rye, can be identified with certainty because of its characteristic shape. Other species have identical or overlapping size ranges, which hamper the identification of individual pollen grains. Three main groups can be distinguished, wild grasses with small pollen and pore *annulus*, the barley group with large size and *annulus*, and scabrate sculpture, and the oat-wheat group with large grains and *annulus*, and verrucate sculpture. The barley group includes some wild grasses (Andersen 1979). Due to overlapping size ranges, these groups must be distinguished by size statistics (cf. Andersen 1988).

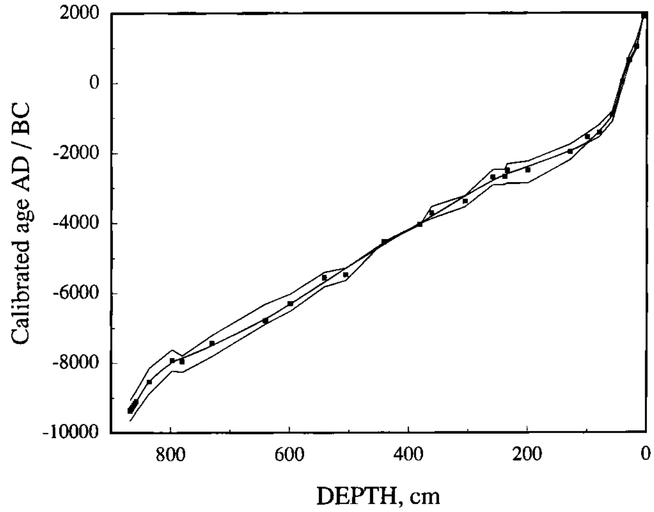


Fig. 5. Age determinations from Hassing Huse Mose used for calculation of a smoothed depth/age curve. The outer bounds for two standard deviations are indicated.

In Hassing Huse Mose, the pollen dimensions are likely to be nearly the same as the figures stated in Andersen (1979). However, the variations in pollen size (the average of the largest and the smallest diameters in each grain) were modified by the fact that nearly all grass pollen grains were more or less strongly crumpled. The average size of crumpled grains may be near that of inflated grains (Andersen 1979) or may have decreased. The *annulus* diameter, in contrast, is rarely modified. The identifications were therefore, based on *annulus* and size measurements, and observations of sculpture type, in combination.

The diameter of the pore *annulus* was smaller than 6.4 µm in 86% of the pollen grains from the grass family. These pollen grains almost certainly belong to wild grasses, as pollen grains with *annulus* smaller than 6.6 µm are very scarce in the cultivated species (Andersen 1979).

Scabrate pollen grains with *annulus* diameter 6.9 µm were mainly 15.0-32.8 µm in size (Fig. 6). Pollen grains of this size range are frequent in wild grasses. The pollen grains 33.4-43.7 µm in size were referred to barley-type, as pollen grains with similar *annulus* size (7.2 µm) are frequent in barley (size range ± 2 standard deviations 33.2-41.4 µm) and other species in the barley group. Scabrate grains with size range 27.6-44.9 µm predominate in grains with *annulus* diameter 8.1 µm, and grains with larger *annulus* (9.25-11.5 µm) vary 26.4-44.9

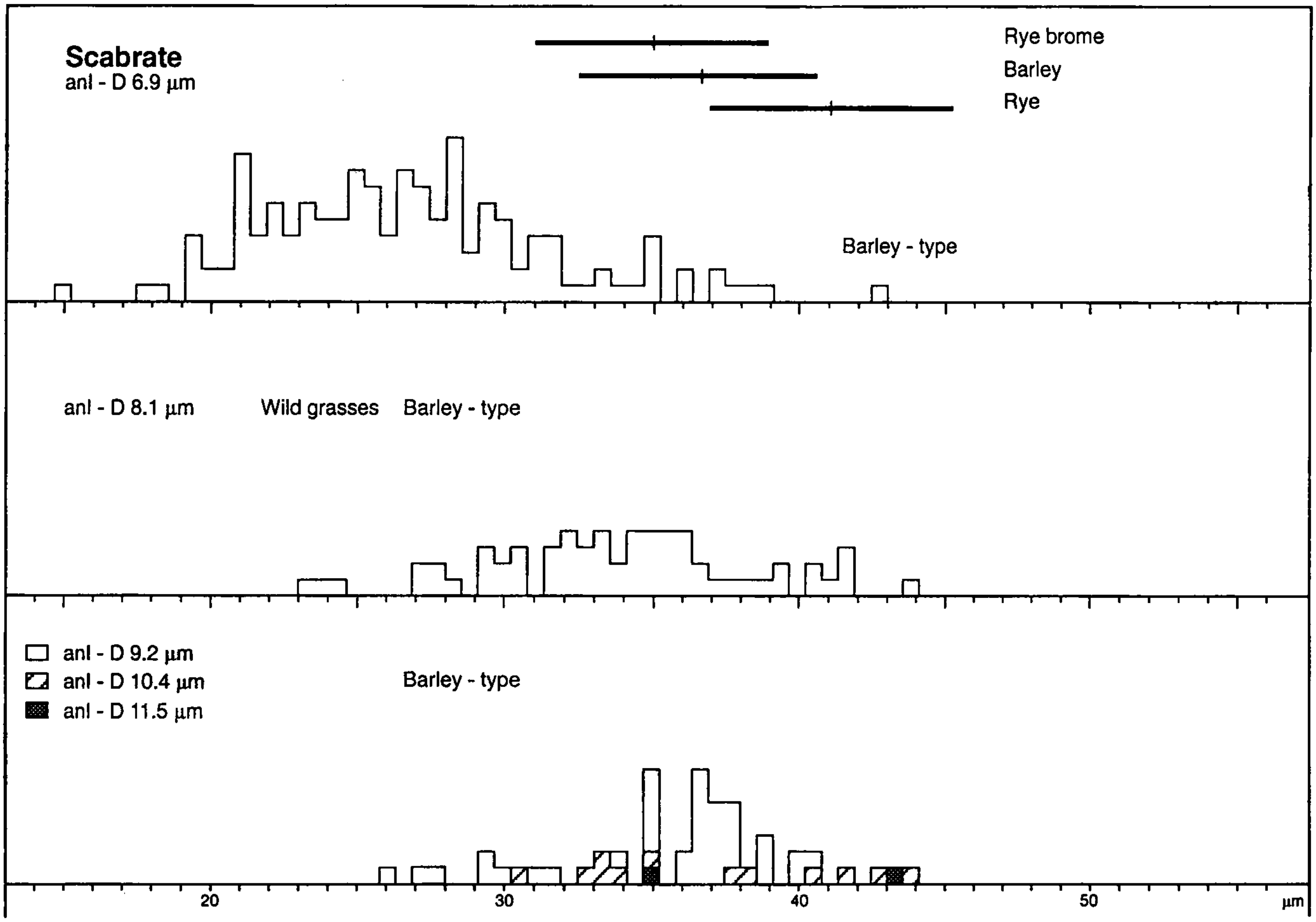


Fig. 6. Average diameters (largest + smallest diameter/2) of pollen grains from the grass family with scabrate sculpture, and *annulus* diameters 6.7-11.5 μm, from Hassing Huse Mose. Mean size (±2 standard deviations) for modern species are indicated.

μm in size. These pollen grains were also referred to the barley-type. Some of them are very small due to shrinking.

Rye-brome, which was cultivated in prehistoric time (Knörzer 1967, Jensen 1985), and the weed *Bromus hordeaceous,* have large pollen grains with somewhat smaller *annulus* than barley (7.64 and 7.55 μm). Pollen grains with *annulus* 7.2 μm predominate in these species, whereas grains with similar *annulus* (6.9 μm) are scarce in the barley-type pollen from Hassing Huse Mose (Fig. 7). The brome species were, therefore, scarce there, if present at all. Pollen of millet with a large *annulus* (8 μm) and small size could not be identified. The pollen grains of einkorn, the weed couch grass, the sea-shore species lyme grass and marram grass, and the aquatic float grass, are similar to those of barley. Pollen of einkorn and the sea-shore plants were probably scarce at Hassing Huse Mose. Couch grass may have occurred as a weed, and a few pollen grains typical of float grass were noticed. Some pollen grains of couch grass and float grass may therefore be included in the barley-type. The barley-type may also include crumpled pollen of rye. No inflated pollen grains of rye were seen.

The average *annulus* diameter of 129 grains of barley-type is 8.50 μm and is slightly larger than that of barley (8.23 μm). Pollen grains with *annulus* diameter 6.9 μm are scarcer than pollen of this size class in barley (7.2 μm, Fig. 7). The lower size limit for grains with a large *annulus* (9.2-11.5 μm) is 26.4 μm. These grains almost certainly belong to barley-type. Barley-type pollen with small *annulus* (6.9 μm) and size-range 26.4-32.2 μm may therefore have been missed, whereas pollen of rye and float grass with larger *annulus* diameter (8.93 and 9.55 μm) may be included in the barley-type pollen.

In conclusion, the barley-type pollen in Hassing Huse Mose is likely to derive mainly from barley, but a few pollen grains of rye-brome, couch grass, float grass and rye may have been included.

Verrucate pollen grains from Hassing Huse Mose with *annulus* diameter 6.9 and 8.1 μm and size ranges 17.3-38.5 μm (Fig. 8) fall within the variations of the pollen of wild grasses with verrucate sculpture. The largest of these species is meadow oat (*annulus* 7.55 μm, size range 29.6-41.7 μm). One pollen grain with *annulus* 8.1 μm and average size 44.9 μm was referred to oat-type. Pollen grains with *annulus* 9,6 μm are very scarce in meadow oat (Fig. 7). The verrucate grains with *annulus* 9.2 μm were therefore included in the oat-type. The size range is 24.2-50.6 μm. A few of these grains may belong to meadow oat or some other wild grass. The grains with *annulus* 10.4-12.7 μm belong to the oat-type. The size range is 33.4-49.5 μm, and is within the range of oat and wheat species.

The average *annulus* diameter of 50 pollen grains included in the oat-type is 9.96 μm, and slightly smaller than that of oat (10.72 μm). Grains with *annulus* diameter 9.2 μm are somewhat more frequent than grains with similar *annulus* in oat (9.6 μm, Fig. 7). Some wild grass pollen may, therefore, have been included. The average annulus diameter in bread wheat (11.88 μm) is larger than in the pollen grains referred to oat type and grains with *annulus* diameter 12.7 and 13.8 μm are considerably scarcer than in bread wheat. The pollen grains of oat-type are therefore likely to belong mainly to oat, and pollen grains of bread wheat and other wheat species with still larger *annulus* are very scarce.

Andersen and Rasmussen (1993) mentioned two pollen grains of wheat-type (*annulus* diameters 10 μm) at 3.68 and 5.14 μm depth (3870 and 5370 BC).

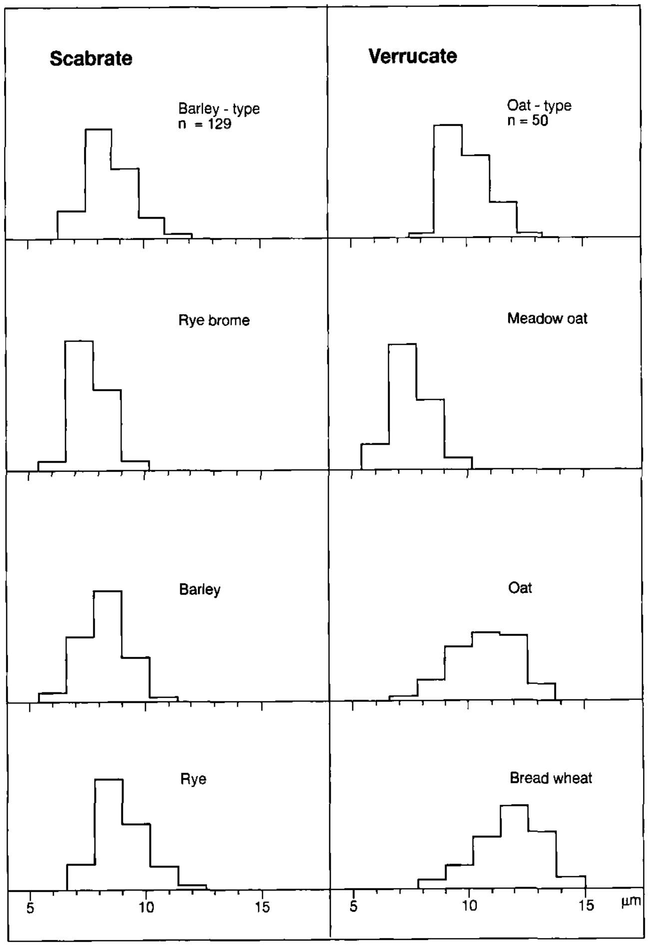


Fig. 7. Variations in *annulus* diameter in pollen grains determined to barley-type and oat-type and in modern species.

### *Vegetation history. Local vegetation*

The pollen diagrams were divided into 13 pollen zones named by characteristic features. 8 zone borders were found by the CONISS program, the others by characteristic changes in the pollen diagram (alder/hazel-birch zones, hazel-birch/hazel zones, herbs 1/herbs 2 zones, herbs 2/herbs 3 zones). The oldest pollen zone is from the Weichselian (late-glacial). The other zones represent the Holocene up to the present day. The Holocene series began at 9080 B.C.

The pollen diagram Fig. 9 shows a survey of land plants, other plant groups, *algae* and charcoal dust. The correlation with cultural periods is shown.

The curves for ambiguous plants, wet-ground plants, aquatics and *algae* are strongly influenced by the change (at 3100 B.C.) from a lake with scarce local vegetation to a swamp with a high local pollen production. Ambiguous and wet-ground plants are frequent in the late-glacial and occur scatteredly up through the gyttja deposit. These plants were most likely members of dry-land or wet-ground vegetation around the lake. Aquatics are frequent in the birch-pine pollen zone and increase again in the uppermost part of the gyttja (white water-lily, pondweed, water crowfoot). Their decrease in the hazel-elm pollen zone was probably due to increased water depth. The increase in the alder pollen zone and again in the hazel pollen zone indicates

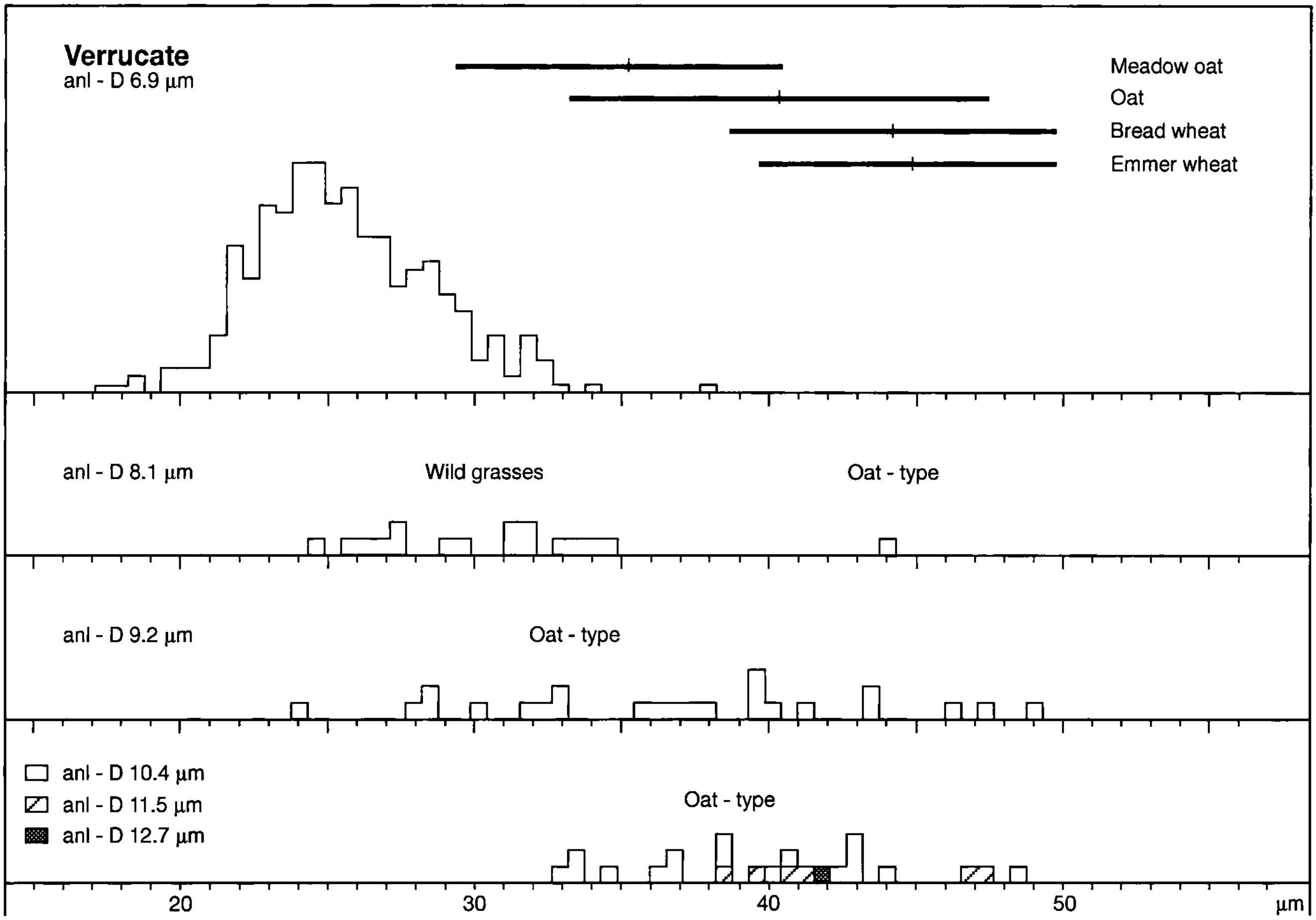


Fig. 8. Average diameters of pollen grains from the grass family with verrucate sculpture and *annulus* diameters 6.9-12.7 µm. Mean size and size ranges for modern species are indicated.

changes to lower water depth probably because of lowering of the water level, or infilling of the basin with sediment. The ash content is high at these levels (above 4.80 m depth, Fig. 4). Masses of algae (*Pediastrum*) occurred in the topmost part of the gyttja (not recorded).

Wet-ground plants (sedges, ferns and cat's tail) are particularly frequent in samples from the lowermost part of the swamp peat. Other local plants (bog myrtle, heather, bilberry, willow, meadow sweet, cinquefoil) are very frequent in the upper part of the swamp peat (above 0.46 m, 220 B.C.). Wet-ground heath vegetation apparently developed in the swamp, probably due to oligotrophication. Heather pollen was scarce (below 5%) up to that time. Aquatic plants (water violet, pondweed, water crowfoot, bladderwort) and *algae* re-appear in the upper part of the swamp peat (after 1100 B.C.) and indicate the presence of shallow pools with neutral or slightly acid water (species of water milfoil). The increase in aquatic plants coincides with the increase of organic matter and decrease in sedimentation rate (above 0.50 m depth) due to increased decomposition of organic matter.

### *Land vegetation development*

Pollen curves for land plants are shown in Fig. 10 A-C and corrected tree pollen percentages in Fig. 11. The tree pollen percentages are likely to be strongly influenced by pollen transported over a long distance at times with a scarce tree cover.

*1. Herb pollen zone, around 9075-9360 B.C.* Tree pollen is scarce (about 40%). About one half of the tree pollen is pine pollen, which is likely to be transported from a far distance. Tree cover was therefore very scarce. A maximum for juniper at the top of the zone is characteristic of the transition from the Younger Dryas to the Holocene. Pollen from grasses and herbs such as mugwort, sheep's sorrel and the goosefoot family are frequent. Plants included in the wet-ground group (crowberry, sedges) were also common.

2. *Birch-pine pollen zone, around 8295-9075 B.C.* Tree pollen increases strongly (74 to 95%) indicating invasion by forest. Birch is dominant (73%) at first, pine increases to a maximum (25%) near the end of the zone, and aspen increases too. Hazel appears and increases to 25% near the end of the zone, and elm appears. Grasses and open-ground herbs decrease and oak fern is common, indicating stabilized forest. Some wet-ground plants (willow, meadow sweet) were common. Pollen of heather is scarce up through the gyttja series and indicates presence of a few acid-type sites.

3. *Hazel-elm pollen zone, around 6975-8295 B.C.* Tree pol-

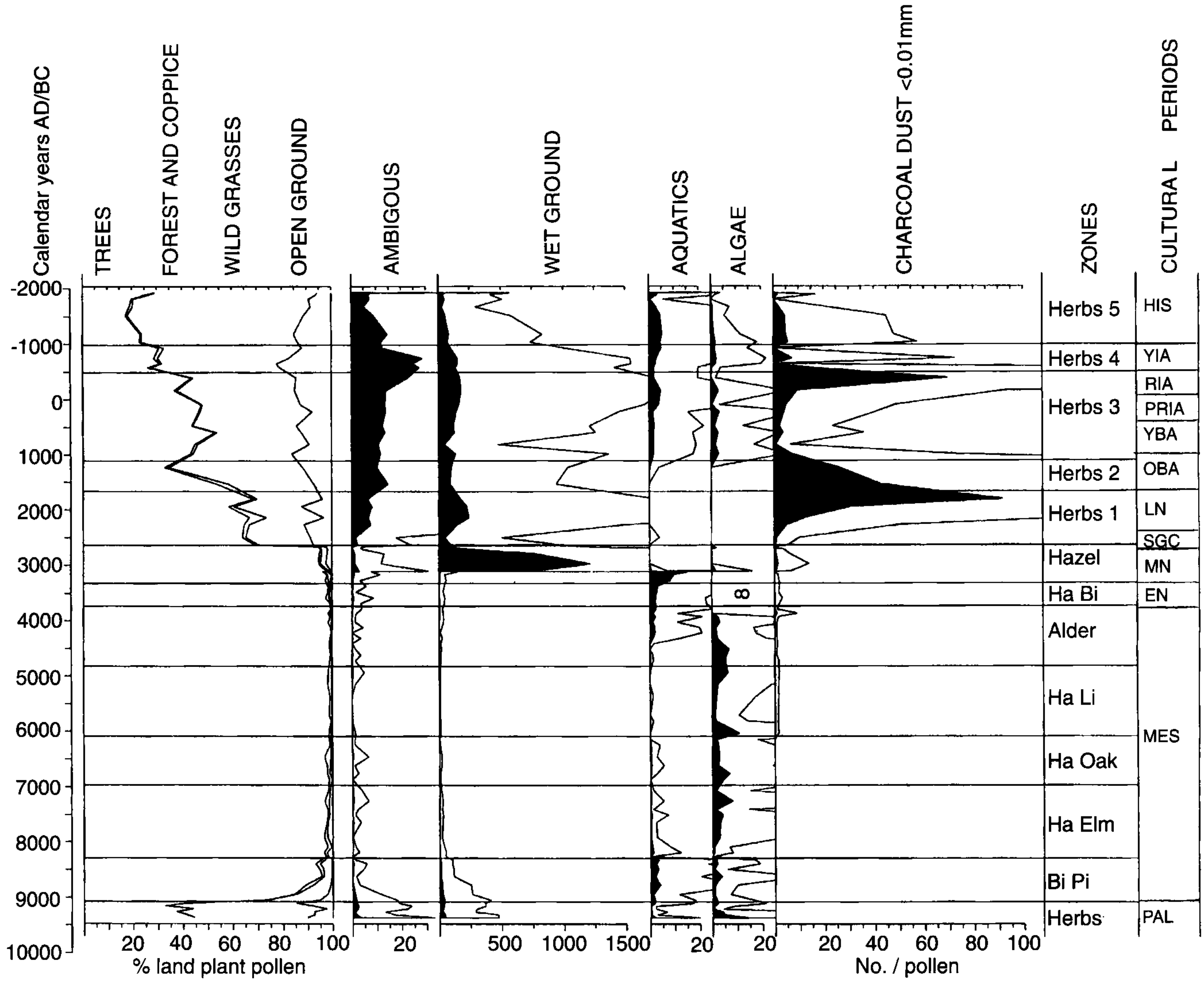


Fig. 9. Hassing Huse Mose. Percentages for plant groups included in the land plants (survey diagram), plant groups excluded from the land plants (black silhouettes, white silhouettes x10), for algae, and the frequencies of charcoal dust particles larger than 0,01 mm, (charcoal dust was not recorded in samples older than 6000 B.C.). Cultural periods are indicated (from Hvass and Storgaard 1993). HIS, Historic time, YIA, Late Iron Age, RIA, Roman Iron Age, PRIA, Pre-Roman Iron Age, YBA, Late Bronze Age, OBA, Early Bronze Age, LN, Late Neolithic, SGC, Single Grave Culture, MN, Middle Neolithic Funnel Beaker Culture, EN, Early Neolithic Funnel Beaker Culture, MES, Mesolithic, PAL, Palaeolithic.

len is frequent (96-98%) indicating a dense tree cover. Birch and pine decrease (to 15 and 5%). Hazel increases at the lower zone border (to 75%) and then decreases in the upper part of the zone (to 58%). Elm increases strongly from the middle part of the zone (to 12%, 22% corrected), and oak and alder pollen appear. Rowan and guelder rose are present, and so are grasses, mugwort, sheep's sorrel and the goosefoot family.

*4. Hazel-oak pollen zone, around 6090-6975 B.C.* Tree pollen is very frequent (97-99%). Oak increases (to 14%) and alder increases at the lower zone border (to 24%). Elm increases slightly (to 16%, 26% corrected) and lime is present. Hazel decreases continually (53 to 48%), and birch and pine decrease to low frequencies (4 and 1%). Hence, the tree communities became richer in species at the cost of hazel, birch and pine. Grasses, mugwort and sheep's sorrel are represented.

*5. Hazel-lime pollen zone, around 4830-6090 B.C.* Tree pollen is very high (98-100%). Lime increases abruptly at the lower zone border (to 12%, 47% corrected) and remains high throughout the zone. Hazel decreases (to 29%, 13% corrected), elm decreases somewhat (12%, 15% corrected), and alder is about 30% (20% corrected). The appearance of bracken and polypody indicate presence of an acid humus layer. Ivy and mistletoe are present, and so are a few pollen grains of grasses, mugwort and the goosefoot family. Andersen and Rasmussen (1993) recorded a pollen grain of wheat-type.

*6. Alder pollen zone, around 3740-4830 B.C.* Alder increases at the lower zone border and remains high throughout the zone (about 40%, 25% corrected) at the cost of hazel in particular (about 20%, 10% corrected). This increase in alder coincides with an increase of the aquatic plants (Fig. 9) and might reflect a lowering of the water level. An increase in ash (to 1%, 5 % corrected) could have the same cause. Lime remains high (10%, 40% corrected). The elm curve increases somewhat at the lower zone border (to 17%). The elm curve then decreases and re-increases twice. These two elm declines precede the classical elm decline at about 3800 B.C. They coincide with slight maxima for hazel. The elm declines were examined in detail by Andersen and Rasmussen (1993), who found, that the elm declines coincided with evidence of disturbance, probably by human activity. This disturbance is not clearly reflected in the present pollen diagram due to the lower pollen counts.

*7. Hazel-birch pollen zone, around 3320-3740 B.C. Early Neolithic Funnel Beaker Culture.* The lower zone border was placed at the classical elm decline, which began at 3790 B.C. The elm curve declines from 9 to 1% and then increases slightly, to 4%. The lime curve decreases slightly later than the elm curve (from 6 to 3%, 32 to 26 % corrected). The elm decline is followed by a maximum for birch (11%) and then an increase in hazel. Grasses, mugwort, sheep's sorrel, ribwort and barley-type are represented. This development was discussed by Andersen and Rasmussen (1993), who concluded that the features mentioned mark the transition to the Early Neolithic (with swidden cultivation of birch coppices and pasture, *cf.* Andersen 1992a). Disappearance of ivy may be due to human pursuance (Troels-Smith 1960).

*8. Hazel pollen zone, around 2640-3320 B.C. Middle Neolithic Funnel Beaker Culture.* The lower zone border was placed at a decrease in birch and elm and an increase in hazel. Tree pollen decreases somewhat in the zone (97 to 91%). Birch decreases (to 5%) and then increases near the end of the zone (to 20%), and elm decreases (to 1%). Hazel increases (to 51%, 47% corrected) alder decreases (to 15%, 10% corrected) and lime is low (around 5%, 15-30% corrected). Grasses, mugwort, sheep's sorrel and ribwort increase. Andersen and Rasmussen (1993) concluded that hazel coppices were used increasingly for swidden cultivation and pasture, a procedure which was typical of the Middle Neolithic Funnel Beaker Culture (Andersen 1992a). The *Verlandung* of the former lake took place in this pollen zone.

*9. Herbs 1 pollen zone, around 1650-2640 B.C. Single Grave Culture and Late Neolithic.* The lower zone border is distinguished by a sudden decrease of the tree pollen. The tree pollen decreased from 91 to 69% (22%) over only 30 years. This sudden deforestation marks a very radical change in land-use. The tree pollen percentages remain low up through the pollen zone (59-69%). The tree pollen curves also change radically. Hazel decreases strongly (51 to 5%, 47-5%, corrected), and birch and alder decrease in the upper part of the zone. There is a maximum for oak in the middle part, and pine and ash increase in the upper part. Local populations of hazel, birch and alder were probably cut away, and there was probably increased influence from more distant populations of pine and oak. Bracken and polypody indicate remains of woodlands or coppices. Grasses and open-ground herbs such as mugwort, sheep's sorrel, the goosefoot family and ribwort increase conspi-

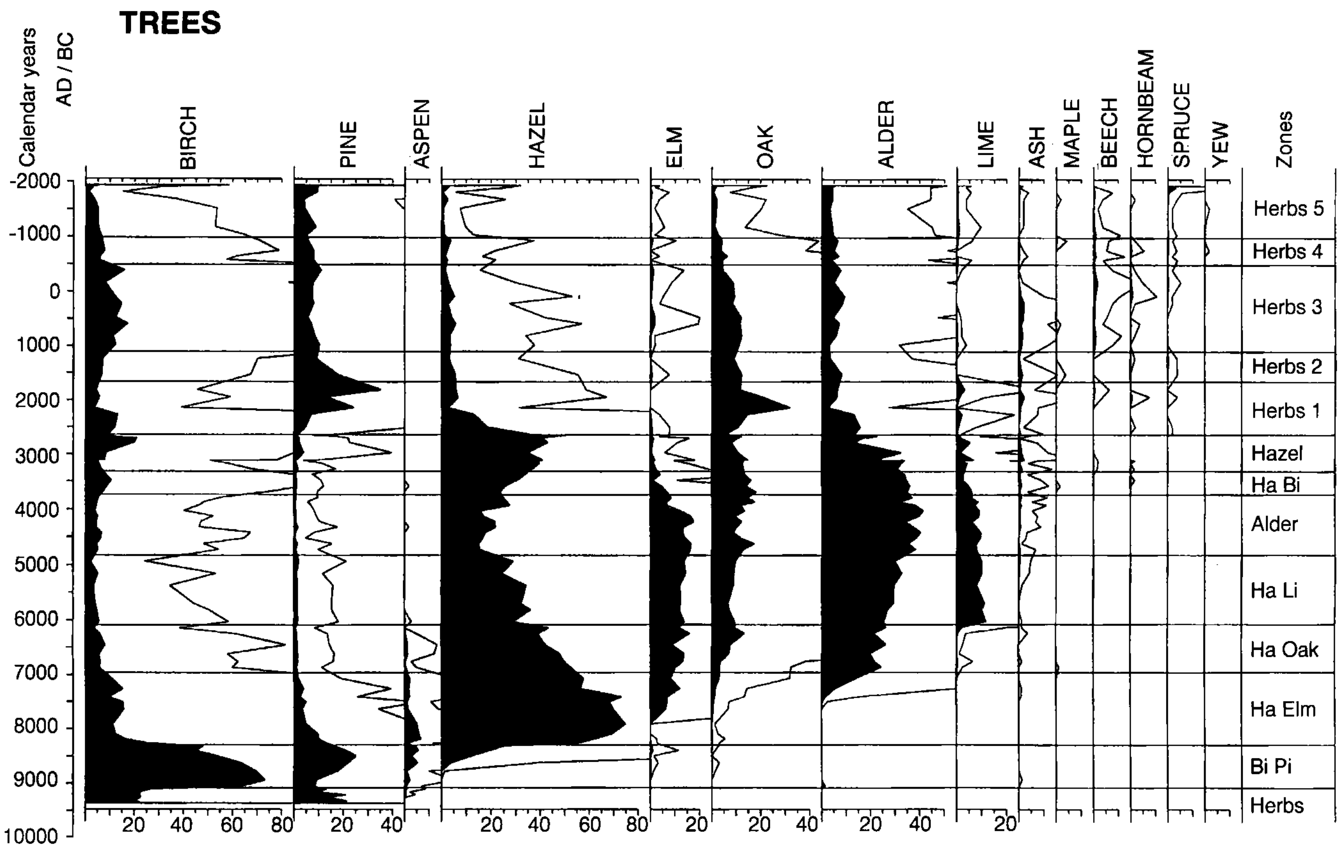


Fig. 10 A. Percentages for land plants in percent of the land plant total (black silhouettes, white silhouettes x10).

cuously, the number of open-ground plants increases, and barley-type pollen is common. The cleared areas apparently were used for pasture and field cultivation. A number of plants classified as ambiguous increase at this level (bedstraw-type, lingulate composites, milfoil-type, groundsel-type) and could have been part of the land vegetation. There is a very conspicuous maximum for charcoal dust in the upper part of the pollen zone (Fig. 9). It is difficult to say whether the charcoal derived from local or distant fires.

*10. Herbs 2 pollen zone, around 1105-1650 B.C. Early Bronze Age.* The lower zone border is placed at the beginning of a new decrease in tree pollen. The tree pollen decreases up through the pollen zone (69 to 33%). This decrease indicates renewed deforestation. All tree pollen curves are low. Birch increases somewhat in importance and pine and oak pollen is still important. Oak fern and bracken indicate presence of coppices. Grasses increase strongly (26 to 54%), plants from open ground increase somewhat (sheep's sorrel, goosefoot family, ribwort), and new species appear. Increased grazing pressure or field cultivation are indicated. The very high peak in grass pollen is not clearly reflected by the open-ground plants and might be due to overrepresentation of locally derived pollen.

*11. Herbs 3 pollen zone, around A.D. 485-1105 B.C. Late Bronze Age, Pre-Roman and Roman Iron Age.* The lower zone border is placed at an increase in tree pollen (33 to 44%). This increase is mainly due to a decrease in grass pollen, and is not clearly reflected by the curve for open-ground plants. The trees decrease slightly up through the pollen zone. Birch and oak are important, and ash increases (up to 28%, corrected). There is now a continuous curve for beech pollen (up to 1%). Mugwort, the goosefoot family and ribwort are frequent. Pollen of oat-type is present. Barley-type and sheep's sorrel increase (especially from around 500 B.C.), and knotgrass is common. These features indicate continued grazing and increased importance of cereal growing particularly in the Iron Age. Oat was introduced in

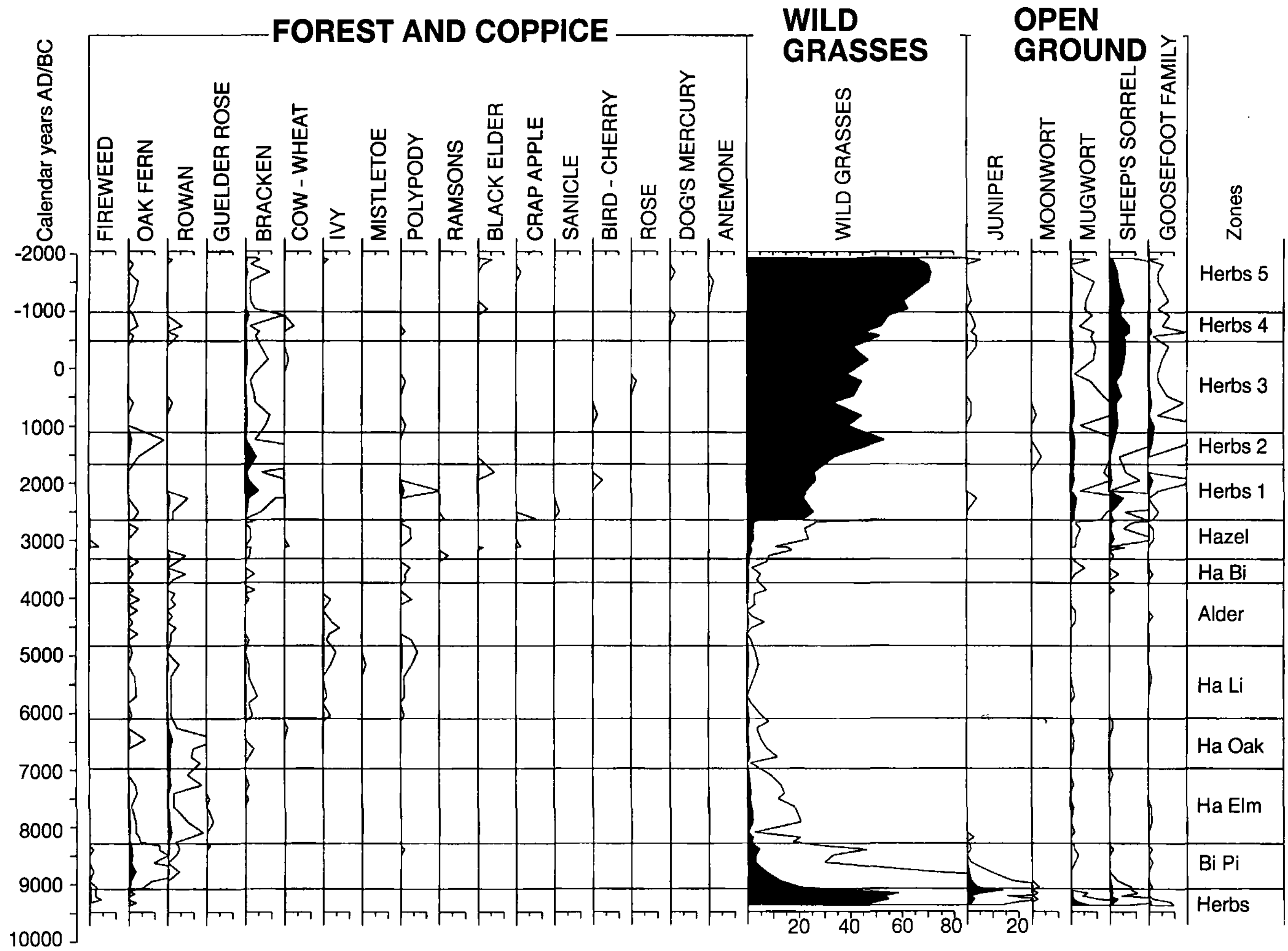


Fig. 10 B. Percentages for land plants in percent of the land plant total (black silhouettes, white silhouettes x10).

the Late Bronze Age (Jensen 1985, Rowley-Conwy 1984). A maximum for charcoal dust in the uppermost part of the zone is difficult to explain.

*12. Herbs 4 pollen zone, around A.D. 485-985. Late Iron Age.* The lower zone border coincides with a marked decrease in tree pollen (44 to 26%). Renewed forest clearance is indicated. All the tree species decrease in importance, birch and oak in particular. The grasses and sheep's sorrel increase, and there are many new additions to the flora of open-ground plants. Hence increased agricultural activity is indicated.

*13. Herbs 5 pollen zone, around A.D 985-1940. Historical time.* Trees decrease at the lower zone border (31 to 23%) and decrease further between A.D. 1185 and 1520 (24 to 17%), the trees increase again after A.D. 1815 (20 to 29%). No woodlands were present in Thy in the 19th century (Ødum 1986). The tree pollen present must therefore have derived mainly by far distance transportation. Increased frequencies of pollen of lime (up to 22% corrected) probably reflect planting around villages and manors. Establishment of plantations in the late 19th and the 20th century is reflected by the increase in the tree pollen, first pine, and then spruce and birch. Mountain pine was planted extensively in the sand dune areas in western Thy from around 1885 and spruce in the 20th century. The grasses increase conspicuously (55-71%). Barley-type and oat-type pollen is frequent, and sheep's sorrel decreases somewhat. This decrease may be due to improved methods to suppress weeds (the wheel plow). Grazing and cultivation of barley and oat were important, whereas cultivation of rye cannot be demonstrated. Increase in rye is usually fol-

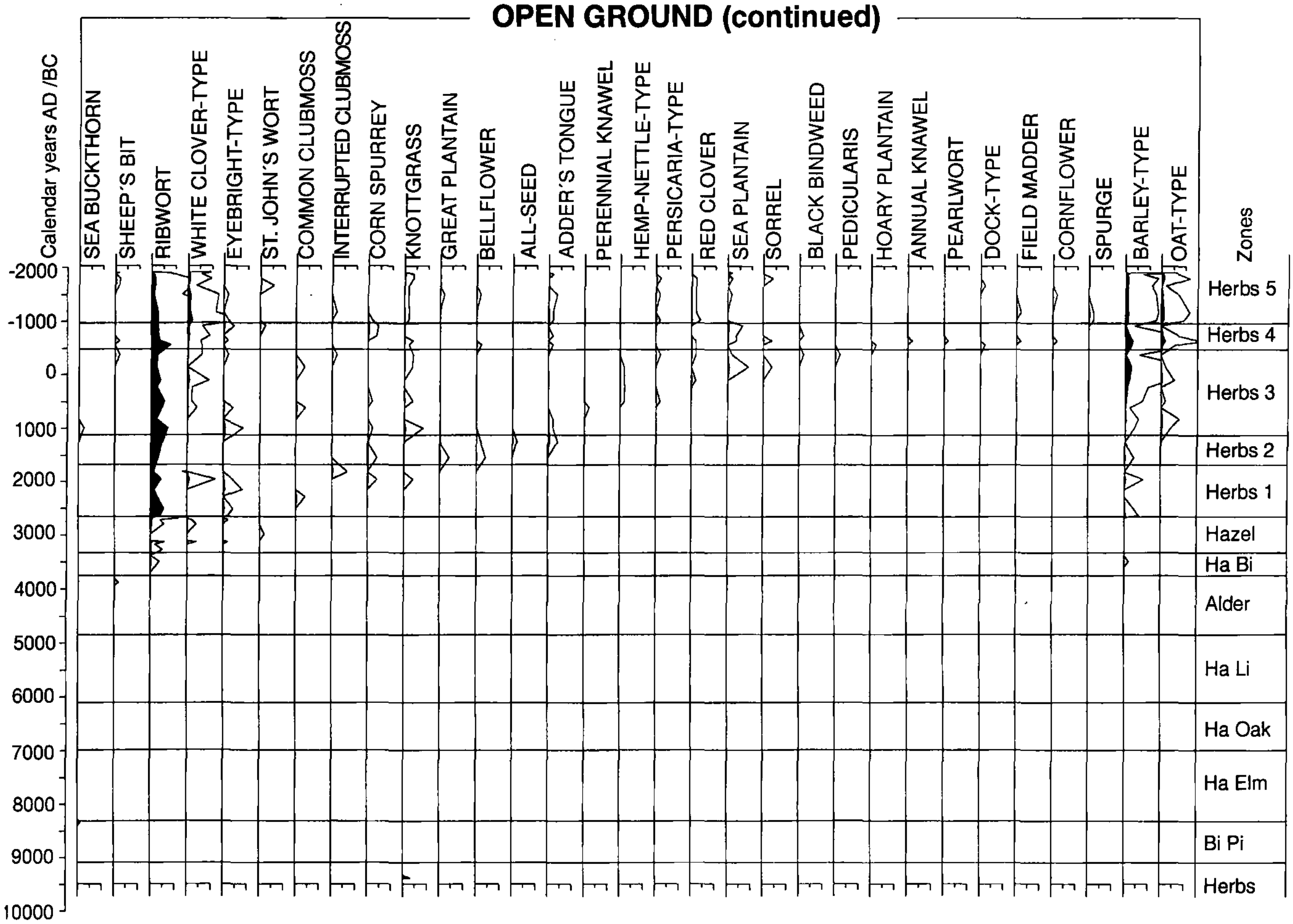


Fig. 10 C. Percentages for land plants in percent of the land plant total (black silhouettes, white silhouettes x10).

lowed by an increase in barley-type pollen, due to inclusion of crumpled rye pollen (Odgaard 1989). The absence of an increase in barley-type pollen at Hassing Huse Mose therefore indicates that rye was not cultivated extensively. The invasion by sand dunes in western Thy is not clearly reflected in the pollen diagram.

### *Landscape diversity*

There are two curves for taxon richness, which were calculated by the rarefaction analysis. The first curve (Fig. 12), calculated for the gyttja series alone, includes the ambiguous plants and the wet-ground plants in order to estimate the whole land-plant flora. The curve is rather irregular due to a large variance. The taxon richness is around 17 in the lowermost herb pollen zone, it decreases in the birch pine pollen zone to around 15, and is around 13 in the hazel-elm to alder pollen zones. This general decrease in taxon richness reflects increasingly stable vegetation in the early pollen zones (protocratic and mesocratic phases, Birks and Line 1992). There is a peak for taxon richness in the hazel-birch pollen zone (22 taxa) just after the elm decline indicating vegetational disturbance. The vegetation stabilizes again, and taxon richness then increases to 22 taxa in the hazel pollen zone. Vegetational disturbance in the Early and the Middle Neolithic is evident.

A more detailed curve for taxon richness based on larger pollen counts (>2015) was shown by Andersen and Rasmussen (1993). This curve showed increased taxon richness during the two pre-Neolithic elm declines, and in the hazel-birch and hazel pollen zones.

The whole land plant flora could not be included in the taxon-richness estimate for the whole pollen series

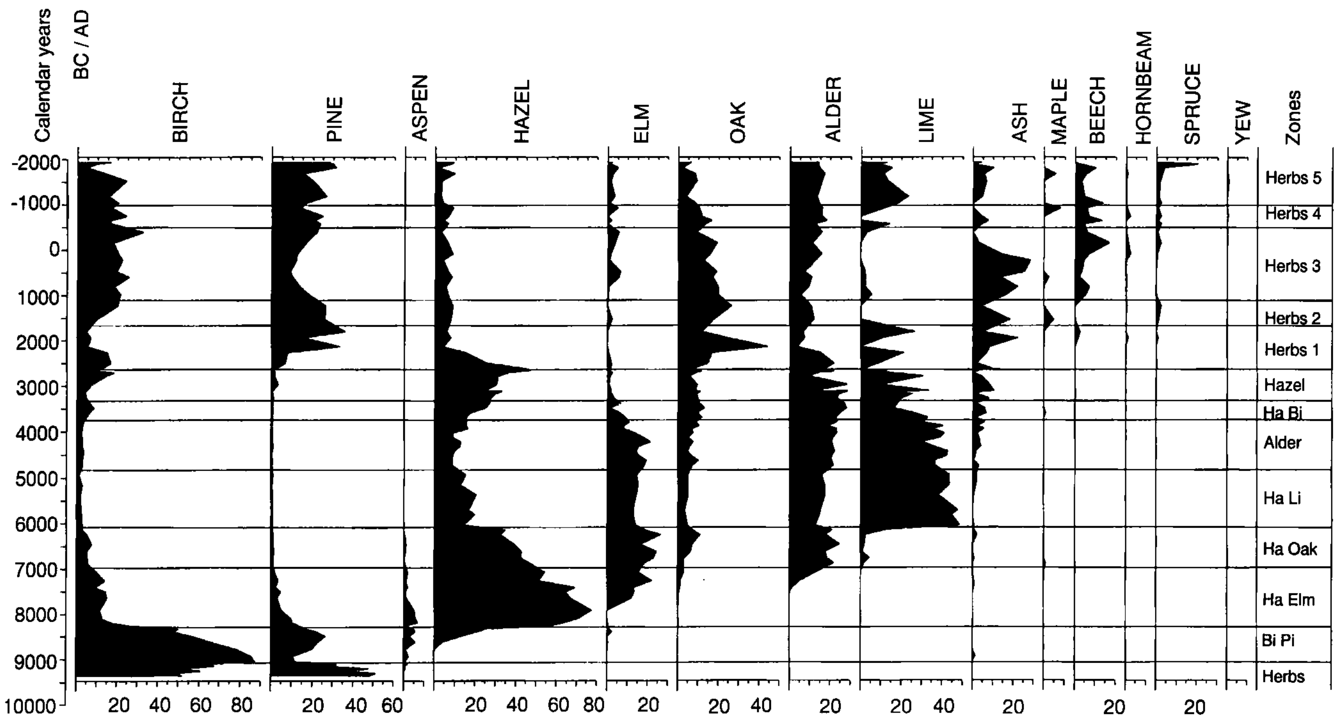


Fig. 11. Tree pollen percentages (percent of tree pollen) after correction for pollen productivity (Andersen 1970, 1980). Correction factors, birch, pine, aspen, hazel, oak, alder, yew, x0.25, hornbeam, x0.33, elm, spruce, x0.5, beech, x1.0, lime, ash, maple, x2.0.

in Fig. 13 because of uncertainties in the distinction of land plants from plants present in the swamp vegetation. The statistical uncertainty is large because of low pollen counts in a part of the swamp peat (lowest count 153 grains). The curve is too low in the earliest pollen zones because some land plants were missed. The taxon richness is fairly constant up through the hazel-elm to the alder pollen zones (around 8 taxa). The curve rises distinctively from the Early Neolithic hazel-birch pollen zone upwards and reaches a peak (19 taxa) in the herbs 4 pollen zone (Late Iron Age). The richness in taxa reflects increasing disturbance of vegetation and creation of diverse habitats caused by increasing land clearance and agricultural activity (*Homo sapiens* phase, Birks and Line 1992). Interestingly, the taxon richness decreases in the herbs 5 pollen zone (Historical period, around 17 taxa). This could reflect decreased vegetation diversity and creation of more uniform habitats at a time when human landscape exploitation was at a maximum (intermediate disturbance hypothesis, see Birks and Line 1992). Peglar (1993) showed a similar decrease in taxon richness at Diss Mere in East Anglia in post-Medieval time. In modern time, 20th century, the taxon richness decreases again (to 14 taxa), probably reflecting the uniformity of the modern agricultural landscape.

## DISCUSSION

The pollen diagram from Hassing Huse Mose is unique in Denmark. It shows natural vegetational development on young till-soil of Weichselian age in northwestern Denmark, far from comparable pollen diagrams, and it illustrates an unusually strong and continuous deforestation upwards from the Neolithic, which in Denmark is matched only by pollen diagrams from the West Jutland heath areas.

### *Natural vegetation succession*

The first 5000 years of the vegetational succession at Hassing Huse Mose were not, or only weakly, influenced by man. Features of the late-glacial vegetation (herbs pollen zone), abundant herbs, presence of crowfoot, juniper maximum, are typical of Danish pollen dia-

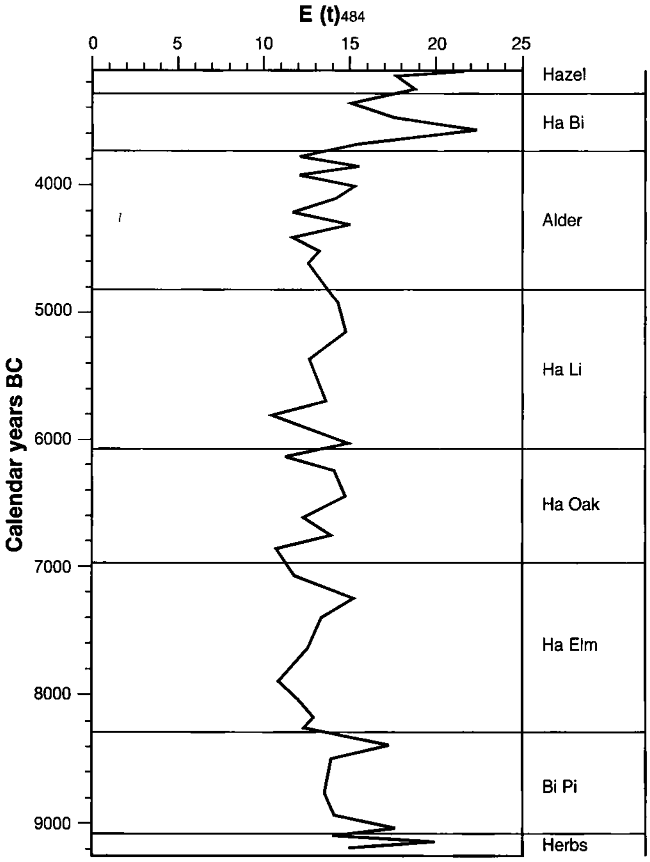


Fig. 12. Pollen taxon richness (E(T)) estimated by rarefaction analysis of pollen counts from gyttja samples in Hassing Huse Mose. Pollen from aquatic plants were excluded. Standard pollen count 484.

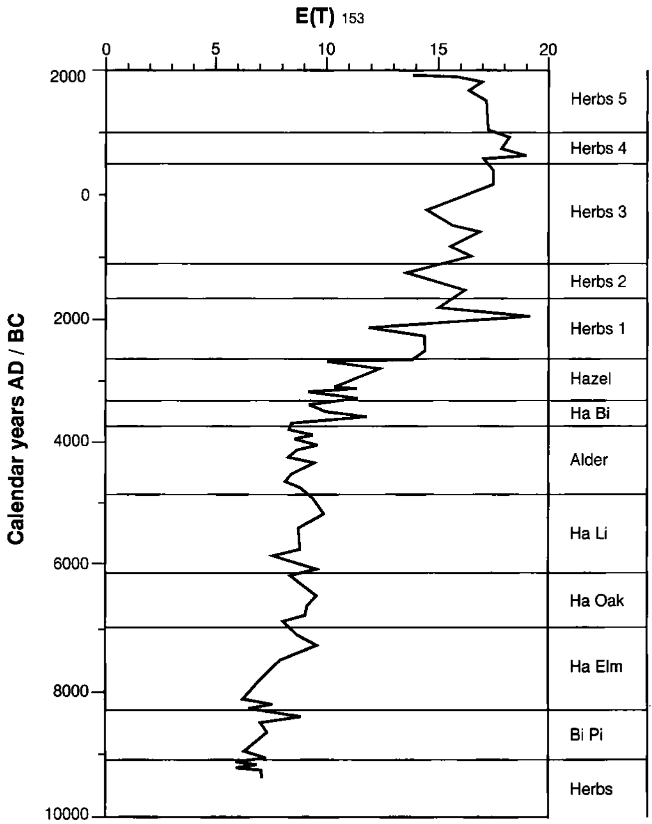


Fig. 13. Pollen taxon richness for all pollen counts from Hassing Huse Mose. Ambiguous plants, wet-ground plants and aquatics were excluded. Standard pollen count 153.

grams from the end of the Younger Dryas and the transition to the Holocene.

The early Holocene tree succession with subsequent maxima for birch, pine, aspen, hazel, elm, oak and lime is similar to that in other pollen diagrams from Denmark. A delay in the immigration of the trees to Thy might be expected. The time of immigration is difficult to assess from pollen diagrams. The first appearance of pollen grains (the rational limit) depends somewhat on the numbers of pollen counted, and the pollen may be derived by far distance transport. An expansion phase (the empirical limit), which reflects massive immigration may also be difficult to define in all cases. Table 5 shows calculated ages for the expansion of tree species at Hassing Huse Mose compared with dates for similar events at other localities in Denmark. Sites with published radiocarbon dated pollen diagrams from the early Holocene are scarce (4 localities). The nearest are Solsø, 80 km to the south, and Fuglsø Mose, 140 km southeast of Hassing Huse Mose. The ages obtained are rather uncertain, partly due to uncertainty in determining exact levels, partly due to difficulties in assessing ages precisely. Therefore, age ranges are shown in Table

| Tree | HHM | Other localities |
|---|---|---|
| Lime | 6100 | 6600-7000 |
| Oak | 6900 | 6600-7700 |
| Alder | 7300 | 7000-7900 |
| Elm | 7900 | 7200-7900 |
| Hazel | 8300 | 8300-8400 |
| Pine | 8900 | 8300-9500 |

Table 5. Calculated ages for the expansion of trees at Hassing Huse Mose, and the range for dates at other localities in Denmark (data from Aaby 1986, 1988, Aaby and Andersen 1986, Andersen et al. 1983, Fredskild 1979, Krog 1973, ages in calendar years B.C.).

5. It appears, that nearly all tree expansion ages from Hassing Huse Mose fall within the ages that could be expected from other sites in Denmark, with one exception, the expansion of lime, which seems to be somewhat younger than the ages obtained elsewhere.

Increasing vegetational stabilization and decreasing floristic diversity is indicated from the late-glacial herb pollen zone, through the early Holocene birch-pine zone to the hazel-elm zone. The decrease of the open-ground herbs and grasses in the birch-pine zone and the formation of a humus layer as indicated by the presence of oak fern are typical of the end of the protocratic and the transition to the mesocratic phase (Birks 1986, Birks and Line 1992).

Hazel, elm and alder expanded rapidly at intervals of 400-600 years. The quick expansion of these trees indicates that they did not meet with serious competition. Hazel was dominant for a short time, 350 years, at the cost of birch and pine. Elm expanded at the cost of hazel, presumably on moist and fertile soils, and alder then invaded the wet soils, at the cost of hazel and birch. Oak appeared together with alder but expanded at a slower rate. The invasion of lime was considerably delayed, around 1400 years later than alder. Lime expanded very rapidly and met little resistance from the other trees. It invaded sites with hazel in particular, and remained very frequent (30-40% corrected) for more than 1000 years. Pollen spectra from small hollows and soils indicate lime dominance and presence of hazel and oak on dry ground, whereas elm and alder were restricted to moist and wet sites, probably mixed with oak and hazel (Andersen 1978, 1984, 1991, Aaby 1983). The increase of alder, at around 4800 B.C., was probably of local significance, connected with a lower water level. Ash, which played a minor role, increased somewhat at the same time. The two first elm declines fell in the alder pollen zone.

Very high tree pollen frequencies, and low diversity, in the hazel-elm to alder pollen zones indicate dense and stable forest cover (mesocratic phase, Birks 1986, Birks and Line 1992). An acid humus layer developed (oak fern, bracken, polypody). Grasses were scarce and pollen from open-ground vegetation (mugwort, sheep's sorrel, goosefoot family) is very scattered. A single pollen grain of wheat-type may be due to far-distance transportation. The stronger winds in this part of Denmark had no effect on the tree density.

*Culturally influenced vegetation*

The first indications of human disturbance were found during the two elm declines in the alder pollen zone examined in detail by Andersen and Rasmussen (1993) and dated at 4520 and 4130 B.C. The specific pursuance of elm was explained by a preference for moist and fertile sites possibly combined with attacks by elm disease.

Anthropogenic influence is clearly reflected from the hazel-birch zone onwards (*Homo sapiens* phase, Birks 1986, Birks and Line 1992). The landscape was opened up only slightly during the Early and Middle Neolithic Funnel Beaker Cultures (hazel-birch and hazel pollen zones). Extensive deforestation began with the land clearances of the Single Grave Culture (2600 B.C.) and proceeded stepwise with new clearances in the Early Bronze Age (1650 B.C.), the Younger Iron Age (A.D. 500), and the Medieval (A.D. 1000) until complete deforestation was accomplished in the 17th to 19th centuries. This development was reversed by the establishment of plantations in the late 19th and in the 20th centuries.

The tree communities were changed drastically during the Early and Middle Neolithic (2600-3800 B.C.). Elm nearly disappeared, lime was strongly reduced, and was replaced by hazel and to some extent by birch, oak and alder. Maintenance of birch coppices and, later, hazel coppices is reflected (*cf.* Andersen 1992a).

The tree pollen frequencies were influenced increasingly by tree pollen transported from a far distance after the land clearance by the Single Grave people (2600 B.C.). The stepwise decrease of the tree pollen frequencies indicates that tree populations were present and available for clearance. Nearly all the tree pollen present at the time of complete deforestation (20%, 19th century) was transported from a far distance, except, maybe, for pollen derived from trees planted around villages and manors (lime, elm?) or a few wet habitats (alder, ash). It is difficult to say which tree pollen was derived from local populations at earlier times. The corrected tree pollen curves (Fig. 11) indicate that first hazel and then alder and birch populations were felled during the Single Grave and Late Neolithic expansion (herbs 1 pollen zone), lime at the Early Bronze Age expansion (herbs 2 pollen zone), and birch and oak in the Late Iron Age and Medieval Period (herbs 4 and 5 pollen zones). Birch, oak and ash were probably present in the Bronze Age and the Older Iron Age (herbs 2 and 3 pollen zones). Pollen spectra from soils beneath barrows from the Early Bronze Age (Andersen 1990, unpublished) indicate that tree vegetation of lime, hazel, birch and alder had been felled and the cleared areas used for cereal growing and then pasture prior to the building of the barrows. The frequency of pine increased strongly at the first land clearance (herbs 1 pollen zone) and remained high up to the present (Fig. 11). There is little doubt that this pollen was transported from a far distance.

Plants from forest and coppices were present from the Early Neolithic (hazel-birch zone) up to present time. Oak fern, bracken and polypody indicate acid humus layers, and several shrubs were probably connected with woodland remains or coppices (rowan, black elder, crap apple, bird cherry, rose).

The wild grasses began to expand in the Early Neolithic (hazel-birch pollen zone) and increased strongly during the intensive land clearance phases. The grasses were probably common in all extensively used habitats, and in fields and pastures. Their flowering was probably reduced in intensively grazed pastures (Andersen 1992a). Conspicuously increased taxon richness indicates increased landscape diversity in the Early and Middle Neolithic (Hazel-birch and hazel pollen zones), but the frequencies of open-ground plants were rather low. Mugwort, sheep's sorrel and the goosefoot family were present since the late-glacial. Ribwort, white clover-type and barley-type are new additions to the flora. The frequencies and numbers of open-ground plants increased continuously from the introduction of the Single-Grave Culture. They probably reflect vegetation on a variety of cleared habitats, such as pastures, fields, fallow land, meadows, roadsides and wasteland, but it is difficult to distinguish these habitats because most of these plants are likely to have occurred in several plant communities (Behre 1981).

Barley-type pollen is common from the time of the Single-Grave Culture, and oat-type from the Late Bronze Age (1000 B.C.). Their importance increases in the Pre-Roman Iron Age (500 B.C.) indicating increased emphasis on cereal growing. Sheep's sorrel was probably associated with the cultivated fields and fallow land together with other plants of weed-type (corn spurrey, knotgrass, perennial knawel, persicaria-type, black bindweed, annual knawel, pearlwort, field madder, cornflower).

Ribwort was common from 2600 B.C. Ribwort is common on various open habitats (Behre 1981), but survives grazing better than most other plants (Andersen 1992a), and its pollen may be extremely common in prehistoric soils indicating intensive grazing (Andersen 1990, 1992a). The continuous occurrence of ribwort pollen at Hassing Huse Mose, therefore, indicates that grazing was important in Thy since the time of the Single Grave Culture. The flora of pastures with high frequencies of ribwort is poor, probably because the herbs were prevented from flowering (Andersen 1992a). A few plants may have been associated with pastures (moonwort, eyebright-type, St. John's wort, adder's tongue). White clover-type is represented from the Neolithic onwards and increases together with red clover in the Iron Age. The clovers may have been promoted by fertilization of the pastures.

As heather was scarce (below 5%) before its expansion in the swamp, heath vegetation was scarce up to that time (200 B.C.). Development of heath since then cannot be proved.

### *Land-use and cultural history*

The changes in land-use around Hassing Huse Mose as reflected in the pollen diagrams is intimately connected with the cultural history in Thy.

The scattered finds and graves from the Early and Middle Neolithic Funnel Beaker Cultures are reflected by evidence of the presence of pastures and open areas, and intensive coppice management.

Large areas were cleared from woodland and were used for pasture and cereal growing during the time of the Single Grave Culture and in the Late Neolithic. The start of these events (2600 B.C.) is slightly later than the introduction of the Single Grave Culture (2800 B.C.) and coincides with the Ground Grave Period (around 2600 B.C., Malmroos and Tauber 1977, Tauber 1986). Finds of Ground Grave-type are particularly frequent in Thy (Glob 1945). Hence, the main Single-Grave occupation of Thy probably took place in the Ground Grave Period. The Late Neolithic is also richly represented by finds (Vandkilde 1990).

Woodlands were cleared again in the Early Bronze Age marking new cultural expansion (from 1650 B.C.). Early Bronze Age graves and finds are particularly rich in Thy, maybe with a slight recession in the Late Bronze Age (maps in Baudou 1985). A recession in the Late

Bronze Age may also be indicated in the pollen diagram.

The pollen diagram indicates new land clearance in the Late Iron Age (from 500 B.C.), Medieval time (from A.D. 1000), and 16th century. Many new settlements appeared in Medieval time (Baudou 1985).

The pollen diagram from Hassing Huse Mose thus reflects increasingly intensive settlements and land-use in Thy from Early Neolithic time till today. There was a radical change from the coppice management of the Funnel Beaker Culture to the creating of large treeless areas from the Single Grave Culture onwards. The emphasis was on stock-breeding, but cereal growing increased in importance from the Early Iron Age. Woodlands were of decreasing importance. The natural forest was changed into secondary woodlands and coppices already in the Neolithic. The hazel coppices were cleared at the introduction of the Single Grave Culture, and only birch and oak coppices, and probably alder and ash on wet ground, remained. It appears that woodlands were cleared away whenever new land was needed, until complete deforestation was achieved. Woodlands were, therefore, of secondary importance in the agricultural economy. The need for woodland products must have been covered by import.

Complete deforestation similar to that in Thy is in Denmark only recorded in pollen diagrams from Lake Solsø and Lake Skånsø in the West Jutland heath areas (Odgaard 1989, 1992b). Deforestation began at Lake Solsø at around 2800 B.C. and at Lake Skånsø at around 2000 B.C. and was completed (around 20% tree pollen) within the last millennium. These sites are situated in areas with poor soils, and heath was prominent, whereas heather was scarce at Hassing Huse Mose, at least up to 200 B.C. Tree pollen was dominant in pollen diagrams from east Denmark up to the forest clearances in Medieval time (pollen diagrams in Mikkelsen 1949, Aaby 1986a, 1988) and woodlands still occurred in the 19th century in contrast to West Jutland and the western Limfjord area (Ødum 1968). The Weichselian till areas were therefore exploited more intensively in Thy than in eastern Denmark. It is difficult to explain these differences in agricultural exploitation. Up to the last century breeding and export of stock was very important in the western Limfjord area, and the peasants there were richer and more independent than in other parts of Denmark (Damgaard 1989). Barley and oat were grown for fodder, whereas bread corn (rye) was imported from the heath areas. Trade with agricultural products may therefore have been an ancient tradition in Thy.

Humification curves from Danish raised bogs (Aaby 1988, in Andersen 1992b) indicate a dry climate in the Early and Middle Neolithic (3000-4000 B.C.) and increases in humidity at around 2800 B.C., 1700 B.C., 0 A.D./B.C., A.D. 600 and A.D. 1600. These increases in moisture coincide with agricultural expansion in Thy (Andersen 1992b). The increasing agricultural exploitation in Thy could, therefore, be a response to increased moisture and availability of sites suitable for grazing or cultivation. The crop of grass and cereals in Denmark depends highly on the availability of moisture, and drought is fatal on light soils even in the moist climate of today (Aslyng 1986). The availability of sites suitable for pasture or cultivation may, therefore, have presented a limit for agricultural expansion. The increases in land-use intensity in Thy in the Single Grave Culture, the Early Bronze Age, the Late Iron Age and Medieval-recent time could be responses to increased production possibilities combined with a high pressure for products. An increase in tree pollen in the Late Bronze Age might be a response to drier climate (from 1000 B.C. to around 0 A.D./B.C.), which could have restricted agricultural exploitation of the lightest soils (Andersen 1992b).

The sediment series from Hassing Huse Mose have provided a radiocarbon chronology. However, the quality of the pollen spectra from the swamp peat is not quite satisfactory and some uncertain points are left unanswered. The pollen counts are very low in a part of the section, the contribution of pine pollen is difficult to interpret and it is difficult to distinguish the contribution of pollen from local swamp vegetation in the pollen spectra. The gyttja series from Ove Sø, which was mentioned in the introduction, is difficult to date by the radiocarbon method due to reservoir effects, but can be dated by cross-correlation with Hassing Huse Mose. A pollen diagram from Ove Sø is in preparation. This diagram will improve and clarify the results obtained in Hassing Huse Mose.

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| | |
|---|---|
| Adder's tongue | *Ophioglossum vulgatum* |
| Alder | *Alnus glutinosa* |
| All-seed | *Radiola linoides* |
| Anemone | *Anemone* |
| Annual knawel | *Scleranthus annuus* |
| Ash | *Fraxinus excelsior* |
| Aspen | *Populus tremula* |
| Barley | *Hordeum vulgare* |
| Bedstraw | *Galium* |
| Beech | *Fagus sylvatica* |
| Bellflower | *Campanula* |
| Bilberry | *Vaccinium* |
| Birch | *Betula* |
| Bird cherry | *Prunus avium* |
| Black bindweed | *Polygonum convolvolus* |
| Black elder | *Sambucus nigra* |
| Bladderwort | *Utricularia* |
| Bog myrtle | *Myrica gale* |
| Bracken | *Pteridium aquilinum* |
| Bread wheat | *Triticum aestivum* |
| Cat's tail | *Typha latifolia* |
| Cinquefoil | *Potentilla* |
| Common clubmoss | *Lycopodium clavatum* |
| Cornflower | *Centaurea cyanus* |
| Corn spurrey | *Spergula arvensis* |
| Couch grass | *Elymus repens* |
| Cow wheat | *Melampyrum* |
| Crap apple | *Malus sylvestris* |
| Crowberry | *Empetrum nigrum* |
| Dog's mercury | *Mercurialis perennis* |
| Dock | *Rumex crispus* |
| Elm | *Ulmus* |
| Einkorn | *Triticum monococcum* |
| Eyebright | *Euphrasia* |
| Field madder | *Sherardia arvensis* |
| Fireweed | *Epilobium angustifolium* |
| Float grass | *Glyceria fluitans* |
| Goosefoot family | *Chenopodiaceae* |
| Great plantain | *Plantago major* |
| Groundsel | *Senecio* |
| Guelder rose | *Viburnum opulus* |
| Hazel | *Corylus avellana* |
| Heather | *Calluna vulgaris* |
| Hemp nettle | *Galeopsis* |
| Hoary plantain | *Plantago media* |
| Hornbeam | *Carpinus betulus* |
| Interrupted clubmoss | *Lycopodium annotinum* |
| Ivy | *Hedera helix* |
| Juniper | *Juniperus communis* |
| Knotgrass | *Polygonum aviculare* |
| Lime | *Tilia cordata* |
| Lyme grass | *Leymus arenarius* |
| Maple | *Acer* |
| Marram grass | *Ammophila arenaria* |
| Meadow oat | *Avenula pratensis* |
| Meadow sweet | *Filipendula* |
| Millet | *Panicum miliaceum* |
| Milfoil | *Achillea* |
| Mistletoe | *Viscum album* |
| Moonwort | *Botrychium* |
| Mountain pine | *Pinus mugo* |
| Mugwort | *Artemisia* |
| Oak | *Quercus* |
| Oak fern | *Gymnocarpium dryopteris* |
| Oat | *Avena sativa* |
| Pearlwort | *Sagina* |
| Perennial knawel | *Scleranthus perennis* |
| Persicaria | *Polygonum persicaria* |
| Pine | *Pinus sylvestris* |
| Polypody | *Polypodium vulgare* |
| Pondweed | *Potamogeton* |
| Ramsons | *Allium ursinum* |
| Red clover | *Trifolium pratense* |
| Ribwort | *Plantago lanceolata* |
| Rose | *Rosa* |
| Rowan | *Sorbus aucuparia* |
| Rye | *Secale cereale* |
| Rye brome | *Bromus secalinus* |
| Sanicle | *Sanicula europaea* |
| Sea buckthorn | *Hippophae rhamnoides* |
| Sea plantain | *Plantago maritima* |
| Sedge | *Carex* |
| Sheep's bit | *Jasione montana* |
| Sheep's sorrel | *Rumex acetosella* |
| Sorrel | *Rumex acetosa* |
| Spruce | *Picea abies* |
| Spurge | *Euphorbia* |
| St. John's wort | *Hypericum* |
| Water crowfoot | *Batrachium* |
| Water milfoil | *Myriophyllum* |
| Water violet | *Hottonia palustris* |
| Wheat | *Triticum* |
| White clover | *Trifolium repens* |
| White water lily | *Nymphaea alba* |
| Willow | *Salix* |
| Yew | *Taxus baccata* |

Table 6. List of English plant names and their equivalents in latin (from Clapham *et al* 1956. Species names in latin follow *Flora Europaea*).

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# Genesis of Iron Pans in Bronze Age Mounds in Denmark

by HENRIK BREUNING-MADSEN and MADS KÄHLER HOLST

## INTRODUCTION

The history of research in the Early Bronze Age in Denmark has to a considerable degree been connected with the burial mounds; one of the reasons being that a number of these mounds have offered unique conditions of preservation. The descriptions of well-preserved oaken log coffins by Boye (1896), Thomsen (1929) and Broholm & Hald (1939) reveal a common feature by these finds; the grave bed is situated in a mound core of very wet or waterlogged soil. The core is often separated from the mantel of more dry material by an iron pan, which is also found below the mound, and in this way the iron pan effectively seals the wet core. It has often been suggested that it is the wet anaerobic conditions of the core which has hindered the decay of the oaken log coffins and bodies, but even though the connection between the iron pan and the remarkable conditions of preservation has been known for long, only few investigations of the genesis of the iron pan have been carried out.

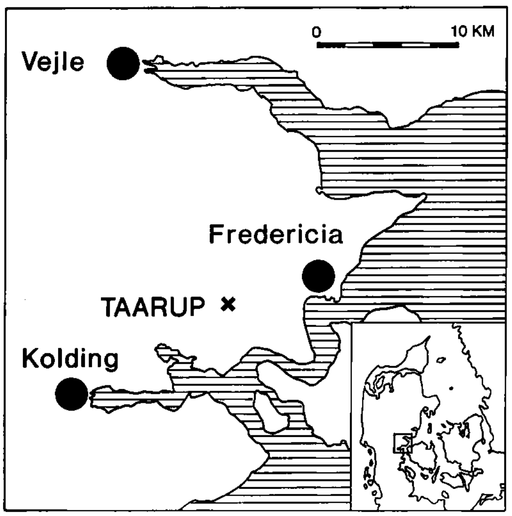


Fig. 1. The location of the Bronze Age mound at Tårup in East Jutland.

In 1992 one of the largest Bronze Age burial mounds in Denmark was partly destroyed during a highway construction at Tårup between Kolding and Fredericia in eastern Jutland (Fig. 1). The mound was nearly circular with a diameter of approximately 60 metres and an estimated height of at least 4 metres. The central part of the mound was totally destroyed, and only the marginal parts were intact when the archaeological investigations were carried out. These were conducted by Vejle Museum.

The investigations revealed that the mound had been erected in several stages, of which the last one could be dated to the Early Bronze Age – probably period II. The oldest part was a dolmen from the Early Middle Neolithic, which in period I or II of the Early Bronze Age had been covered by a turf mound having a diameter of 15 metres. The construction of the large mound began with the erection of a circular mound with an estimated diameter of 20 metres in close proximity to the older mound covering the dolmen. This new mound also consisted of turfs, the outlines of which, however, were difficult to recognize during excavation. In section the mound appeared dark blueish grey with many rusty mottles, mainly surrounding the coarse pore system. Superimposing this, a mantel of more brownish soil was found with much more distinct turf structures. These belonged to the final stages of the monument, in which the blueish mound and the mound covering the dolmen were built together and greatly extended. Finally the large mound was surrounded by a 1.5 metre deep ditch. Except for the unique size, the construction of the Tårup monument is rather typical for the Bronze Age with several building phases and the turfs placed upside down. The small dark coloured Bronze Age mound only seems to have been freestanding for a short period of time, and in the following description this phase will be referred to as the mound core, whereas the later stages of extension are called the mantel.

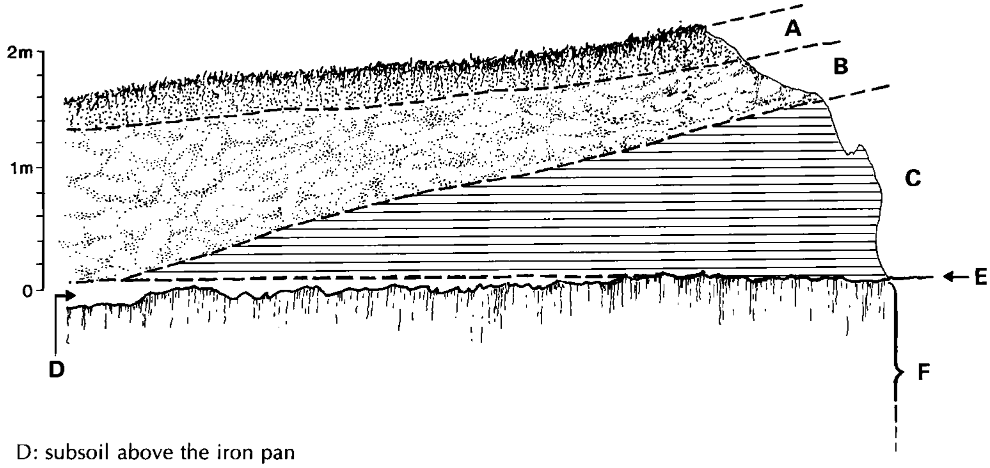


Fig. 2. A schematic drawing of the investigated profile wall.

Fig. 2 shows a schematic drawing of the section used for detailed examination of the genesis of the iron pan. A greyish brown plough layer of sandy loam is superimposing the mantel of similar texture class. It is yellowish brown with part of more greyish brown colours. Distinct turf structures are present consisting of greyish brown topsoil and more yellowish brown subsoil. Few rusty mottles are present in the right part of the mantel; in the left part rusty mottles are more common. Below the mantel the central core is found. It is a dark blueish grey sandy loam with many rusty mottles. In the left side of the profile wall the core is missing and the mantel is resting directly on the sub-soil.

The substratum, on which the mound was build, is a yellowish brown loam. In shallow depth meltwater deposits of medium sand are found securing a good drainage of the superimposing more clayey deposits. Thus, no mottlings were observed in the substratum. On the border between the central core and the original subsoil a continuous thin reddish brown cemented iron pan was observed. It was approximately 1 cm thick and so strongly cemented that hammering was necessary for crushing the sample. To the right on the section it was located exactly on the border between the two layers, while in the remaining part it was situated up to five centimetres down into the original subsoil, but no more. The continuous iron pan was only found below the core. In the part where the mantel is resting directly on the substratum the iron pan is weak and discontinuous if present.

Mounds with iron pans have been registered mainly in Jutland, on both clayey and sandy soils, and in the majority of these finds the situation is identical to the situation in Tårup, with only a well-developed iron pan on the bottom of the mound between the subsoil and the turfs. The burial mounds in which there has also been developed an upper layer sealing the core make out a minority (Aner & Kersten 1973ff).

Already Boye (1896) offered the iron pans some attention, but did neither discuss its genesis nor its influence on preservation. Already in 1898, however, Sarauw argued on the basis of a theory developed by Emeis in 1875 that the iron pans beneath burial mounds as well as those in the top of the mounds were a result of podzolization (in Danish: *al-dannelse*). Therefore he saw the phenomenon as an indication of heath vegetation at the time of construction of the burial mound.

In 1921 the discussion of the iron pans was renewed with the excavation of the famous Egtved log coffin. Here the wet core of the mound was completely surrounded by a thin, strongly cemented iron pan, which had been penetrated by later digging into the inironed central core. Afterwards the hole was refilled, and a new iron pan around the intrusion was formed showing the process of creating iron pans was still potentially active many years after the funeral. Based on results from soil samples from the mound, the geologist A. Jessen concluded: The mound core consisted of soil material from a wetland while the mantel was constructed of dry farmland soil. The iron pans were still considered to be formed by podzolization, but now the genesis was seen as a result of the use of wet soils in the mound core

(Thomsen 1929).

This theory was questioned somewhat when a new well-preserved log coffin was discovered at Jels in 1935 (Broholm 1938) and another one later in the same year at Skrydstrup (Broholm & Hald 1939). Even though the iron pans, which also here surrounded the core, were interpreted as a podzolization product, the geologist W. Christensen returned to the view that the lower pan predated the mound (Broholm & Hald 1939), and in Jels, J. Iversen concluded that even though the core of the mound appeared very different from the mantel, they actually consisted of the same soil material (Broholm 1938).

During the excavation of another Bronze Age burial mound near Skrydstrup, Becker (1946) also found that the soil material of the core and mantel had originally been identical. Furthermore, Becker explained the genesis of thin iron pans according to the theory of K. Gripp (Gripp 1942). According to this theory podzolization played an important role. The upper iron pan was unstable, and through a continuous process of precipitation by influence of oxygen and disintegration, the pan will slowly move downwards and in the end reach the lower iron pan with fatal consequences for the conditions of preservation in the mound. This explanation was generally accepted, and today the iron pans are described in Danish archaeological literature as "al-kapper" (e.g. Jensen 1988) which in soil science means a horizon enriched by iron, aluminium and organic matter due to podzolization.

## GENESIS OF THIN IRON PANS

The development of thin iron pans follows one of the two main processes in the soil: podzolization or reduction/oxidation (gley formation).

The podzolization process, which leads to the formation of a spodic horizon (in Danish "al"), is typical for well-drained sandy soils in Denmark under coniferous or heather vegetation (Petersen 1976). Although the podzolization process is not fully understood in detail, the process is in broad terms as follows: The soil is leached due to excess of rain and pH drops to about 4. Worms and other soil mixing animals disappear and a mor layer of more or less decomposed litter, branches etc. is developed upon the mineral soil. Organic acids from the mor layer make complexes with the immobile iron- and aluminium (hydr)oxides in the top soil. These complexes are mobile and they will be translocated by the infiltration water to a certain depth where the iron- and aluminium (hydr)oxides will be precipitated together with organic matter. This might be due to increasing pH, changes in biology or due to an oversaturation of the iron-aluminium-humus-complexes. Normally the precipitation of iron and aluminium will not take place in a narrow part of the soil but cover a depth of half a metre or more. The organic matter content is mainly precipitated in the uppermost part of the spodic horizon making it black, while the maximum value of iron and aluminium (hydr)oxides is found somewhat further down in the spodic horizon, where reddish brown colours dominate due to the ferri iron. Only in well-sorted sand deposits such as dune sands and fluvial sands, some part of spodic horizon might be deposited as narrow bands between the different sand beds. In the eluvial topsoil, where the leaching of iron and aluminium has taken place, the soil particles lose their brownish colours and turn into greyish or white colours.

Thus, the typical podzol will have the following horizon sequence: The uppermost part of the mineral soil is the greyish eluvial horizon due to a lack of brownish iron(hydr)oxides. Below the eluvial horizon, which normally has a thickness of about 30 cm, the black humus-spodic horizon occurs superimposing the reddish-brown iron-spodic horizon. Below the spodic horizons, the yellowish brown parent material is found.

In wet soils reduction/oxidations processes dominate. Due to the high water content in these soils, the diffusion of oxygene and carbondioxides is restricted and the biological activity (metabolism) gives rise to oxygene depletion in the root zone. Under such conditions several elements in the soil are reduced, e.g. sulphates to sulphides, nitrate to nitrogen (gas) and ferri iron ($Fe^{3+}$) to ferro iron ($Fe^{2+}$). While ferri iron is almost immobile in the soil, ferro iron is mobile and it will follow the water movements, or by diffusion move towards a more oxidized part of the soil and there precipitates as ferri iron. Hereby the more reduced parts of the soil will be blueish or greyish (ferro iron or a complete lack of iron), while the more oxidized part will be rusty or reddish brown (ferri iron). In some cases the ferro iron will be oxidized and precipitated as ferri iron in thin pans if a sudden change in redox conditions occurs over some lateral distance. Such strongly cemented iron pans are called placic horizons. Contrary to e.g. iron and manganese, aluminium does not change valence due to oxidation/reduction conditions and it will remain in an immobile form. Therefore, the gley processes will not lead to a rearrangement of the aluminium content in the soil, which happens by the podzolation process.

It is possible analytically to separate the two processes and show which of these have been the dominating soil forming process. If podzolization has taken place, the precipitation of organic matter, iron oxides and aluminium oxides in a thin spodic horizon gives rise to at least a local maximum of all three elements in these horizons. Furthermore, most of the iron and aluminium are precipitated linked to organic matter so the major part of the non-silicate iron and aluminium must be in organic form. Contrary, the gley process only involve iron and this on an inorganic form. This leads to a movement and precipitation of iron exclusively and there is no distinct maximum of organic matter and aluminium connected to the iron pan.

## SOIL SAMPLING AND ANALYSIS

Soil samples have been taken at different depths from two sites on the exposed section, Fig. 2. One sample was collected from the ploughlayer, 3 samples have been taken from the mantel: one from the upper part, one from the vegetation layer of one of the turfs in the lower mantel and one from the subsoil of the turf also in the lower mantel. Two samples have been taken from the core and three samples have been taken below the core in the subsoil, one above the iron pan, one of the iron pan and one immediately below.

In the soil laboratory texture analyses were carried out using sieving for determining the sand fractions and the Andreasen-pipette method for determining the silt and clay fraction. The content of organic matter was determined by using an IR-Leco apparatus where the carbon content of the soil is determined based on the amount of carbondioxide ignite from the sample after heating to 1600°C. The organic matter content is then calculated based on the assumption that 58% of the organic matter is carbon. On samples suspended in water and 0.01 M calcium cloride, pH was measured potentiometrically. For both liquids a soil-liquid ratio of 1:2.5 was used. Dithionite-citrate and pyrophosphate soluble iron and aluminium were determined as described in Soil Conservation Service (1972). It is a general assumption that the extraction of iron and aluminium with dithionite-citrate ($Fe_d$ and $Al_d$) gives the total amount of non-silicate iron and aluminium in the soil, while the extraction with pyrophosphate ($Fe_p$ and $Al_p$) only gives the organic-bound iron and aluminium. This is surely true for iron where dithionite reduces the iron, and citrate makes complexes with the ferro iron. This makes a very effective extraction of the non-silicate-bound iron. This is not the case for aluminium, however, which is not reduced by dithionite. Therefore in some cases the pyrophosphate-soluble aluminium might be higher than the dithionite-soluble.

## RESULTS AND DISCUSSION

Table 1 shows the soil texture and organic matter content in different layers. The mound is made of a poorly sorted sediment with a clay content between 10-15%. Geologically it is a sandy loamy till. The undisturbed subsoil below the mound has about 20% of clay – the low clay content and high content of gravel and coarse sand in the iron pan are due to a strong cementation of clay-particles so it was impossible to disperse them totally. The subsoil is poorly sorted too and it is geologically a loamy till. The texture analyses show that the mound is made of nearly the same material as the subsoil, which means that the constructors have used the soil just

| | >2000 | 500-2000 | 200-500 | 125-200 | 63-125 | 20-63 | 2-20 | <2 | OM |
|---|---|---|---|---|---|---|---|---|---|
| ploughlayer | 1 | 5 | 10 | 15 | 14 | 16 | 20 | 19 | 2.1 |
| upper mantel | 1 | 5 | 9 | 15 | 16 | 26 | 18 | 11 | 1.1 |
| lower mantel | 1 | 6 | 11 | 15 | 15 | 25 | 16 | 10 | 1.0 |
| lower mantel | 1 | 5 | 11 | 16 | 16 | 22 | 17 | 13 | 1.1 |
| upper core | 1 | 5 | 10 | 26 | 16 | 19 | 14 | 11 | 1.1 |
| lower core | 1 | 5 | 9 | 15 | 17 | 21 | 19 | 15 | 1.3 |
| subsoil: | | | | | | | | | |
| above iron pan | 2 | 9 | 15 | 17 | 13 | 5 | 13 | 26 | 0.3 |
| ironpan | 30 | 16 | 9 | 11 | 8 | 5 | 9 | 12 | 0.9 |
| below iron pan | 2 | 8 | 13 | 17 | 13 | 6 | 14 | 26 | 0.3 |

Table 1. Texture and organic matter content. Grain sizes in μm, figures in percentage. OM means organic matter content.

| | non-silicate | | organic | | |
|---|---|---|---|---|---|
| | Fe% | Al% | Fe% | Al% | OM% |
| ploughlayer | 0.6 | 0.1 | 0.2 | 0.3 | 2.1 |
| upper mantel | 0.3 | 0.1 | 0.2 | 0.3 | 1.1 |
| lower mantel (plowlayer) | 0.3 | 0.1 | 0.2 | 0.4 | 1.1 |
| lower mantel (subsoil) | 0.4 | 0.1 | 0.2 | 0.2 | 0.9 |
| upper core | 0.3 | 0.1 | 0.2 | 0.3 | 1.1 |
| lower core | 0.5 | 0.1 | 0.2 | 0.3 | 1.3 |
| subsoil above iron pan | 0.4 | 0.1 | 0.3 | 0.5 | 0.3 |
| ironpan | 14.5 | 0.3 | 0.4 | 0.2 | 0.9 |
| subsoil below iron pan | 0.8 | 0.1 | 0.2 | 0.3 | 0.3 |

Table 2. Non-silicate and organic bound iron, aluminium and organic matter content (OM) in the different soil layers.

around the mound for building the grave. The minor difference in clay-content between the mound and its substratum may be due to the fact that most of the Danish tills show clay illuviation. By that process clay minerals are translocated from the topsoil (e.g. 0-40 cm) to the soil layer immidiately below (e.g. 40-130 cm), where they are deposited as clay cutans on the soil peds. The mound is then built up by clay eluviated topsoil placed on a clay illuviated subsoil. Furthermore, many turfs in the mound show two layers, a dark topsoil with a little more organic matter content than a brighter sub-soil, which also indicates that the mound is built up by nearby topsoil. The central core is made of the same material as the rest of the mound, and there is no evidence that it should have been taken from a nearby wetland. This is in accordance with results from a number of Bronze Age burial mounds, e.g. from Arnum, Jels, Skrydstrup and Egtved where analysis of the core shows pollen from heather vegetation or from dry farmland (Thomsen 1929; Broholm & Hald 1939).

Table 2 shows the organic matter content, and the dithionite-citrate soluble and pyrophosphate soluble iron and aluminium in the different horizons. The organic matter content is highest in the plough layer exceeding 2%. In the mantel the vegetation layer of the turf shows a slightly higher organic matter content than the bottom. The core has between 1 and 1.5% of organic matter indicating that it is not wetland deposits. Below the core in the subsoil, the organic matter drops, but shows a minor local maximum in the iron pan.

The content of pyrophosphate soluble aluminium ($Al_p$) is significantly higher than the dithionite-citrate soluble aluminium ($Al_d$). The iron pan has not a local maximum for $Al_p$ but a minor one for $Al_d$. The dithionite soluble iron ($Fe_d$) content is significantly higher than the pyrophosphate soluble. The iron pan shows a significant maximum for $Fe_d$ (10-20%) but not for $Fe_p$. If we use the general assumption that the extraction of iron and aluminium with dithionite-citrate ($Fe_d$ and $Al_d$) gives the total amount of non-silicate iron and aluminium in the soil, while the extraction with pyrophosphate ($Fe_p$ and $Al_p$) only gives the organic-bound iron and aluminium, it is possible to determine whether the soil forming process has been a podzolization or a gleying.

If podzolization has occured, there should at least be a local maximum of iron, aluminium and organic matter content in the iron pan, and according to Soil Survey Staff (1975) and FAO (1990) the iron pan must fulfil the following equation:

$$Fe_d + Al_d < 2 \star (Al_p + Fe_p)$$

This means that the organic bound Fe + Al is to account for more than half of the total amount of non-silicate iron and aluminium. Furthermore, above the iron pan an eluvial horizon should be found containing bleached sand grains, because the iron coatings have been removed by the podzolation process.

If gleying is the main process, the inorganic iron content must show a distinct maximum in the iron pan and it must exceed the amount of organic bound iron several times $Fe_d >>> Fe_p$. Furthermore, there should not be a distinct local maximum for organic bound aluminium and iron and organic matter content in the iron pan. The presence of gley features like mottlings in the neighbouring soil layers will strongly support the theory of reduction/oxidation as the driving process in the iron pan formation.

Table 2 shows that the chemical data do not support the podzolization process; the amount of organic iron and aluminium is too small compared to the inorganic amount, there is no local maximum for organic bound iron and aluminium in the iron pan and bleached mineral particles were not observed above the iron pan. Contrary, the analytical data clearly support the gleying process, especially the extreme high content of inorganic iron ($Fe_d$). A mineralogical investigation of the iron pan by X-ray revealed that the iron was mainly goethite but also a trace of lepidocrosite formed under wet condition was detected. The gley process is also sup-

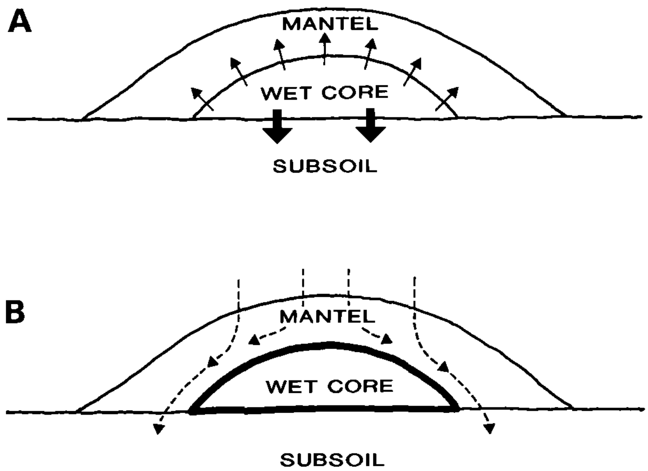


Fig. 3. A schematic drawing showing the water movement in a Bronze age mound.

A: just after the construction of the mound
B: some years later when an iron pan was developed.

Full arrows: water movement from the core out into the mantel
Dotted arrows: percolation water in periods with excess of precipitation.

ported by the field observations of mottlings in the core, the blueish colour which is typical for wet anaerobic soil material, and the reports of free water in the log coffins from the excavation of some mounds. Furthermore, a gley process might happen very fast, within months, while the podzolation process, developing a hard pan, will take at least decades. The corpse will never survive the time it will take to form the iron pan by podzolization. It must therefore be concluded that the process forming the iron pan is gleying and not podzolization. The traditional Danish word "alkappe" for this type of iron pan is therefore misleading, because "al" is more or less equivalent to the spodic horizon indicating the podzolization process.

One question then arises; how does the wet and anaerobic condition turn up in the core surrounded by a well-drained mantel or substratum. It has been shown through many pollen analyses that the core of the Bronze Age mounds is made of nearby soil material from dry farmland. This is also the case for the Tårup mound according to texture analyses showing the glacial till origin of the material. It is not possible, based on the present investigation, to give a final explanation but a hypothesis could be as follow: the mound is normally placed on the top of a minor hill, so it must be assumed that the subsoil is well-drained, no groundwater is present near the surface. The corpse stored in the oaken log coffin is placed in the centre of the mound surrounded by stones. Then the central core of the mound is constructed using wet farmland soil to ensure that the soil could be packed tightly around the body. If the soil material is dry, which it will be in summertime, it has to be rewetted to ensure compaction. The core is made very compact compared to the mantel, which are made of the same material as the core but has been placed more loosely and may be in a more dry form. The construction of the two visually distinct stages of the mound can only have been separated by a short time span, and in this way both core and mantel belong to the same continuous building sequence. The beginning decay of the body and the turfs will create anaerobic conditions in the core, and the ferri iron (oxidized form) will be reduced to ferro iron (reduced form). Ferro iron is mobil contrary to ferri iron and will by the water be transported to the subsoil or up in the drier mantel, where the soil water suction is lower, Fig. 3. Here aerobic conditions dominate and the ferro iron will precipitate as ferri(hydr)oxides forming the iron pan. This might be so strongly developed that it impede water movement. First the bottom iron pan will be developed to the stage of non-permeable for water because of the gravity (more water goes downwards than upwards). In the period where the lower iron pan is impermeable for water contrary to the upper pan the excess of precipitation will fill up the central core with water. When the upper iron pan becomes impermeable too, we have a completely cealed corpse stored in anaerobic water containing some organic acids from the initial decay, which at this stage has completely stopped.

The analytical data strongly support the above-mentioned theory but final proves need hydrological investigations and further soil physical and chemical investigations in other excavations, especially some with well developed iron pans completely surrounding the core. Furthermore, simulation experiments developing iron pans in imitations of Bronze Age mounds could also clarify the genesis of the iron pan and the methodology used for building up mounds.

## CONCLUSIONS

*The following conclusions can be made:*

– The mound of Tårup is made of loamy till taken from nearby dry farmland. The material is clay-eluviated topsoil, and the material building up the brownish mantel and the blueish core are identical.

– The genesis of the iron pan below the core is oxidation/reduction processes (gleying).

– The Danish word "alkappe" for the iron pan is misleading, because no podzolization has taken place.

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# Settlement Structure and Economic Variation in the Early Bronze Age

by MARIANNE RASMUSSEN

## INTRODUCTION

The thousands of Danish burial finds dating from the Early Bronze Age constitute an exceptional source material, which for many years has formed our main basis for investigating the cultural development and for building a general picture of a dynamic age with great diversity (e.g. Kristiansen 1978, 1983 & 1987; Larsson 1986; Asingh & Rasmussen 1989, 1990). Nevertheless, our knowledge of basic aspects of this particular society is strikingly insufficient. We need greater insight into the organisation of the primary production, a better understanding of the social behaviour and clearer evidence about the settlement structure. In other words, more knowledge about those specific living conditions which ultimately are tied to such essential problems as: how and where can a possible production surplus be made as an exchange object for the desired bronzes? Is it realistic or relevant to assume an economic surplus at all? (Larsson 1986:85).

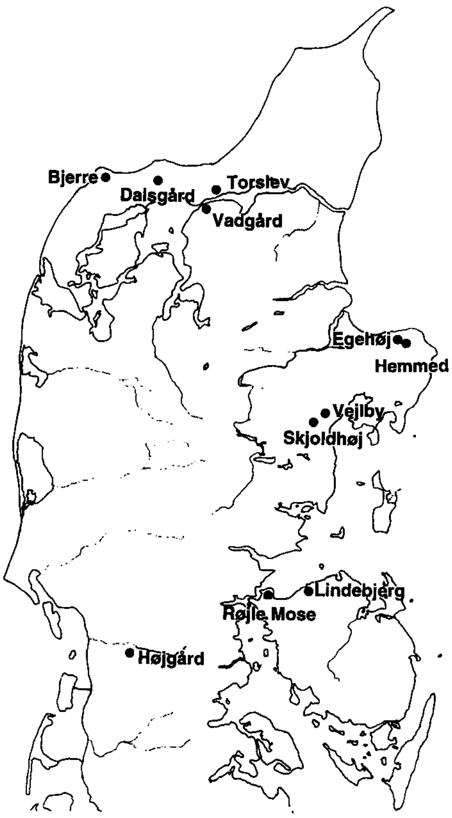


Fig. 1. Danish settlements mentioned in the text.

Due to several new and important settlement excavations, some of which have already been published (e.g. Ethelberg 1987, 1993; Boas 1991, 1993), the archaeological evidence has recently improved significantly, both quantitatively as well as qualitatively. Considering the many new sites collectively and retrospectively, it is striking how varied the material is, and how few regularities there are. A well-known example is the highly unexpected environment that surrounded one of the best sites, Bjerre at Hanstholm (Bech 1991). So far only a few sites containing finds of a specific economic nature (i.e. settlements with preserved bones, plant remains, etc.) are known, yet quite a number of aspects concerning living conditions and the subsistence economy in the Early Bronze Age can be outlined.

The construction of a relative chronology based on the pottery from a selection of Early Bronze Age sites in Jutland has created a framework for a comparison of the settlements. The chronological variation and significance are in particular based on changes in the selection, character, and position of so-called specially modelled points executed on the vessel profile (Fig. 2) (M. Rasmussen 1993a:104ff.). The shape classes of the vessels as a whole do not change markedly through time, and generally speaking the pottery is not very characteristic, with undecorated, rough and relatively simple shapes. In addition to the pottery chronology, a number

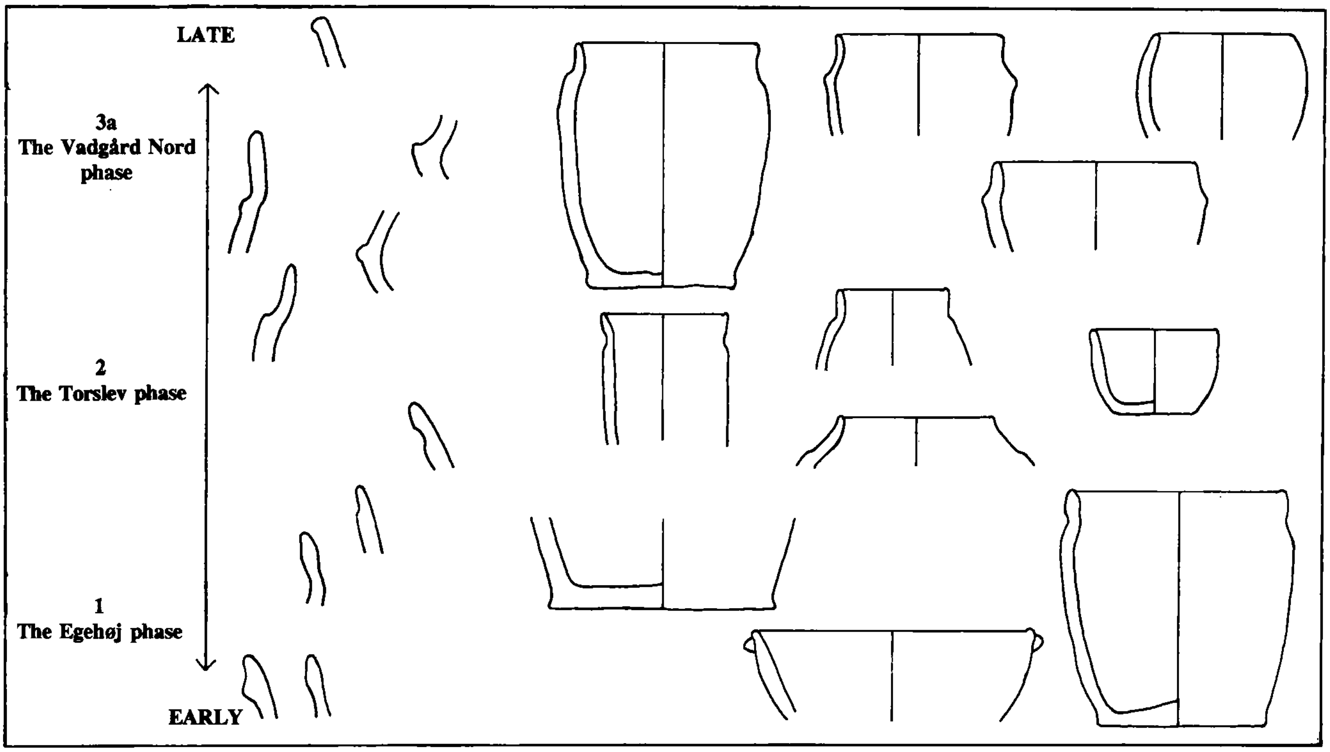


Fig. 2. Selected features of the settlement pottery, phase 1, 2 and 3a (app. period I and II). Left: specially modelled points executed on the vessel profile. Right: vessel shapes.

of radiocarbon dates are available which can supplement and elaborate discussions of the chronological order of the settlements. As is often the case, however, dates arrived at by different means can give rise to debate.

In the following, the situation in Per.I and Per.II is considered, using the material from Torslev in Øster Hanherred as a starting point. The settlement at Vadgård in the northwestern part of Himmerland and a few other sites are also referred to for comparison (Fig. 1). Only 11 km separate the two sites, and – as will become evident – they display certain similarities as well as differences.

Torslev was excavated in 1982 by Ålborg Historiske Museum (Johansen 1985). The site consists of a homogeneous, c. 20 cm thick compacted culture layer sealed under a barrow. A primary burial from Per. II had partly been dug down into the culture layer (Johansen 1985:117). No traces of constructions or similar features were found, except for a dense system of ardmarks which could be traced through the culture layer down into the sub-soil, and which was obviously older than the burial (Johansen 1985:118ff., Fig. 5). Neither the culture layer, the ploughmarks nor other features were preserved outside the area covered by the barrow. The circumstances of the excavation did not call for further investigations of a larger area. The stratigraphy of the site is simple and reflects only three major events: Accumulation of the culture layer, ploughing and construction of the barrow (Fig. 3). None of the layers were separated by visible vegetation layers, nor could a buried soil be traced under the culture layer which lay directly over the sub-soil (Johansen 1985:117). Apparently, the three events occurred very soon after each other. This fact causes the excavator to interpret the whole process as an intentional act, with the interment as the final goal (this being the reason why the culture layer as well as the ploughmarks are limited to the area of the later barrow) (Johansen 1985:120). Vast concentrations of oyster shells in the culture layer have promoted the preservation of a small sample of bones, some worked, as well as fragments of antler (Nyegaard, this volume). Additionally, large amounts of flint and pottery were found.

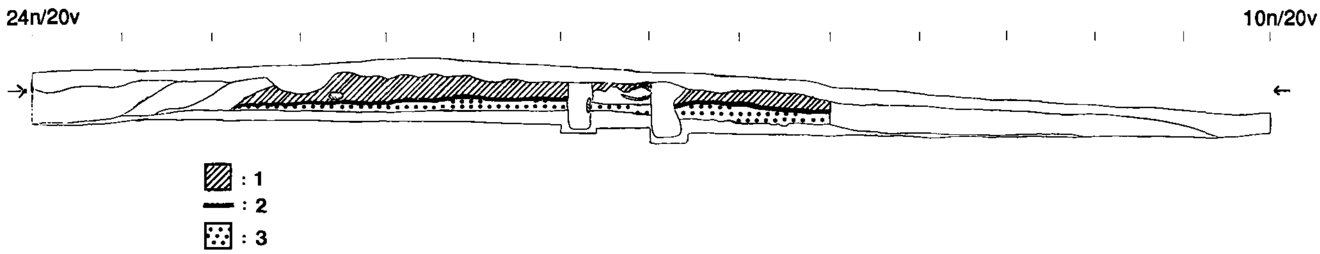


Fig. 3. N-S section through the Torslev barrow. Legend: 1) primary barrow; 2) ploughmarks; 3) culture layer.

Vadgård was excavated in 1971-76 by the late Ebbe Lomborg of the Danish National Museum (Lomborg 1973, 1976, 1980). It consists of two separate settlement units (Fig. 4) (Lomborg 1980:122): a rather large one, Vadgård Nord, which on the basis of the pottery and radiocarbon dates belongs to Per. II, and a smaller one, Vadgård Syd, which is a little older and presumably dates from the end of Per. I (M. Rasmussen 1993a:65). The settlement at Vadgård has been fully excavated and delimited; the whole area contains 15-16 dwellings or house-like constructions together with a variety of other features.

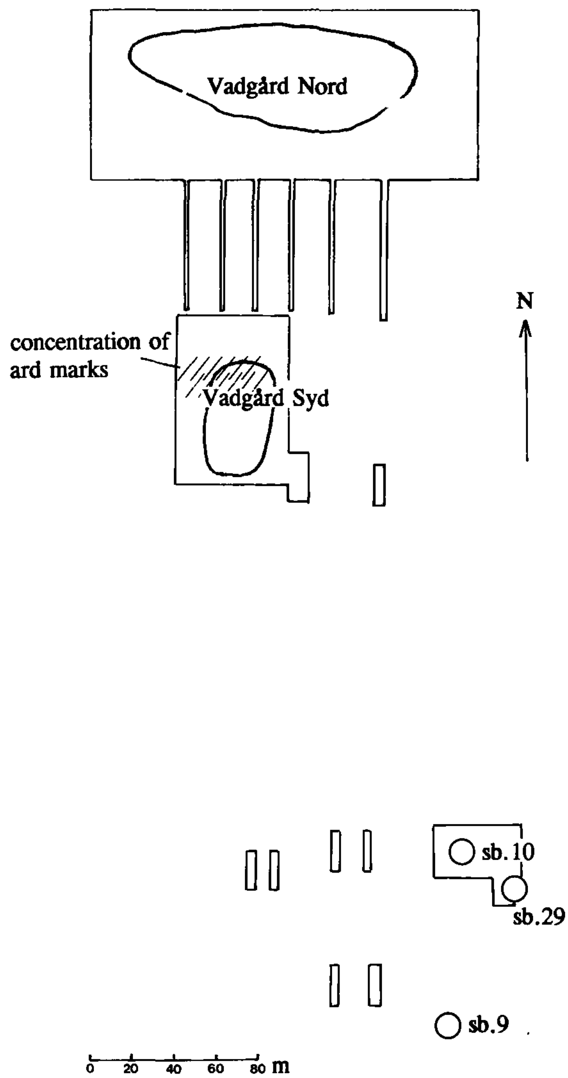


Fig. 4. Excavated areas at Vadgård with the position of the settlement units and the barrows.

## THE FINDS FROM TORSLEV

### *Flint*

The flint material from Torslev was found scattered throughout the culture layer without particular concentrations of waste products or specific tools. Undoubtedly, the flint had been worked on the site (Johansen 1985:118). The tools found are partly made on flakes and partly by the use of pressure-flaking techniques (Fig. 5 and 6) (Johansen 1985, Fig. 2). At least a quarter of the very abundant flint debitage consists of waste products from pressure-flaking, such as thin flakes with very small striking platforms and large quantities of tiny chips. The many roughouts of daggers and sickles also testify to the presence of all stages of manufacture based on this technique. Tools made on flakes were apparently also important. Particular mention should be made of scrapers as well as flakes with partial and continuous retouch along the long edge (Fig. 5). All scrapers are

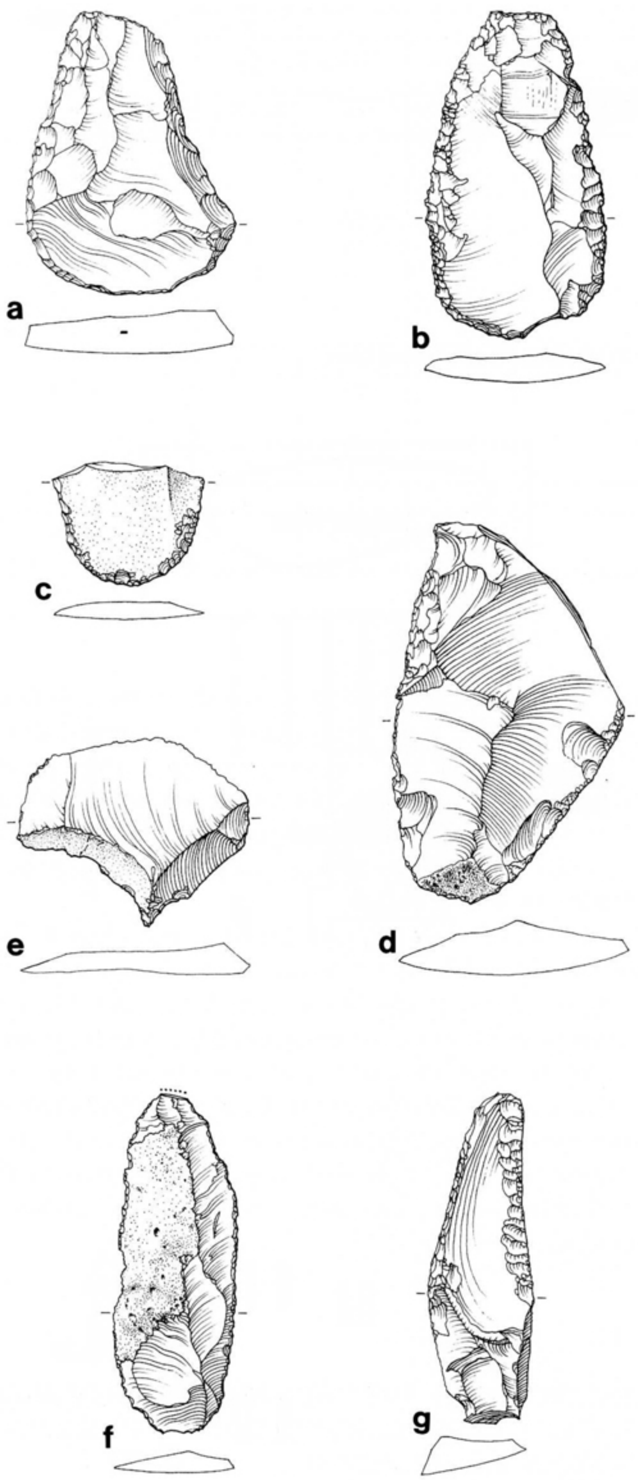


Fig. 5. Flint tools from Torslev; a), b) & c) different kind of scrapers; d) knife; e) borer; f) strike-a-light; g) flake with retouch along the long edge. Jørgen Mührmann-Lund del. 1:2.

made on flakes, but morphologically they can be divided into simple flake scrapers and hafted scrapers.

It is difficult to make comparisons with earlier published finds from the Early Bronze Age, as the categories of tools do not correspond, the criteria of the different groups may vary and the methods of calculation cannot be compared directly. Certain aspects may be mentioned, however. The relationship between tools and waste products generally corresponds to that seen at Røjle Mose and Lindebjerg (Jæger & Laursen 1983, table I), with a degree of utilisation of 7-10%, whereas at Egehøj it is only 2% (Boas 1983:95). The various types of scrapers constitute almost one fifth of the tools on most sites, which demonstrates their great significance. Only at Røjle Mose are the scrapers less frequent. A more specific variation appears when comparing Egehøj and Torslev: At Torslev the simple flake scrapers dominate, while the hafted scrapers are most common at Egehøj (Boas 1983:95). Differences among the various types of worked pieces can also be observed. Torslev and Egehøj contain a relatively large number of pieces with edge retouch, while Lindebjerg and Røjle Mose contain mostly notched or toothed flakes (Jæger & Laursen 1983, table I). This situation may however be partly due to different criteria used in categorisation. On the other hand, the categories of daggers, sickles and arrowheads are more comparable. Torslev contains a remarkable number of daggers and sickles, compared with the other sites. The comparison with Egehøj is considered reliable, because roughouts are included in the calculation. Torslev contains twice as many daggers and sickles (almost 20% of the total number of tools) as Egehøj (almost 10%). On the other hand Egehøj has an exceptionally high frequency of pressure-flaked arrowheads (about 35%) (Boas 1983:95), which are present at the other three sites at a frequency of only 3-5%.

Although the validity of certain variations cannot be confirmed, it can be concluded that the distribution of the various flint artifacts on the individual sites reflects particular needs. It is striking that the variation is primarily seen in the tools made by pressure-flaking (daggers, sickles, arrowheads), while there is a higher degree of correspondance as regards tools made on flakes. For instance, there are large numbers of scrapers, somewhat fewer borers and vitually no burins. The general characteristics of the flint material and the appearance of the individual tools show however a good measure of agreement. As regards shape, manufacturing technique

| | | | |
|---|---|---|---|
| Flakes | | | 1549 |
| Cores, core fragments and nodules | | | 163 |
| Tools made on flakes: | | | 75 |
| Scrapers: | | 20 | |
| Flake scrapers | 14 | | |
| Hafted scrapers (spoonshaped: 4, pearshaped: 2) | 6 | | |
| Borers | | 5 | |
| Flakes with partial edge retouch | | 20 | |
| Flakes, toothed or notched | | 11 | |
| Flakes with continuous edge retouch: | | 19 | |
| continuous retouch along one long edge | 15 | | |
| continuous retouch along both long edges | 4 | | |
| Pressure-flaked tools: | | | 45 |
| Daggers or sickles roughouts | | 26 | |
| Daggers, dagger fragments, roughouts and strike-a-lights | | 7 | |
| Sickles, sickle fragments and roughouts | | 9 | |
| Arrowheads and arrowhead roughouts | | 3 | |
| Stone tools: | | | 7 |
| Hammerstones | | 6 | |
| Whetstone | | 1 | |

Fig. 6. Inventory of finds of flint and stone tools from Torslev.

etc., the tools from Torslev can thus easily be parallelled with those from Lindebjerg and Røjle Mose (Jæger & Laursen 1983:108ff).

### *Pottery*

With regard to quantity, the pottery (Fig. 7) (Johansen 1985, Fig. 3) from Torslev stands out compared with other contemporaneous sites. The sherds represent at least between 29 to 41 whole vessels, including both single-, bi- and tri-segmented shapes. Both the single- and bi-segmented vessels belong mainly to a group of small, slim beakers or more plump cups: there are also a few bowl types. The tri-segmented vessels dominate and can be classified into two groups; barrel-shaped, medium-sized vessels with a highly placed transition between neck and bowl, and smaller, more open vessels with a characteristic carination, curved conical neck and rim part and a highly placed transition between neck and bowl. Generally speaking, several of the latter must be described as concave-convex vessels. The bases are very similar and the predominantly weak inclination relates them to the common barrel shape. Bases both with and without a marked foot are present. The wall thickness of the majority of the sherds (2/3) varies between 0.8-1.3 cm, but the overall range is considerable, from 0.4 to 1.8 cm. All sherds are tempered with angular grains of granite, but in terms of quantity, size, density and mixture with other materials (sand, moraine gravel and shells) the extent of the coarseness varies. There is also variation in the degree of care taken in the treatment of the surface. The most common finish is a so-called self-slip treatment, which primarily can be recognised from the protruding temper grains surrounded by a cracked surface.

The pottery is very typical of the first part of the Early Bronze Age with regard to elements of its shape, the range of shapes in the inventory and the ware. Thus it serves as a reliable basis for a general typology for Jutish settlement pottery, and has in this respect been described in detail elsewhere (M. Rasmussen 1993a:53ff.). As a result of the find conditions the pottery is quite fragmented. It is evenly distributed throughout the culture layer with no concentrations of sherds resulting from whole vessels.

## THE DATING OF THE FINDS FROM TORSLEV AND THE SETTLEMENT CHRONOLOGY AT THE BEGINNING OF THE BRONZE AGE

There are several possibilities for an archaeological dating of Torslev. A flint dagger of Lomborg's type VI points towards Per. I-II (Johansen 1983:118). This is in accordance with the stratigraphical position of the cul

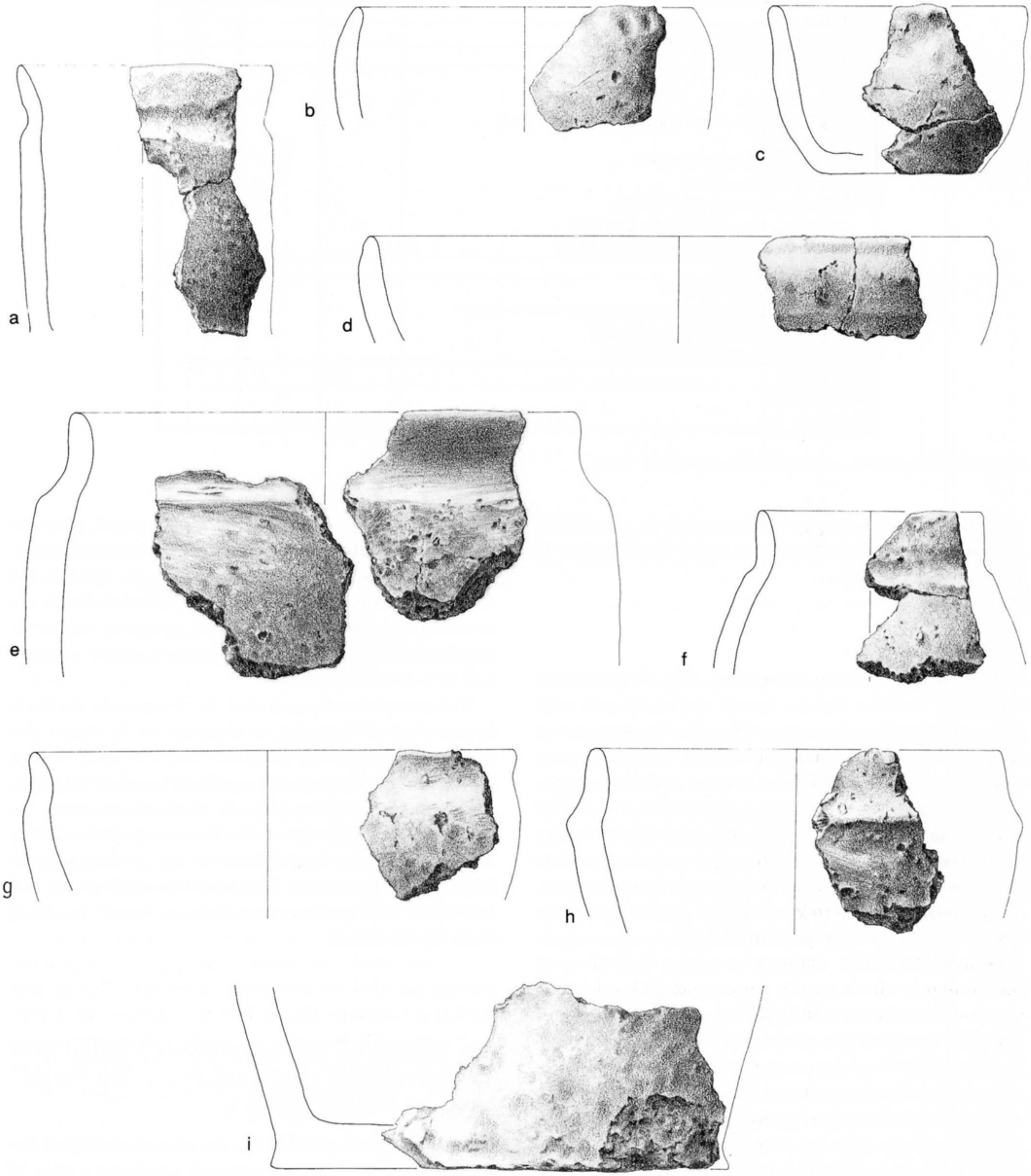


Fig. 7. Pottery from Torslev; a, b, c & d) single- and bi-segmented beakers, cups and bowls; e & f) tri-segmented barrel-shape; g & h) tri-segmented vessels with a characteristic carination and curved neck and rim part; i) base with a marked foot. Jørgen Mührmann-Lund del. 1:2.

| Sample no. | Site and context | $^{14}C$ years b.p. | Calibrated B.C. | ± 1 std. dev. B.C. |
|---|---|---|---|---|
| K-4413 | Vadgård N, CO, fireplace | 3040 ± 80 | 1290-1270 | 1400-1130 |
| K-2073 | Vadgård N, BE, wall-ditch | 3070 ± 100 | 1380-1320 | 1430-1140 |
| K-2074 | Vadgård N, BF, cooking pit | 3110 ± 100 | 1400 | 1500-1230 |
| K-2238 | Egehøj, house III, posthole | 3160 ± 100 | 1420 | 1520-1310 |
| K-2602 | Vadgård N, CB, pit | 3180 ± 85 | 1430 | 1520-1330 |
| K-2601 | Vadgård N, CC, oven | 3200 ± 85 | 1440 | 1520-1400 |
| K-4294 | Vadgård S, FD, fireplace | 3230 ± 80 | 1510 | 1600-1410 |
| K-2240 | Egehøj, well II | 3240 ± 100 | 1510 | 1620-1410 |
| K-4293 | Vadgård S, KB, wall-ditch | 3260 ± 80 | 1520 | 1620-1430 |
| K-4295 | Vadgård S, FE, posthole | 3270 ± 85 | 1520 | 1630-1430 |
| K-2709 | Vadgård S, FD, house depression | 3270 ± 90 | 1520 | 1670-1430 |
| K-2239 | Egehøj, well I | 3340 ± 100 | 1620 | 1740-1510 |
| K-5756 | Torslev, culture layer | 3360 ± 80 | 1670-1640 | 1740-1520 |
| K-5755 | Torslev, culture layer | 3390 ± 80 | 1680 | 1750-1530 |
| K-5754 | Torslev, culture layer | 3420 ± 70 | 1730-1690 | 1860-1630 |
| K-4024 | Vejlby, house depression | 3420 ± 80 | 1730-1690 | 1870-1620 |

Fig. 8a. Radiocarbon dates from Early Bronze Age settlements. Vejlby after Jeppesen 1984:101; Egehøj after Boas 1983:101. Calibrations according to Pearson and Stuiver 1993.

ture layer, which excludes a date later than Per. II. During this period the first phase of the barrow was built, sealing the culture layer in connection with the construction of the primary burial. The pottery also indicates a date in the early part of the Early Bronze Age. It is characteristic of a ceramic phase that typologically must be placed between the pottery from the houses at Egehøj and that from the northern site at Vadgård (Fig. 2) (M. Rasmussen 1993a, Fig. 139). Consequently, an archaeological dating to Per. I or around the transition between Per. I and II is probable.

Nevertheless, three radiocarbon dates from Torslev both widen the basis for the dating and lead to further discussions of the chronology at the beginning of the Early Bronze Age as well as to considerations about Torslev's relationship to other contemporaneous sites (Fig. 8) (1). The dating based on the ceramic typology and the absolute datings apparently do not correspond. Previously, the situation was more straightforward as the radiocarbon dates from Egehøj and the northern site at Vadgård, which were virtually the only ones available, could be regarded as corresponding to Per. I and Per. II, respectively. The new datings from Torslev, together with the analysis of the pottery, undeniably reveal a somewhat more complex situation.

According to the classification and chronology worked out for the pottery from Early Bronze Age settlements (M. Rasmussen 1993a), Torslev and the southern site at Vadgård belong to ceramic phase 2, while Egehøj and Vejlby (Jeppesen 1984) must be placed in phase 1 (Fig. 2). However, the radiocarbon dates from the southern site at Vadgård correspond with the dates from Egehøj (K.L. Rasmussen 1993:157), while the dates from Torslev are even older (Fig. 8). Not just the pottery, but also the flint artifacts separate Torslev and Egehøj chronologically, as Torslev only contains a type VI-dagger, while Egehøj contains the well-known combination of miniature daggers of type V and VI (Boas 1983:99f.). Only Vejlby, from phase 1, has earlier dates than Torslev. Vejlby contains pottery of the same appearance as that at Egehøj, and collectively the radiocarbon dates from these sites could suggest a very long duration of the Egehøj-type pottery. However the situation is not so simple. Firstly, the question is whether the

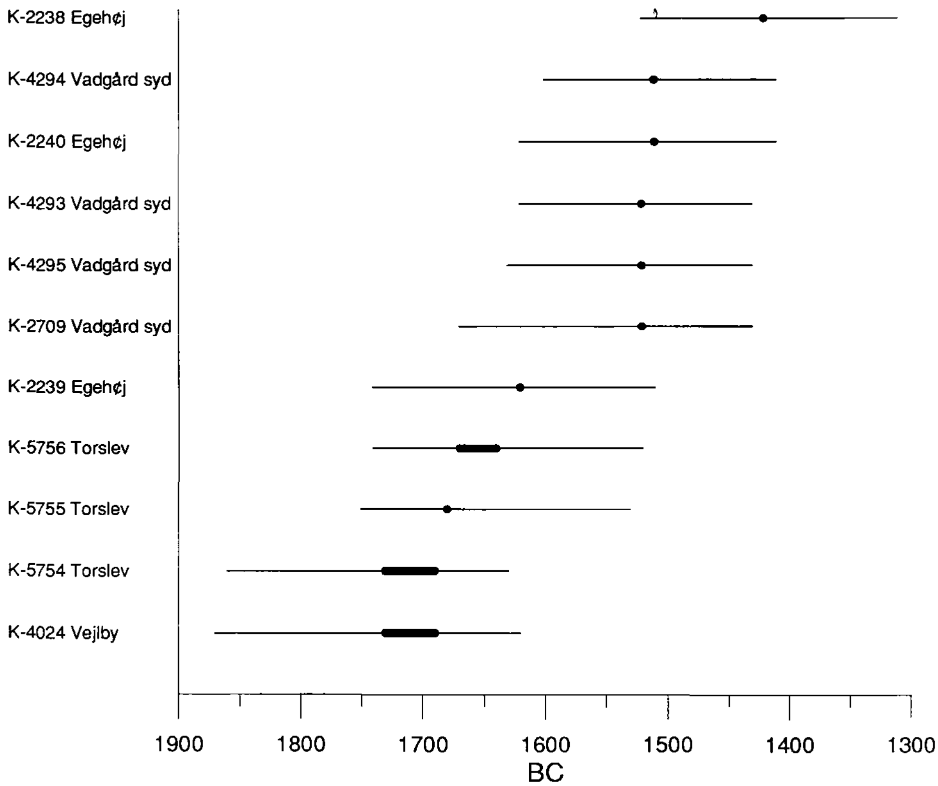


Fig. 8b. Radiocarbon dates with ± 1 standard deviation.

radiocarbon dates from Egehøj actually represent the same settlement phase as the main part of the pottery. The site certainly includes elements from the Late Bronze Age, but also other secondary elements from the Early Bronze Age (M. Rasmussen 1993a:121). Secondly, the dating from Vejlby cannot be regarded as absolutely reliable, as it is a small site with a dating from a structure that may contain other, secondary elements. With regard to both the ceramic typology and the radiocarbon dates, Torslev is definitely older than the northern site at Vadgård. Compared to the southern site at Vadgård, Torslev is contemporaneous with regard to ceramic typology, while the radiocarbon dates are older. This may either indicate that the pottery typical of Torslev also covers a long time-span, or that the southern site at Vadgård must be viewed as a transition between Torslev and the northern site at Vadgård. This question cannot be resolved, due to the small amount of pottery from the southern site at Vadgård.

So far, the pottery as well as the radiocarbon dates from Torslev and Egehøj form the most important basis for discussions of chronology at the beginning of the Early Bronze Age. The discrepancies and the lack of correlation may suggest regional differences in the development of the pottery, but without further evidence and analyses this hypothesis cannot be proved. It is clear, however, that the radiocarbon dates from Egehøj are not without problems, and they may not just represent Per. I. They may be too young, just as the datings from Torslev may be too old. The lack of correspondence between, on the one hand, the pottery and the house types at Egehøj and, on the other, the fairly young dates, is also emphasized by the fact that contemporaneous dates from other sites are connected with a possibly later, three-aisled house-type (Højgård, house I, Ethelberg 1993, Fig. 18).

## TOPOGRAPHY AND ECONOMY

Though both are located fairly close to the Limfjord, Torslev and Vadgård each represent parts of the large diversity which characterizes the settlements from the Early Bronze Age with regard to the surrounding topography. Torslev is situated in the middle of a plateau, about 35 m above sea-level, and with clear views in all directions. The ridge is located on an approximately 3 km wide and very hilly moraine tongue, which slopes down towards the Limfjord, surrounded by a raised sea floor (Johansen 1985:115). The topographical factors of its location form the basis for an evaluation of the resource potentials of the site. Despite the rather short distance to the Limfjord, the location faces inland and has traditional connections with areas suitable for arable agriculture (Fig. 9). This is apparent in particular from the local, hilly, well-drained landscape inside the 1 km zone. There is however no major watercourse here. With regard to the resource area inside a 2 km zone, a stream, Pallisvad Å, is reached to the west, and simultaneously the proportion of meadow or raised sea floor increases to 1/3 of the resource area. It is difficult to determine the importance of these wetland areas for the economic basis of the settlement, as we do not know the exact sea level in the Bronze Age. The banks of Pallisvad Å have offered potential grazing, but the hinterland to the north and west (approx. 2/3 of the area) is characterized by large, well-drained inland areas with good arable potential. In conclusion, the factors of location point to a position which is ideal for agriculture, but at the same time provides easy access to the fish and shellfish resources of the fjord. The distance across the channel of the Limfjord nowhere exceeds 4 km in this area, a fact that offers splendid possibilities for passage and communication.

Vadgård, on the other hand, is situated only 10-15 m above sea level, on top of a Littorina slope, which delimits the site to the north, and which falls steeply towards a wetland area bordering the present-day Limfjord. There can be no doubt that the original location was coastal (Fig. 10). Only about 1/3 of the area inside the 1 km zone can be characterized as suitable for arable agriculture. On the other hand, this area is well-drained and rises evenly to the south. The remaining 2/3 of the area at present consists of raised sea floor and was either open sea or a water meadow in the Bronze Age. However, a distinction must be made between the wetland to the north and that to the west of the site. The area of Vesterkær is sheltered by Højrimmen which is a rather large gravel bank (2). It may be that this area was an enclosed water meadow, while the area of Nørrekær, which at present still must be heavily drained in order for it to remain dry land, was perhaps open sea and thus

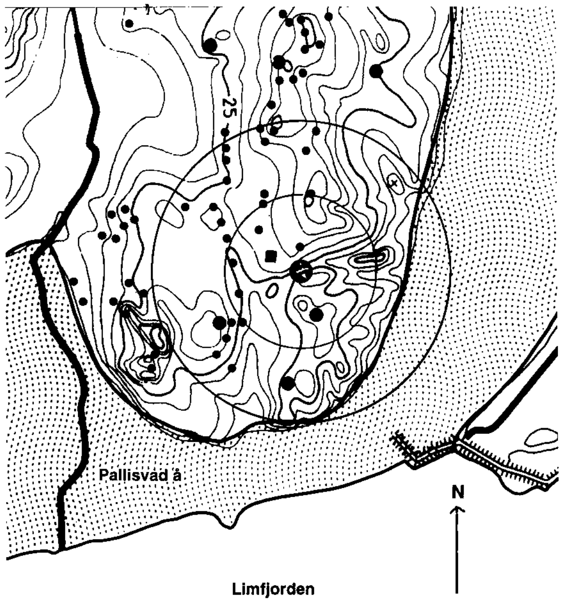


Fig. 9. Geomorphological map showing the location of the Torslev site. The larger dots indicate barrows dated to the Early Bronze Age. The square dot indicates the position of a ploughed over settlement site, sb.88. 1:50,000.

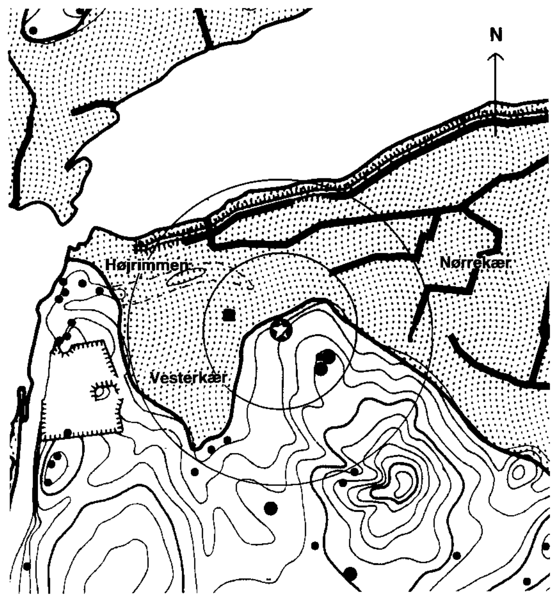


Fig. 10. Geomorphological map showing the location of the Vadgård site. The larger dots indicate barrows dated to the Early Bronze Age. The square dot indicates the findspot of the flintdagger, sb.36. 1:50,000.

the inner shallow part of the fjord. A flint dagger of type VI was collected in the Vesterkær area in 1976, in connection with a dark, oblong structure. Lomborg proposed that this structure could be an inhumation grave below ground level dating from the Early Bronze Age (3). If this interpretation is correct, then Vesterkær must have been dry land in the Bronze Age. Inside the 2 km zone, approximately the same relation exists between dry arable areas and wetlands, including meadows and the fjord. The narrow channel of the fjord, with a depth of more than 8 m, is reached at the far end of the zone. Before this point the fjord is fairly shallow. The broad, shallow section between Vadgård and the channel must have offered good opportunities for gathering shellfish and fishing for, for instance, flatfish and eel. The various factors reflect a location which primarily has attached importance to the access to the Limfjord both with regard to the exploitation of its resources and passage across, as well as access to large grazing areas. The sizes of the wetlands cannot be calculated exactly without better knowledge of the sea level in the Bronze Age. If arable areas had been the primary factors of location one would expect a differently located settlement.

The soil at each site consists mainly of moraine sand. The almost classical "Early Bronze Age location" of Torslev is confirmed by a dense distribution of other barrows in the neighbourhood (Fig. 9). However, only a few have been excavated and consequently dated. Inside the 2 km zone, there are six other barrows containing burials from the Early Bronze Age, but none are with certainty contemporaneous with Torslev. One is definitely considerably younger, as it dates from Per. III. At Vadgård the picture differs (Fig. 10). Apart from three located just south of the site (Fig. 4), the barrows in the vicinity are very scattered. Only two other barrows from the Bronze Age are present inside the 2 km zone. To this the aforementioned inhumation grave and the three barrows must be added. It was tempting to imagine a relationship between the three barrows and the settlement. For this reason they were investigated during the settlement campaign, but unfortunately none of them contained finds which can be related to the settlement in a chronologically convincing way (M. Rasmussen 1993b:178).

The finds from Torslev reflect a broad economic spectrum, mainly due to the excellent conditions for preservation for the time period in question. The gathering of oysters must have been important judging from the concentrations of shells. The preserved bones include examples from flatfish, cattle, sheep/goats, pigs, dogs and red deer – the latter are also represented by antler fragments (Nyegaard, this volume). Although the sample is small, it reflects a broad spectrum of species, and it is evident that the occupants of the site had all the common domestic animals, in addition to which they hunted as well as fished and gathered shellfish in the fjord. Agricultural activities are revealed by the presence of pressure-flaked sickles, impressions of cereal-grains inside vessels and ardmarks.

At first glance the ardmarks appear only to originate from a single criss-cross ploughing together with another ploughing direction to the north and west (Johansen 1985, Fig. 5). The latter was related to other finds with circular delimiting ardmarks, interpreted as ritual ploughing in connection with the construction of barrows (Johansen 1985:120). According to this hypothesis, the purpose of the ploughing was primarily to delimit the area of the subsequent barrow, and thus the fact that they could not be traced outside the barrow was explained. However, it appears on closer inspection that other parts of the area also contain traces running in the same direction as the northwestern ones. Likewise, the northeastern corner contains traces that cross the outline left by a delimiting ploughing direction: thus it does not delimit all existing traces. As the ardmarks thus represent two different directions in two different systems, the possibility exists that they originate from two different ploughings, which means that the area had been ploughed during at least two seasons (Thrane 1991:115). The ploughmarks in the northwestern corner are straight and cross each other at right angles. They do not form a neatly rounded circle, as can be observed at the suggested ritual ploughings (Wiell 1976, Fig. 8). This must mean that they originate from a real criss-cross ploughing, which normally is related to practical agricultural activities (Thrane 1991:116). Obviously, a congruent direction of all traces cannot be expected in order to suggest that they originate from the same system. At Gadbjerg, a stratigraphical documentation of two systems shows a deviation of 22.5 degrees between them (Thrane 1967:41). Subsequently, if we allow for a deflection of 10 degrees to each side of the main direction of the system, the proposed number of existing systems is not exaggerated. Especially not when compared with the small deflections, which are

Fig. 11. The possible two ploughing systems at Torslev. Redrawn after Johansen 1985, fig.5.

used elsewhere as a basis for isolating several systems (Fowler 1983, Fig. 44). Fig. 11 illustrates the two ploughing systems, that might be isolated at Torslev. Due to the lack of stratigraphical evidence, the chronological relationship between the two systems cannot be determined. At Gadbjerg, the younger system could be traced everywhere in the deeper layers together with the older system, despite a difference in the first observable level of 1 cm (Thrane 1967:41). Accordingly, the least well-preserved system at the level of the natural sub-soil is not necessesarily the youngest/last created, and conversely the best preserved one is not necessesarily the youngest, destroying the oldest. It may be a matter of different degrees of intensity in ploughing. It has often been proposed that a distinction must be made between several kinds of ploughing. Deep ploughing, which cuts through the former top soil and leaves traces in the sub-soil, perhaps represents a special kind of ploughing, different from that used in tilling the soil (Reynolds 1981:99ff.; Pedersen 1987:172; Thrane 1990:485).

The area under the barrow at Torslev may have been cultivated for several seasons prior to the primary burial and the construction of the barrow. Although this influences the estimation of the exact time span over which events took place, it cannot change the impression that it all took place very rapidly. If we discount the significance of the other small and scattered traces of a similar orientation, another possibility could be that the special orientation of the ploughing in the northwestern corner represents the remains of a field boundary. Field boundaries have been observed in a few cases (Thrane 1990, Abb.3 & 4; Bech 1991, Fig.6). This suggestion also implies, however, that cultivation took place over a longer period of time. The evidence for cultivation demonstrates the importance of agriculture as a part of the broad economic strategy on the site. The arguments in favour of ritual ploughing must be rejected no matter which of the above interpretations is correct. The cultivation of the area was not confined to a single, isolated ploughing, and the proposed delimitation is not consistent: it does not have the right shape, neither does it delimit all traces and it can readily be regarded as either another ploughing system or a field boundary. The conditions of preservation may explain why the ploughmarks are only visible inside the area of the barrow. The original suggestion that there had been ritual ploughing in connection with the later interment was founded on the missing vegetation layers between the sub-soil and the culture layer and the culture layer and the mound fill, respectively (Johansen 1985:117ff.). There may be other reasons for this phenomenon, such as the deliberate removal of the turf for other purposes or sand drift in connection with cultivation (M. Rasmussen 1993b:179ff.). All things considered, the period of cultivation may have lasted longer than previously suggested, especially if not all ploughing episodes have left traces in the soil. We know far too little about the preservation of ardmarks (Thrane 1991:112). In spite of this it still seems likely that all the events which took place on the site belong in the same cultural context.

The economic evidence from Vadgård is dominated by agricultural elements. In several areas ardmarks were observed during the excavation, which clearly indicates the integration of fields in the settlement area (Fig. 4). The ardmarks are not documented in the form of photographs or drawings, however, which means that the description is based solely on the information in the report. The report states that the main orientations were north-south and east-west, but also that various other orientations and varying distances between furrows

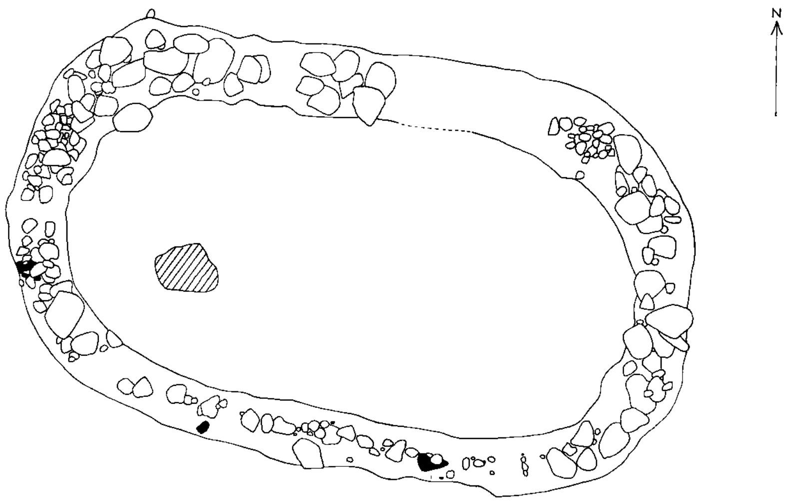


Fig. 12a. Vadgård Nord, turf-construction BJ. 1:100.

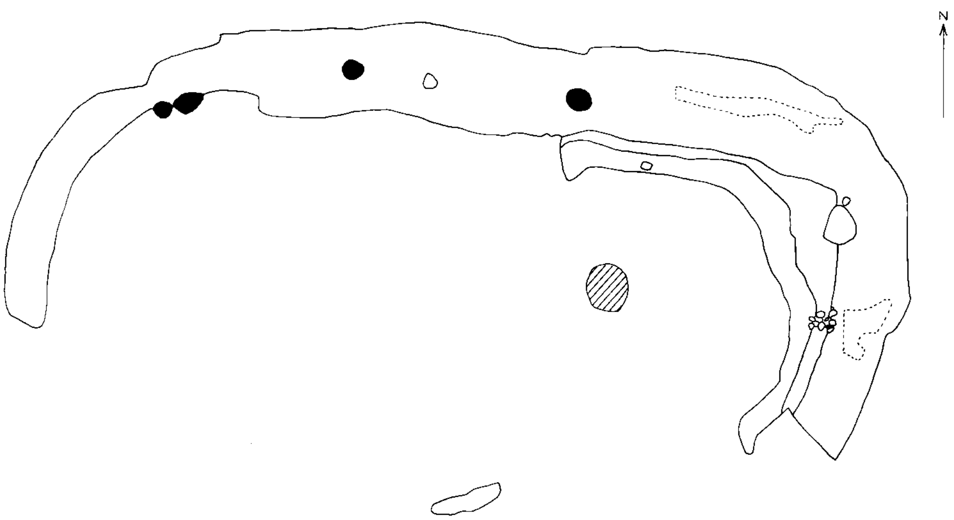


Fig. 12b. Vadgård Nord, turf-construction BG. 1:100.

could also be observed, indicating several different systems of ploughing. Other evidence of agriculture was present in the form of impressions of cereal grains in pottery vessels, pressure-flaked sickles and large amounts of quernstones. Of primary importance is the find of carbonised cereal grains, particularly of Spelt, but also of Naked and Hulled Barley as well as weed seeds from species common on arable land (Jørgensen 1979:136f.). The clear indications of agriculture from the finds at Vadgård are almost in contradiction to the locational indications with regard to the exploitation of resources. This is just as thought-provoking as the impression that the finds from Torslev, which is situated in a typical agricultural environment, reflect a broad economic spectrum.

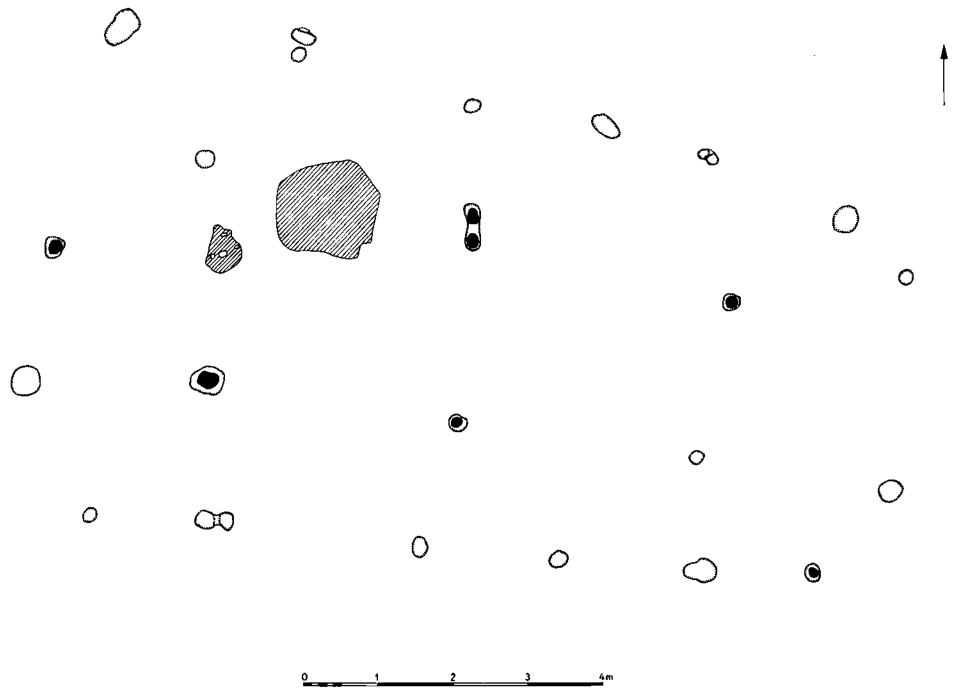


Fig. 12c. Vadgård Nord, post-built house BL. 1:100.

## SETTLEMENT STRUCTURE

In addition to the specific finds, the sites also provide other kinds of information concerning the activities and way of life. At Vadgård the house constructions form the most distinctive evidence. At Vadgård Nord there is a total of five houses or huts with thick, turf walls (Fig. 12). They only measure between 7-12 m long by 4-5 m broad, and occur in two versions: One, an oval construction totally enclosed by turf walls is generally a little older than the other, which has had a southern wall of a lighter construction (M. Rasmussen 1993a:69). None of the houses have internal roof-bearing constructions and only a few have a hearth.

Only a few parallels to these special house types are known. The very use of turf as a building material is a phenomenon well-known from historical times, which, in the case of the Islandic farms for example, must be due to the resources available. Whether this also applies to turf buildings from the Iron Age will not be discussed here, but with regard to both of these examples, each turf building represents a single farm-unit. Thus, they have presumably had a different function from the turf buildings at Vadgård. It is not certain that the archaeologically visible part of the construction – the buried wall-trench containing pieces of turf – necessarily represents the entire construction of the original wall. It may represent a buried foundation for a supplementary material which is no longer preserved. Stabilization of wooden walls with a base of earth or turf is known from, for instance, Hemmed Church, house I (Boas 1991:90). However, this is in the form of a footing placed on the surface to support the wall, not a buried foundation. At the same time it is difficult to imagine which supplementary material other than turf could have constituted the wall without leaving a single trace.

Rather than the actual building material, parallels to outline and size should be sought. Small, so-called U-shaped houses with a buried wall of earth or turf are known from sites in Rogaland in Norway (Løken 1989:143). So far, the oldest dated example of this house-type is from 3360±70 bp, but the type is apparently present throughout the Bronze Age and into the Pre-Roman Iron Age (Løken 1989:143f.). Some of the houses, for example, the house from Sandve, Ogna (Skjølsvold 1970, Fig. 3), are very similar to the ones at

Vadgård, where the buried walls enclose the whole house and where there is no internal roof-bearing construction. Others differ in that the buried turf wall has apparently only constituted one of the gables, while the other is not preserved, together with the fact that they contain internal roof-bearing posts. An example of this is a house from Forsand (Løken 1989, Fig. 3). From Denmark, the closest parallels are seen at Røjle Mose. They belong to the category without systematically placed internal roof-bearing posts and are dated to the Early Bronze Age (Jæger & Laursen 1983, Figs. 7, 9 and 12). That other examples must also be present, however, is demonstrated by a hitherto unnoticed Danish site, Skjoldhøj, which has a small building measuring 10.5 by 7 m. This house was constructed with a northern turf wall, an eastern turf gable, and more "normal" wall trenches to the south and west. Alongside the walls some posts were found, but an internal, systematic roof-bearing construction was lacking. This house did however contain a hearth. On the basis of the pottery, the house must be dated to the Early Bronze Age (4).

These constructions differ markedly from the two- and three-aisled longhouses of the Bronze Age and may have had special functions in connection with special economic conditions. Recently, a number of sites have revealed the presence of house types and constructions over and above the three-aisled longhouses (Boas 1993:123f.; Ethelberg 1993:147). They represent several different types, which may have had specific functions, but which are often just designated "economy buildings". The actual function of the turf buildings is difficult to determine. Together with an ordinary longhouse, a Dutch Hilversum-Culture settlement at Nijnsel in northern Brabrant contained some small horseshoe-shaped trenches (Beex & Hulst 1968, Fig. 4). They are interpreted as the possible remains of pits for storing root or tuberous crops because of their similarity to the trenches around potato and beet mounds which one finds nowadays (Beex & Hulst 1968:125). The structures from Nijnsel are smaller than the other parallels, but the suggestion that they have a storage function must be noted. The Norwegian structures are interpreted as dwellings in a specially adapted agricultural economy, differing from that which characterizes larger sites with three-aisled longhouses (Løken 1989:144ff.).

Any suggestions as to the function of the turf buildings must be based on various factors, such as location, interior arrangements, size and the special interior climate which exists due to the turf walls. It is not at all certain, that all buildings are to be interpreted similarly. The parallels at Røjle Mose and Skjoldhøj demonstrate that the houses at Vadgård are not to be regarded as a

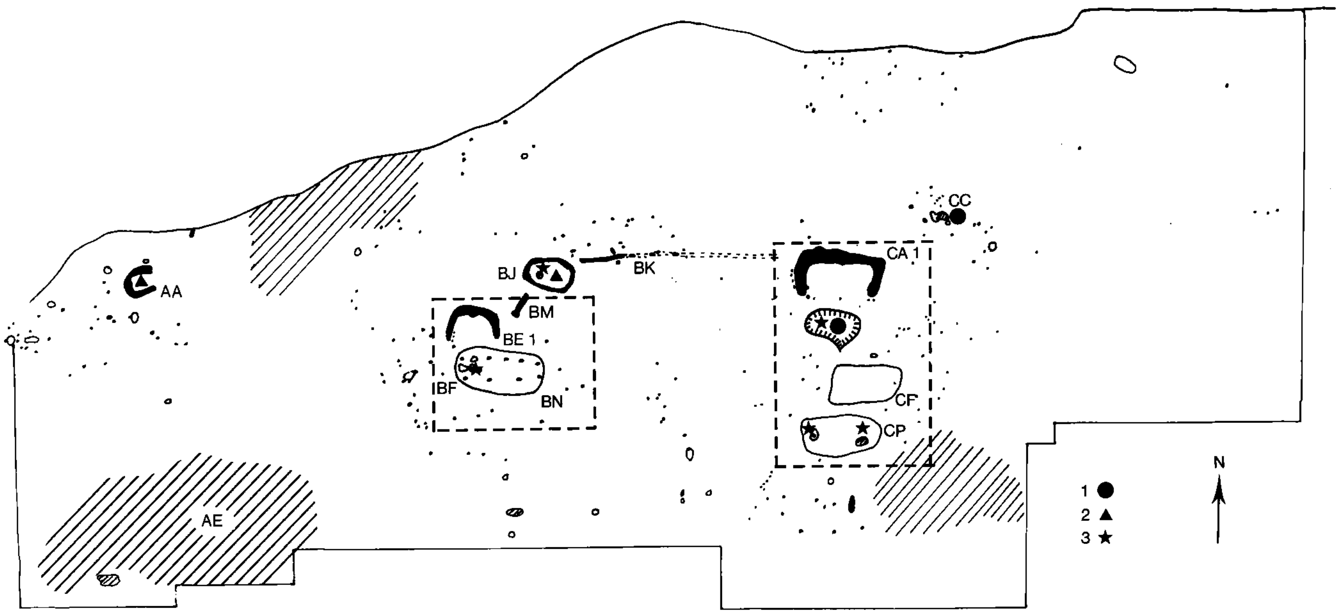


Fig. 13a. The building groups at Vadgård Nord, early phase. AE is the mentioned waste area. Legend: 1) structures older than the main phases; 2) single turf building with a special function; 3) hearth.

local phenomenon. The Norwegian houses, the houses at Skjoldhøj and Røjle Mose all contain hearths, while this only applies to a few of the houses at Vadgård. Buildings with hearths and the larger huts with internal roof-bearing posts may have functioned as dwellings, while the huts at Vadgård lacking hearths may primarily have been used for other purposes. The theory about storage buildings is tempting but seems difficult to combine with the interior climate of turf buildings. The interior has almost certainly been frost-free and warm; on the other hand the room must have been very humid, which makes it difficult to see the advantage of storing, for instance, foods like cereals, dried fish etc. However, there is no doubt that the huts provided shelter with their solid eastern, western and northern walls. An alternative to the theory that they were used for storage space may be a function as housing for cold-sensitive animals. However, also the accessible resources may have been a determining factor. Large grazing areas indicate that it was possible to obtain plenty of turf, while it is not at all certain that wood was easy to obtain. A reflection of which may be the small light post-built buildings. While the available resources may have determined the building material, the size and interior arrangement of these huts must be related to their function.

However, not only the turf buildings at Vadgård are small and short, when compared to other contemporaneous house types. The same also applies to the post-built houses, which measure ca. 12 m by 5-6 m (Fig. 12). The existence of these particular house types and the fact that so many different types are present at the same site, gives rise to further speculation as to the character and structure of the settlement.

A contemporaneous existence of all the houses is physically impossible. The results of radiocarbon datings and especially the observations of distinct phases in the turf buildings (i.a. fire layers and repairs) indicate that the site was inhabited over a longer period. When combining the different chronological information, such as absolute datings, the phases of the constructions, the stratigraphical relations and the mutual location, two main phases and a few older events can be separated at the northern site at Vadgård (M. Rasmussen 1993a:68ff.). In each main phase the buildings are divided into two separate groups in the eastern and the western sections of the site, respectively (Fig. 13). Neither the contemporaneous ones, nor the chronologically differentiated groups are completely similar, but each is made up of at least two different house types. It is characteristic that each group in both phases contains at least one turf building lacking a hearth as well as a

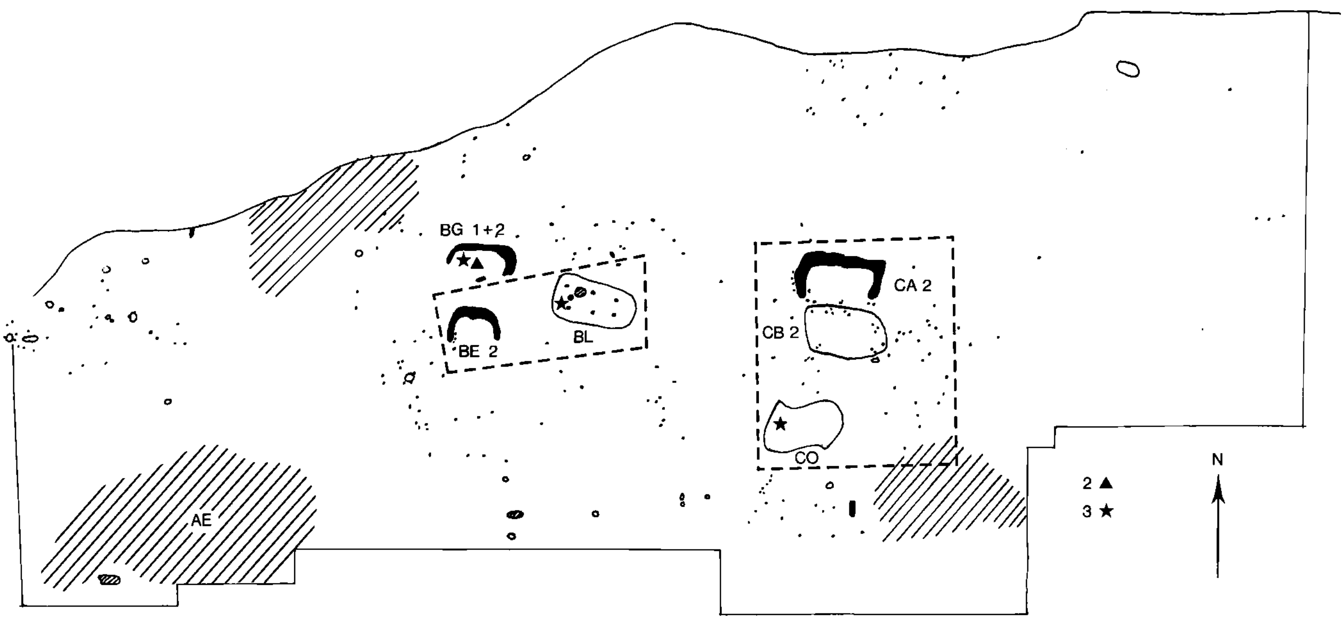


Fig. 13b. The building groups at Vadgård Nord, late phase. AE is the mentioned waste area. Legend: 1) structures older than the main phases; 2) single turf building with a special function; 3) hearth.

post-built house with a hearth. The division into two groups of contemporaneous buildings, the closeness of the buildings inside the single groups as well as the above-mentioned composition of house types, collectively suggests that the groups represent units that belong together. Each unit consists of at least one post-built dwelling-house and one so-called economy building made of turf. Apart from these central buildings, the western group in each main phase contains a single turf building with a hearth, which may represent quite another function, or which might have been used for housing a certain group of people.

The structure of Vadgård Nord during the two phases testifies to a settlement structure of a quite strong organisational character. Not only the buildings, but also the distribution of the finds, can shed light on the organisation of the settlement. It is well-known that bronze artifacts only rarely are found at these sites, but also the more common find categories – flint and pottery – usually occur only in very small quantities. The scarcity of finds, i.e. waste, is so striking for this period that rather than being merely accidental, the causes must have been culturally determined.

The majority of the pottery found at Vadgård comes from a huge concentration of waste in a single natural depression on the periphery of the site (Fig. 13), and from the wall ditches of the turf buildings. The latter group consists of large, well-preserved sherd collections deriving from whole vessels which have been deposited in connection with the foundation of the wall before the turf-building began. They probably represent deliberate depositions of a ritual nature (Lomborg 1976:418f). Only a very small amount of the pottery-waste comes from a few of the several pits in the area. Apparently this reflects a somewhat unusual deposition pattern, according to which the waste has been moved to the aforementioned depression outside the central settlement area. The specially selected character of the waste area is emphasized by the fact that six similar depressions did not contain finds but only material deposited by the wind.

The site at Torslev in itself is an example of this situation, where waste is deposited in a specific area selected for the purpose. As already mentioned, no structures were found in connection with the culture layer, which therefore does not belong to that part of the settlement, where buildings were erected. All the pottery from this site consists of waste from worn-out and bro-

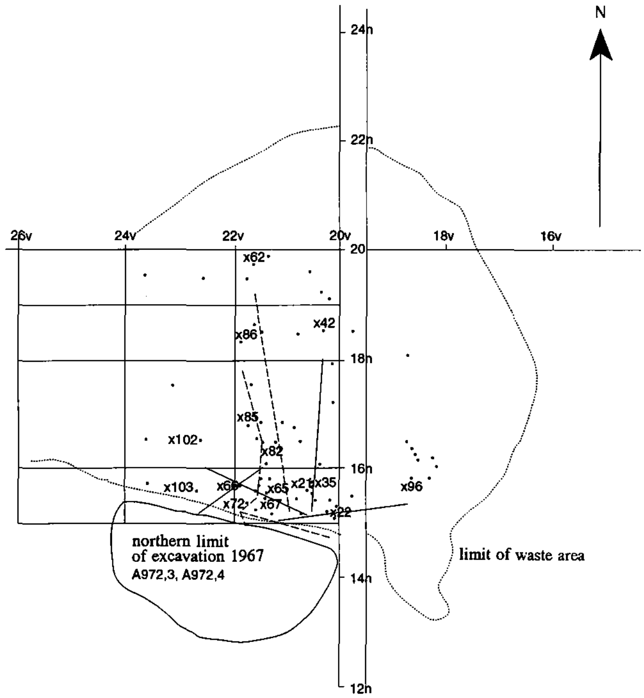


Fig. 14a. The horizontal distribution of pottery-sherds at Torslev. Lines indicate examples of different situated sherds from the same vessel.

ken vessels. Based on criteria of ware as well as shape, a series of experiments were undertaken involving refitting of sherds from the culture layer. These experiments showed that fragments from different levels and different surface-squares belonged to the same vessel (Fig. 14), and in a few instances they could be refitted to larger vessel fragments or almost whole vessels (M. Rasmussen 1993a:61f.). The pottery reflects a complete dispersal caused by the accumulation of completely accidental dumpings of waste. The totally homogenous character of the whole culture layer as well as the obvious affinity of the finds, physically as well as chronologically, demonstrates that the layer is one unit, accumulated over a short time-span. The large amount of waste, collected during a short time, demonstrates further that the area had been deliberately chosen for the deposition of waste. The site must be regarded as a midden or rubbish dump belonging to a no longer preserved settlement, the exact position of which cannot be determined. As the culture layer contains all sherd sizes, from large vessel fragments to very tiny pieces, it seems reasonable to assume that almost all the waste was

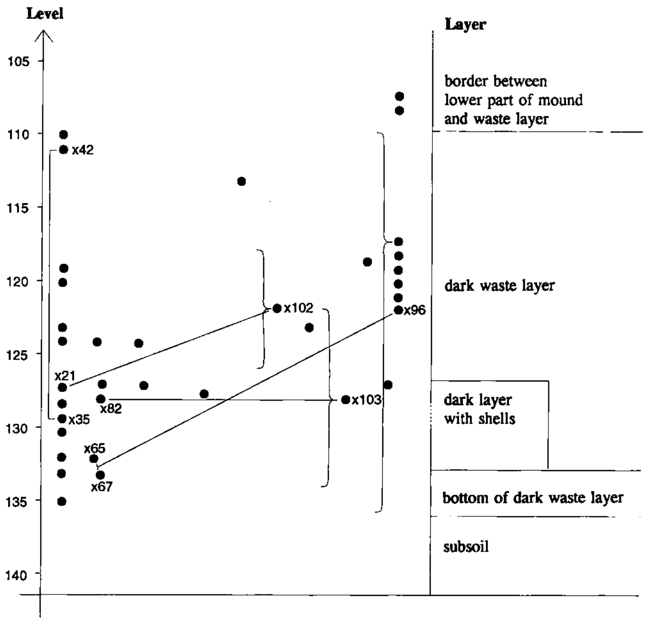


Fig. 14b. The vertical distribution of pottery-sherds at Torslev. Lines indicate examples of different situated sherds from the same vessel.

deposited here. The original extent of the dump cannot be determined. The reason for its preservation just under the primary barrow phase may be due to it never having been larger, or that what was outside was destroyed by ploughing already in prehistory before the construction of the secondary barrow phase (M. Rasmussen 1993b:182).

The Torslev midden is not an outstanding phenomenon, as more examples of such relatively rapidly accumulated culture layers with large amounts of waste are known. Dalsgård from Vester Hanherred is a very similar site where a pile of waste was preserved due to an overlying barrow (5).

The deliberate removal of waste to areas on the periphery of the settlement, where it either accumulates directly on the topsoil, in a natural depression or in an old pit, is an expression of settlement organisation and the general behaviour of the people. The pattern of deposition may be part of the explanation for the scarcity of finds from the majority of the known settlements from the Early Bronze Age.

## SUMMING UP

Torslev presumably only represents part of an originally much larger settlement area. The actual settlement with buildings was not preserved. The huge amount of waste accumulated through a short time span as well as other sites in the neighbourhood indicate relatively extensive settlement activities in the area (6). The rather rapid succession of the events on the site makes probable the suggestion that this represents a settlement unit which had been in existence during at least the first half of the Early Bronze Age. The location reflects what seems an ideal choice for a prehistoric agricultural society, but at the same time the finds emphasize that a very broad economic potential had been exploited, including the resources of the fjord.

Vadgård, on the other hand, presumably represents a complete settlement area with a succession of phases. The location was coastal, while giving access to grazing areas. The diversity of the surrounding landscape stands almost in contrast to the clear agricultural evidence of the finds. In addition to the location, the presence of particular house types also indicates a more complex production strategy.

Generally it is a problem that, due to their comprehensiveness and the conditions of preservation, finds indicating agriculture are often much more visible in the record than indications of other economic activities. The importance of cultivation is often overestimated unless several other factors are taken into consideration (Thrane 1984a:7f).

A certain behavioural pattern undoubtedly lies behind the organisation of the settlement area. Three aspects point in that direction: The distribution of the different house types at Vadgård reflects a well-organized settlement with two contemporaneous social and economic units. The deposition of waste also indicates an organised structure, and it is obvious to regard the purpose of the special midden areas as related to the economic strategy and the movements inside the resource area as a whole. The final aspect, the exploitation of the resource area, presumably rests on a complex principle of rotation which includes the integration of both arable fields, grazing areas, settlement areas and barrows (Thrane 1984b:116ff; Rasmussen 1993b, Fig. 9). Torslev and Vadgård are both examples of parts of this pattern. The stratigraphy at Torslev may thus reflect a whole settlement unit through, firstly, its dumping area, secondly sections of its field areas (the ardmarks in the culture layer) and finally part of the burial area (Fig. 3). Altogether it probably is the result of frequent movements inside a certain defined settlement and resource area. At the site of Vadgård, it is especially the relations between the two settlement areas that shed light upon this problem. The character of the pottery, its contextual aspects, and the particular house types, all point to a close connection between the two settlements (M. Rasmussen 1993a:70). It seems reasonable to interpret the southern site as the predecessor to the northern site. The fact that part of the southern site has been ploughed after abandonment (Fig. 4) perhaps indicates that the area later formed a part of the arable field area for the northern site (Lomborg 1980:122).

Vadgård and Torslev display identical as well as different traits. The characteristics in terms of topography and economy are different and indicate that the specific composition and priority of economic activities may differ between the settlements even though the various forms of economic activities are basically the same. A broad, compounded and varied economic strategy is, however, a shared trait.

## ECONOMIC VARIATION

There remains the question, whether this varied and complex economic structure is a regional characteristic. Until now, the Limfjord area in particular, has been known for a specific economic tradition which combines fishing in the fjord and small-scale farming.

As mentioned at the beginning, the known settlement sites are characterized by great variation. This may be due to several factors, but the differences between the settlements should be seen in relation to the exploitation of resources and economic strategy.

The character of the environment points to other examples: Røjle Mose in the northwestern part of Funen has a typical coastal location (Jæger & Laursen 1983, Fig. 5). As to the constructions, a direct comparison with Vadgård can be drawn, but the finds show greater variety. In addition to a small sample of carbonised cereal grains and some pressure-flaked sickles, a couple of oval stones with grooves were found, which, according to the excavator, were used as weights in longline fishing (Jæger & Laursen 1983:111f.). Røjle Mose belongs to the same chronological ceramic group as Torslev (M. Rasmussen 1993a:137f.).

Bjerre in the northern part of Thy is situated very low on an area of raised sea floor, which usually is not regarded as an ideal environment for an agricultural society (Bech 1991:41). However, the connection to the open coast line is delimited by the Hanstholm ridge (Bech 1991, Fig. 1A). The many settlements from the Bjerre area probably span most of the Bronze Age with the emphasis on the later parts (Bech 1991:43).

A far more ideal location in terms of agricultual activities is occupied by the settlement at Højgård (Ethelberg 1987:152). Højgård has a typical inland location on relatively high, dry and well-drained terrain surrounded by meadows and river valleys with grazing potential (Adamsen & Rasmussen 1993:140). Radiocarbon dates, stratigraphical factors and the pottery demonstrate that the site at Højgård covers several phases throughout the Early Bronze Age (Ethelberg 1987:161ff.; Ethelberg 1993, Fig. 19; M. Rasmussen 1993a:124).

The same applies to the site at Hemmed Church (Boas 1993, Fig. 23). Here, too, the location is inland on slightly sloping ground above the broad river-valley of Treå to the south (Boas 1991, Fig. 1). Even though the open coast is only 4-5 km to the north as the crow flies, the neighbouring environment mainly indicates ideal agricultural potential. The finds primarily reflect agricultural activities (ploughmarks, quern-stones, cereals, pressure-flaked sickles etc.) (Boas 1991:98 & Fig. 13), and pollen diagrams as well as the measurement of dust-deposition on the bog at Fuglsø only 11 km west-south-west of the site, both indicate an increase in open cultivated areas in the region (Aaby 1985, Fig. 5 and 6; Malmros 1991:110).

In connection with the sites at Bjerre the existence of an open landscape with sparse tree growth has been mentioned. In this region it is linked to grazing areas and live-stock, based on the evidence from pollen diagrams (Bech 1991:44ff.). Agricultural activities are, however, very visible in the archaeological record, including some of the finest examples of fields in Denmark, as well as evidence of extensive production of pressure-flaked sickles (Bech 1991:46ff.).

Various types of landscape are present, and the significance of the variation is demonstrated by the fact that it extends beyond the mere topographical location and includes the structures of the settlements as well. As already mentioned, Røjle Mose contained three constructions very much like the turf buildings at Vadgård, but not a single longhouse. At Højgård, as well as at Bjerre and Hemmed Church, regular post-built longhouses were found, although they display differences. In addition to the longhouses, Bjerre contained some smaller, circular post-built structures (Bech 1991:43 & Fig. 3). A semicircular feature was also found at Vadgård though the interpretation of this is open to discussion (M. Rasmussen 1993a, Fig. 19). The economic units must have consisted of several buildings with different functions. In comparison, on a site like Højgård, the individual houses seem to have been autonomous units. They are very similar in terms of interior arrangements, including for instance concentrations of cooking pits in the western part, yet the contemporaneous houses at the site differ for example with regard to length (from about 30 m to 16-17 m) and the presence of partition walls (Ethelberg 1987:156f).

The Early Bronze Age is characterized by a number of different kinds of settlement in different kinds of environment. Even when the economic strategy of the various sites cannot be compared directly due to insufficient evidence with regards to the specific composition of economic activities, other aspects testify to the diversity among the sites. Detailed investigations of the finds from the sites, as for instance the aforementioned comparison of flint tools, reflect marked and significant differences in the assemblages. There seems to be no simple connection between the preferred location and the economic activities indicated by the finds. Features such as the exploitation of the coastal environment, a characteristic of the sites at the Limfjord, can also be found elsewhere.

The topographical location, the relationship between exploited resources, circumstances of continuity and systems of rotation are all very important aspects of the organisation. The relationship between buildings and other structures with different functions as well as the pattern of deposition reflects an organized settlement area. A settlement like Vadgård cannot be characterized as a village with a clear division between several contemporaneous economic units (cf. Lomborg 1973; 1976). Vadgård should rather be seen as series of successive occupations by a few (but not single) social and economic units consisting of a complex of buildings and structures. It is tempting to regard the removal and concentrations of waste as an expression of more permanently used settlements. The exploitation of the manuring potential of former settlement areas for later arable areas should be considered a possibility (Thrane 1984b:117f.).

Varied exploitation of several different resources must have been practised. The composition and relationship between these have differed from place to place in connection with the location of the site and other aspects. However, the individual settlements have not been isolated from each other which the mere fact of the wide distribution of the bronzes demonstrates. The presence of various types of houses and structures in the Early Bronze Age are not only due to chronological, but also to functional and socio-economic factors (M. Rasmussen 1993a:142f.).

According to Harding, it is not realistic to assume an agricultural surplus as a basis for participation in the exchange of bronzes. The settlements have only been capable of producing food and, for instance, providing storage space for local consumption and eventually for small-scale exchange with the nearest neighbours (Harding 1984:143). It is not a question of a measurable surplus of production based on, for instance, large-scale production of cereal or cattle. Perhaps the variation itself regarding economy and production can be the key to the problem. With the exploitation of a broad spectrum of economic resources, the individual settlement would be able to contribute to and participate in the superior societal interaction. Not a large-scale production, but rather a differentiated production, may have determined the economic dynamics in this society. This applies both to the individual settlement and to the relationship between the communities. The participation in the bronze exchange systems was not based on surplus in the traditional sense of the word, but rather on the diversity of the subsistence-economy and on extensive circulation and communication.

There was a change affecting a number of factors important for the economy towards the end of the Early Bronze Age, which indicates a limited duration of the outlined characteristics. It is claimed, that an open landscape was created in the middle of the Bronze Age, when a cultural landscape really came into being (Jensen 1988:162f.). This assumption is based on several scientific analyses carried out during recent years (Andersen, Aaby & Odgård 1983; Aaby 1985 and 1986; Malmros 1991). However, only the landscape and vegetational history of single regions have been mapped. To what degree the landscapes and their development were similar or different, and when and how fast the regional changes took place is not yet clear. Some variations of this picture should be expected. For instance, it is not at all certain that the scarcity of wood in Thy also applies to other areas. The changes in the economy and exploitation of resources may not have taken place simultaneously everywhere and may not have been of the same extent. For that reason it is not possible to determine the general significance of the creation of the open cultural landscape. However, it is not unreasonable to assume a somewhat different economic structure after the years around 1000 BC.

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NOTES

1 Radiocarbon dates from Torslev (calibrations according to Pearson and Stuiver, 1993, calibrated ±1 standard deviation), published in agreement with Erik Johansen:
K-5754 charcoal: 1470 ±70 bc (1740 BC cal.). Central part of the culture layer.
K-5755 charcoal: 1440 ±80 bc (1730-1690 BC cal.). Central part of the culture layer.
K-5756 shells: 1410 ±80 bc (1680 BC cal.). Central part of the culture layer.

2 I am not aware of the existence of any comprehensive scientific study which has determined exactly the age of these "rimme". They are a well-known phenomenon in the Limfjord area, though, and on one situated on the western coast of Himmerland settlement remains were found dating to the Atlantic period. Søren H. Andersen, Moesgård is thanked for kindly providing this information.

3 Højrimmen. Næsborg parish, sb.36, Ålborg county, NM 1976/1806. Bent Jensen, Løgstør, is thanked for further information about this find, circumstances of discovery, etc.

4 Skjoldhøj. Brabrand parish, sb.45, Århus county, FHM 1812. Excavated in 1974 by Torsten Madsen, Moesgård, who is thanked for drawing my attention to the site and for permission to mention it.

5 Dalsgård. Tømmerby parish, sb.138, Thisted county, THY 2150. Excavated in 1985 by Jørgen Seit Jespersen, Værløse. Description in "Archaeological Excavations in Denmark", 1985 p.93. The site consisted of a compact and homogeneous culture layer sealed by a barrow with a primary burial from Per. II. The layer was separated from the mound-fill by a thin vegetation layer, but neither other layers nor structures were found. The site contained pottery, charcoal and flint. Among the tools must be mentioned pressure-flaked flint sickles of the "Jutish type".

6 An example is a ploughed-over settlement site, positioned just 250 m northwest of Torslev, where pressure-flaked flint was found during surveying. Torslev parish, sb.88, Hjørring county, ÅHM 945.

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Journal of Danish Archaeology vol. 11, 1992-93, pp 108 – 110

# Animal Bones from an Early Bronze Age Midden Layer at Torslev, Northern Jutland

by GEORG NYEGAARD

## INTRODUCTION

There are to date only a few known samples from Denmark of animal bones from settlements dating to the Early Bronze Age. This is a natural consequence of both the relatively small number of sites from the period which has been excavated, and of the preference for siting such settlements on well drained, sandy subsoil. The latter provides generally unfavorable conditions for the preservation of organic refuse. In the collections at the Zoological Museum in Copenhagen there are only four such finds, including that from Torslev. All of them consist of rather small numbers of bone fragments (1).

In 1982, Aalborg Historical Museum excavated a midden layer preserved beneath a small burial mound, which was situated on a hilly moraine a short distance from the Limfjord, and about 30 km west of Ålborg (Johansen 1985; Rasmussen 1995, this volume). The layer is presumed to have accumulated over a rather short period of time during the first half of the Early Bronze Age. It lay over a sandy subsoil and contained typical settlement debris such as pottery, flint, animal bones, oyster shells and charcoal. The preservation of the animal bones was partly due to the presence of oyster shells in the southern part of the deposit. Outside that area the bones had more or less decomposed (Johansen 1985:118).

## MATERIAL

In all, 112 animal bone fragments, with a total weight of 342 grams, were retrieved from the midden. Only one fragment, an *os anale* of a flatfish, belongs to the marine fauna (2). Of the remaining 111 mammalian bones, 42 have been identified either to species (20 fragments) or two alternative genera (22 fragments), see Table 1. The identified bones include the following anatomical parts for each animal group:

### *Dog*

A canine from right lower jaw.

### *Pig*

The root of a milk tooth incisor from lower jaw; a rib fragment; greater part of a right ulna; a small fragment of fibula. – Minimum number of individuals: 1.

### *Red deer*

Four antler fragments; a molar from upper, left jaw; a diaphysis fragment of a metapodium. – Minimum number of individuals: 1.

### *Sheep/goat*

A skull fragment (piece of temporal bone); an upper right molar (fragmented); an incisor; one left and two right molars from lower jaw (none of them complete); two rib fragments; a fragment of ulna; lateral half of the proximal end of a right metacarpus; a diaphysis fragment of metacarpus; a diaphysis fragment of femur; middle part of the shaft of a right tibia; three diaphysis fragments of tibia; a fragment of the proximal end of a left metatarsus; middle part of the shaft of metatarsus; a diaphysis fragment of metatarsus; three diaphysis fragments of metapodials. – Minimum number of individuals: 2.

### *Cattle*

Fragments of a molar from upper jaw; fragment of a milk tooth from lower jaw (dp4); a left molar from lower jaw (M1/M2) (from a juvenile); fragment of sacrum; middle part of left ulna; lateral part of the proximal end of a left metacarpus; a diaphysis fragment of metacarpus; middle part of the diaphysis of left tibia (from a juvenile); a diaphysis fragment of a right tibia; distal part of a proximal phalanx. – Minimum number of individuals: 2.

The majority of the recovered bones has an orange-grey or orange-brown patina, and their state of preservation is fairly good. Ten fragments have either been burned or otherwise damaged by fire, while a single bone has been gnawed by dogs. Seven fragments show traces of having been deliberately worked, these include:

No. 946 X 97 (see Johansen 1985, Fig. 4, middle): Section of a tine of red deer antler (L = 8,0 cm) with an old breakage towards the root, at an 1,8 cm wide, cylindrical shafthole, half of which is preserved. At the tip the tine has been worked from two sides to form a narrow, vertical edge, which is now missing (partly recent breakage).

No. 946 X 102 (see Johansen 1985, Fig. 4, top): Outer part of a tine of red deer antler (L = 7,2 cm), with smoothed surface, and an old, irregular fracture towards the root. The tip has been worked from two sides, probably by grinding, to form a narrow edge, the point of which is broken. It is likely, that there has been a shafthole on the missing part of the tine.

Implements of this type occur now and then in South Scandinavian settlements dating to the Late Bronze Age (e.g. Stjernquist 1969:129, Fig. 48). In particular, there is a rich bone find from Ängdala at Sallerup, near Malmø, which includes several antler tines that have been worked in exactly the same way (unpublished) (3). As single stray finds, this type may easily be confused with the so-called antler "chisels" belonging to the Ertebølle Culture (Andersen 1981:12).

No. 946 X 88 (Fig. 1): Middle section of the diaphysis of a right tibia of sheep or goat (L = 6,4 cm) sawn off distally and with irregular breakage proximally. A ring of cutmarks, perhaps stemming from incipient sawing, encircles the diaphysis just below the breakage. Furthermore, a line of cutmarks is seen running lengthwise, and finer marks on the surface show that the bone has been smoothed. At the distal end the marrow cavity has

Fig. 1. Worked middle section of the diaphysis of a right tibia of sheep or goat showing cutmarks. Photo: Gert Brovad. 1:1.

Fig. 2. Distal end of the bone shown in Fig. 1. The marrow cavity has been enlarged by drilling. Photo: Gert Brovad. C. 1:1.

been enlarged a little by drilling (see Fig. 2). The upper third has been damaged by fire, indicating that the bone may have been used as a mouthpiece for a kind of bellows.

A splinter of a long bone (L = 9,9 cm) from an animal of the size of a cow has been shaped from two sides into a blunt point (no. 946 X 10). A long bone fragment (L = 3,3 cm), probably from either a sheep or goat, forms part of a carefully made awl or needle (no. 946 X 2). A small fragment of metatarsus (L = 2,2 cm), also belonging to a small ruminant, has been split longitudinally through the natural furrow that runs along the diaphysis (no. 946 X 96). Finally, this artefact group also includes a further small fragment of worked antler (no. 946 X 96).

## CONCLUSION

In spite of the small size of this bone sample, it gives a glimpse of a varied faunal exploitation. The inhabitants of the Torslev site kept a range of livestock, that included the most common domesticated animals. Compared to bone collections from the Late Bronze Age, only the horse is missing. Yet this animal may very well have been a member of the domestic livestock, as its remains occur on other sites dating to the Early Bronze Age, for instance Bjerre, near Hanstholm, in North West Jutland (1). Red deer were hunted in the surrounding countryside, and the apparently frequent use of their antlers for tool production indicates harvesting of the yearly shed antlers. Fishing took place in the Limfjord, as well as the gathering of shell fish (oysters), which seems to have been a common activity.

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NOTES

1 In addition to Torslev, the following three finds dating to the Early Bronze Age have produced animal bones: Bjerre (Thisted Museum, file no. 2728) (Bech 1991); Rumohrsgård (Haderslev Museum file no. 1659); Vester Kærby (Fyns Stiftsmuseum file no. 181/72).
2 Identified by Inge Bødger Enghoff, The Zoological Museum, University of Copenhagen.
3 The site was excavated by Ulf Säfvestad, Malmö Museum (file no. MHM 6120).

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| | | | | |
|---|---|---|---|---|
| PISCES: | *Fragments* | | | |
| Flatfish, *Heterosomata* | 1 | | | |
| MAMMALIA: | *Fragments* | *(Pct.)* | *Weight* | *MNI* |
| Dog, *Canis familiaris* | 1 | (3) | 2 g | 1 |
| Pig, *Sus domesticus* | 4 | (10) | 20 g | 1 |
| Red deer, *Cervus elaphus* | 2 | (5) | 22 g | 1 |
| Sheep/goat, *Ovis aries/Capra hircus* | 22 | (56) | 51 g | 2 |
| Cattle, *Bos taurus* | 10 | (26) | 128 g | 2 |
| Sum | 39 | (100) | 223 g | |
| Antler pieces: | | | | |
| Red deer, *Cervus elaphus* | 3 | | 50 g | |
| Unidentified | 2 | | 4 g | |
| Unidentified mammalian bones | 66 | | 65 g | |
| Sum | 110 | | 342 g | |

Table 1. Animal bones from Torslev.

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# *The Chieftains' Farms of the Over Jerstal Group*

by PER ETHELBERG

During the past ten years several sites of the Early Roman Iron Age have been excavated in south Jutland. Excavations in the NE of the area near Vojens, Haderslev and Christiansfeld have yielded particularly valuable new information about settlement in this period. The objects of investigation include fenced and unfenced villages: Ndr. Ringvej in Tyrstrup (1), Galsted (2), and Ladegårdsvænget (3); there were also isolated large farmsteads: Hammelev Nørremark (4), Kærbølling (5) and Stepping Mølle (6); cemeteries: Frørup (see Christensen 1988) and Stepping Mølle (7), and an enclosure with surrounding ditch at Favrvrågård (see Madsen 1987) (8).

Of particular interest are isolated large farms of a type not earlier recorded within the area of the Over Jerstal cultural group. Only those at Hammelev Nørremark and Stepping Mølle have been excavated in full, and they are the subject of this preliminary report (Fig. 1). Stepping Mølle is particularly important because the cemetery was found and excavated as well as the settlement.

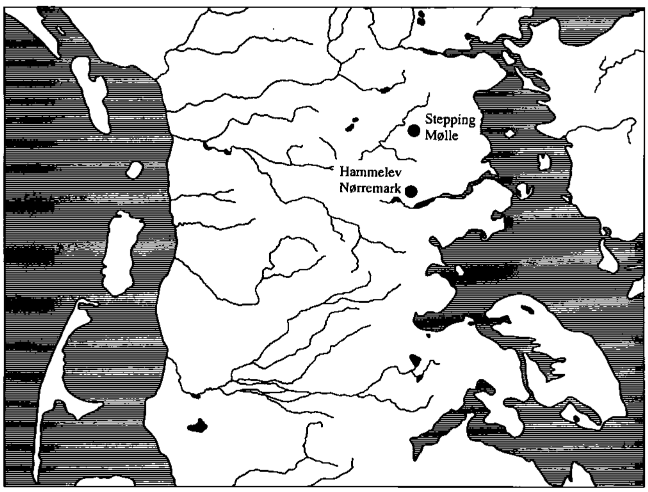



Fig. 1. Location of the settlements at Hammelev Nørremark and Stepping Mølle in southern Jutland.

## HAMMELEV NØRREMARK

In 1990 three areas with settlement traces from the Early and Late Iron Ages were discovered when an area of 10 hectares west of the motorway between Vojens and Haderslev was laid out as an industrial area (Fig. 2). This is a typical dead-ice landscape characterized by elongated and round-topped hills with intervening hollows. The natural deposits are therefore very variable, and even over short distances can change from sticky clay to stony gravel or silty sand. The hollows contain peat deposits of very different thickness and composition.

### *"The small farm"*

In the east there was excavated an area of ca. 2,300 square meters, where a small farm was found (Fig. 3). It included a ca. 11 m long and 3.5-4 m wide building (X), protected on the east by a curved palisade, which started from a low wet area close N of the building and could be followed for more than 16 m in a southerly direction. Even taking into account that the trench of the palisade grew shallower southwards, it is unlikely that it ever went all the way around the building. 25 m NE of this building were found three small granaries (XI, XII, and XIII), which certainly belonged to the farm. Trial trenches established that there were no further structures to the north or south, and on the two other sides the farm was bounded naturally by steep slopes descending to lowlying wet areas.

The farm was probably only in use for a short time, for only a single building phase could be identified. In building X a single roof-bearing post had been renewed. The farm is dated by pottery to the Early Roman Iron Age (Fig. 4).

A small number of pits were found between the buildings. The majority of them must have been con-

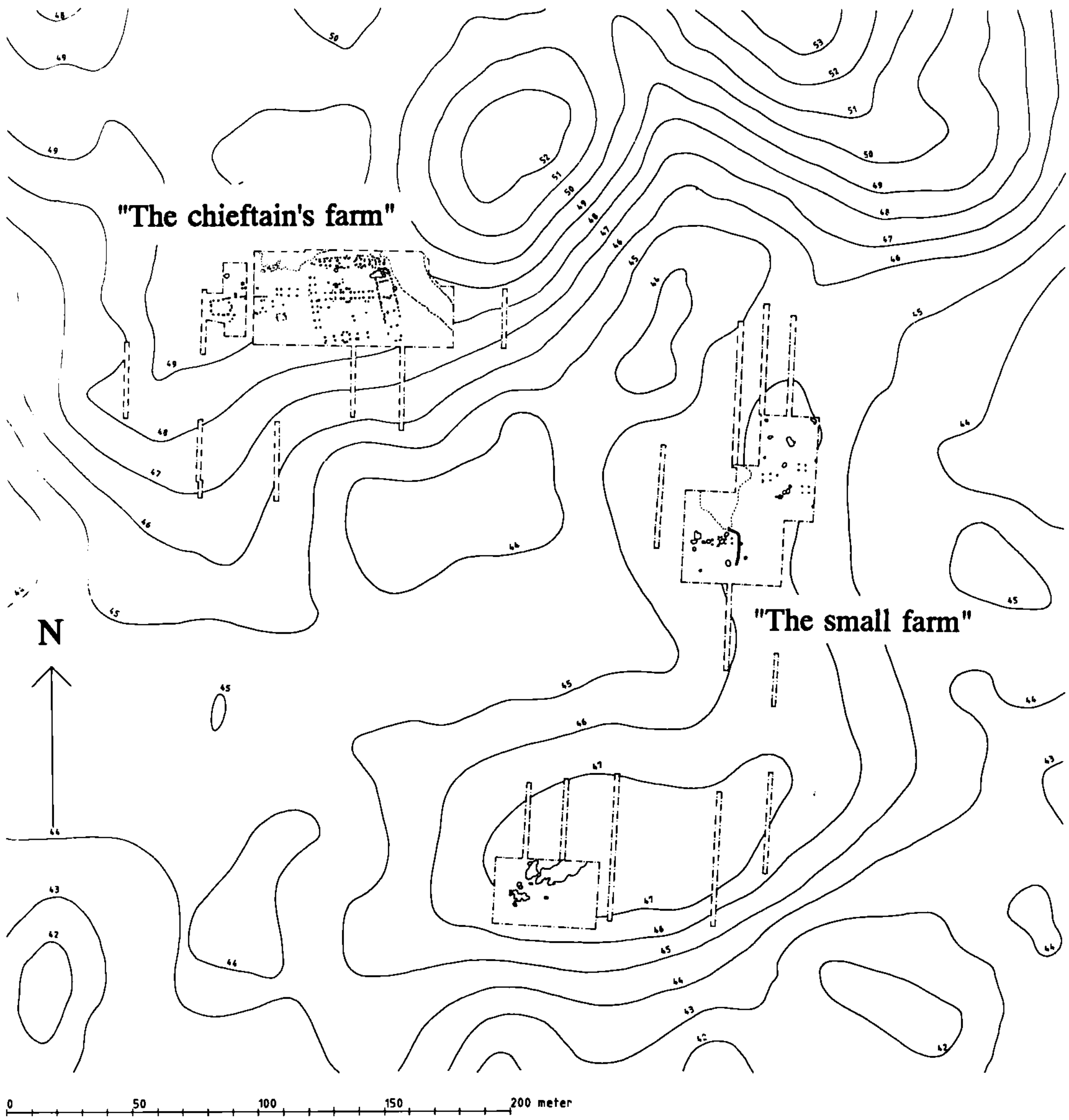



Fig. 2. General plan of the excavations at Hammelev. 1:3000.

temporary with the farm as they contained sherds of the same types as found in the main house. Several nearly complete pots could be reconstructed (Fig. 4).

### *Western settlement remains*

To the west an area of about 3,000 square meters was opened. Here there were found a large farm from the Early Roman Iron Age, an isolated farmstead from the Early Viking period, and an activity area datable mostly to periods II and IIIa of the Pre-Roman Iron Age.

### *The Pre-Roman activity area*

This consisted of pits and an occupation layer formed in a damp hollow north and east of the later farm. Of particular interest was a pit containing a large number of more or less reconstructible pots. All the sherds (Fig. 6) lay pressed against the sides of the pit. This seemed more likely to be a ritual than a rubbish pit. There was

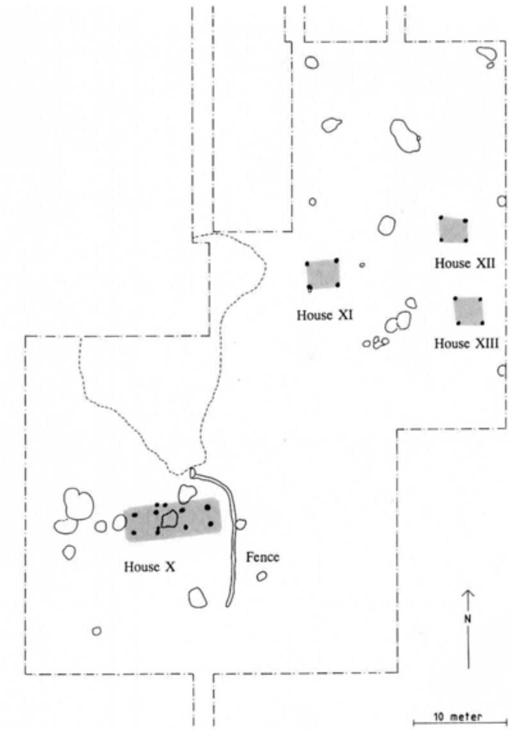
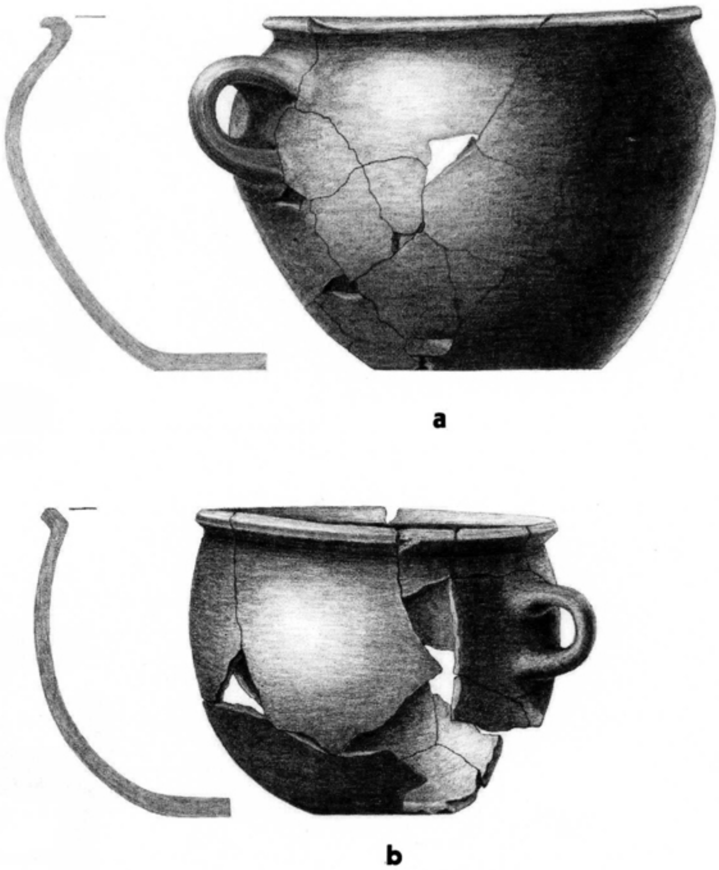



Fig. 3. Hammelev Nørremark. "The small farm". 1:800.



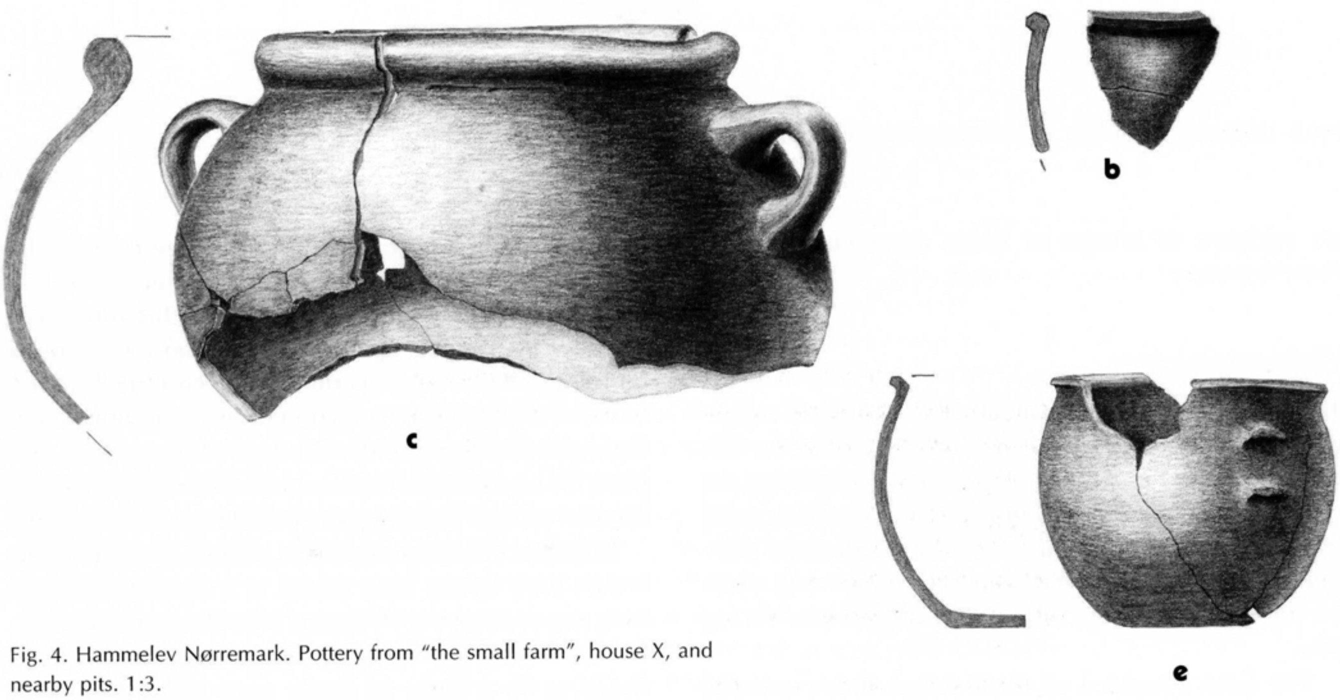




Fig. 4. Hammelev Nørremark. Pottery from "the small farm", house X, and nearby pits. 1:3.


Fig. 5. Hammelev Nørremark. The chieftain's farm phases 1 and 2. 1:800.

no evidence of houses or farms contemporary with these features.

### *The chieftain's farm*

This was situated on the east end of an elongated roughly E-W orientated plateau and was bounded on the south, east, and north by damp hollows containing occupation earth, which curiously enough was from a different period than the farm. On the north there were found sherds from the Pre-Roman Iron Age only, while on the east there were also sherds of globular Viking pots.

The farm consisted of three large, nearly parallel three-aisled longhouses – III, IV, and V. On the west the farm was sheltered by a N-S orientated structure following a fence line – VI – which united the buildings into a whole (Fig. 5). It is open to discuss whether this was a building, a fence of posts that had been renewed, or a fence of double posts. Interpretation as a building conflicts with the slight southward slope of the surface, and posts for an entrance have not been identified; also the number of roof-bearing posts would be unusually large.

In favour of interpretation as a fence of single posts, is that such fences have found at a number of other sites, e.g. at Stepping Mølle and Ndr. Ringvej in Tystrup. On the other hand the posts seem to stand too symmetrically to be a fence of single posts with two phases, while the distance between the two rows would be excessive in a fence of double posts.

Similar fence buildings are known from a contemporary large farm at Kærbølling, where they run both E-W and N-S. The most natural explanation is therefore to regard the posts as remains of a fence building. What the feature most reminds of is the fence buildings with ridged roof from the Late Roman and Early Germanic periods. Perhaps it is precisely in the Early Roman fence building that we should look for the origin of the fence buildings with ridged roof of the Late Roman period.

Building III is recognizable in two phases. In the older it was about 26.5 m long with its greatest width of 4.5 m near the two opposing entrances, whereas the width at the ends was only about 3.5 m. There were 7 sets of roof-bearing posts – three west and four east of the entrances. The side walls were strongly curved, but the shape of the ends was indeterminable owing to the small number of postholes traced. Neither fireplaces nor stall divisions could be seen. There is some resemblance to a Viking longhouse, but it differs from these in the absence of roof-bearing posts in the end-walls and in details of the entrance section. Also the wall postholes are rounded instead of rectangular.

In the later phase the eastern end of the building was reconstructed, perhaps because it was originally more lightly built than the western, cf. the smaller dimensions of the roof postholes. The ground plan was made less boat-shaped, and the outer walls less curved. The northern row of roof-bearing posts was replaced and moved about 0.75 m northwards, which called for a corresponding replacement of the northern wall. The same may also have been done with the southern wall, but the postholes are less well preserved. The southern roof post in the pair nearest the entrances was also replaced and moved slightly northwards. The southern wall was shifted westwards, and an extra set of roof-bearing posts was inserted between the last and penultimate pairs in the western end.

Building IV was more rectangular in shape. It also had two phases. In the earlier it measured 15 x 5.5 m and had five pairs of roof-bearing posts – two west of the two opposed doorways and three east of them. In the younger phase the building was considerably lengthened, coming to measure 23 x 5.5 m with seven sets of roof-bearing posts – three west and four east of the entrances.

Building V could only be followed for a single phase

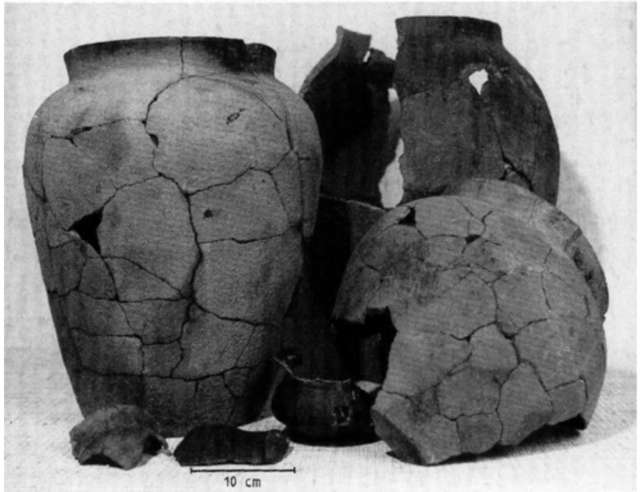



Fig. 6. Hammelev Nørremark. Pottery from the ritual pit.


Fig. 7. Hammelev Nørremark. Pottery from the chieftain's farm. 1:3.


Fig. 8. Hvesager. Top: after Hvass (1988) and Mikkelsen (1991). Below: alternative interpretation. 1:800.

and was completely symmetrical around the two opposed doorways. Its dimensions were 21 x 4.5 m and it had six pairs of roof-bearing posts.

Fence building VI consisted of eight pairs of roof-bearing posts standing slightly closer together than in the long buildings III, VI, and V (1.5 – 2 m). The smallest length it could have was 22 m, and its largest possible width 4 m. Entrance posts were not observed. It is impossible to establish whether the roof-bearing posts stood in the line of the wall or inside the building, or whether there was a wall only on the side away from the farmyard.

Buildings III and IV are dated to the Early Roman period by pottery, which included comb-ornamented wares (Fig. 7). The farmstead had four buildings, and was in use for a substantial time, for one of the buildings was completely rebuilt and another considerably altered. The entire complex measured 30 x 35 m, and may certainly be called a chief's farm. The enclosed area was twice as large as at the somewhat older chief's farm at Hodde (Hvass 1985).

However there are considerable differences from the contemporary big farm at Hvesager near Jelling (Hvass 1988: 64; Mikkelsen 1991). The Hvesager farm was more than twice as large and consisted of eight buildings enclosed by a fence of double posts.

One reason for the difference could be that the Hvesager farm belonged to a different cultural group, but an alternative explanation is that the Hvesager complex was really three similar farms of about the same size as the one at Hammelev Nørremark. At least six farms of this kind formed the youngest phase of the village at Galsted, which is pottery-dated to period B2. This reinterpretation is in no way incompatible with the published plans, for some possible fence lines starting from the main buildings in the middle could imply such a division. Unfortunately the most important part of the area could not be excavated (Fig. 8). If these thoughts are correct, the Hvesager complex could only be a village settlement of the same type as Galsted.

Phosphate analysis at Hammelev Nørremark seems to show that the three-aisled longhouses served different functions (Fig. 9). The southern building had no phosphate and must have been residential. In buildings III and IV the phosphate concentration was about equal in the eastern and western parts. Though the levels of phosphate are modest, they are substantial in the context of the phosphate map of the whole area. A possible reason is that the phosphate samples were taken after removal of the topsoil.

The phosphate could imply that both buildings served as byres. But why two byres? The lesser width of building III as compared with IV, in combination with the generally slightly smaller phosphate concentrations, could suggest that it was used for small stock like sheep, goats and pigs, while building IV perhaps was used for larger animals such as cattle and horses. Comparison with the Hodde estimates shows that building IV could have housed 45-55 head of cattle.

Fence building VI showed a marked increase northwards in phosphate content, which supports the interpretation that it was a building.

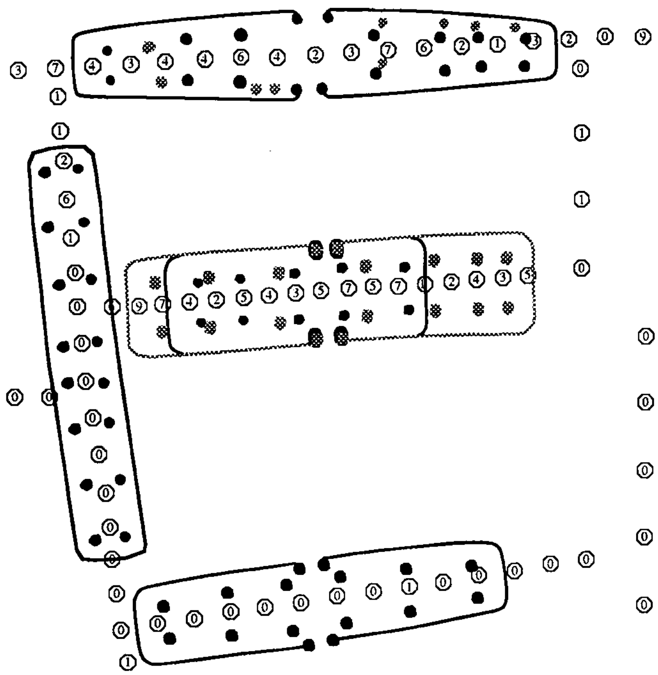


Fig. 9. Hammelev Nørremark. Phosphate map of the chieftain's farm. The relative phosphate content is shown as levels 0-10. Black, postholes from phase 1. Grey shading, postholes from phase 2.

The above is only an attempt to find explanations. The analyses do not contradict the explanations, but do not prove them correct either.

The farmstead was abandoned at some time during the Early Roman period, after which the spot was uninhabited until the beginning of the Viking period, when an isolated farm was again established.

### *The isolated Viking farm*

This cannot be described as a "chieftain's farm", but is still the first Viking farm in southern Jutland that has been fully excavated (Fig. 10).

The finds from the earlier phase, represented by building I, which is N-S orientated, and building II, will be passed over briefly (Fig. 11). They all come from building I. The potsherds are unremarkable, consisting of remains of hemispherical vessels. Of greater interest is the base of a glass cone-beaker with concave base. Fragments of cone beakers occur in large numbers in the rubbish layers at Ribe (Jensen 1991:14-15). Elsewhere they are considerably less usual. There is a find

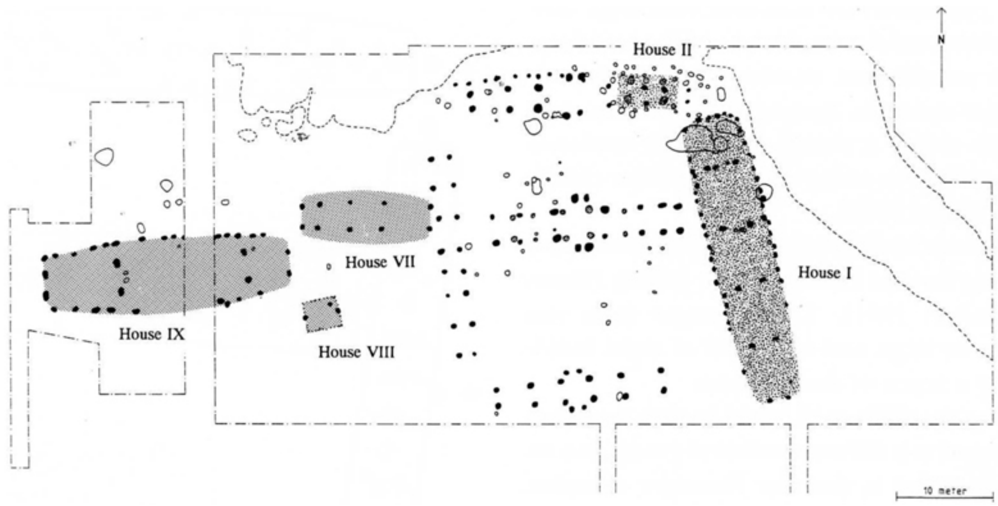



Fig. 10. Hammelev Nørremark. The Viking farm, phases 1 and 2. 1:800.

from a grave at Darum (Arbman 1937:46) and an isolated discovery from Hjerndrup (Arbman 1937:47) only 8 km north of Hammelev.

In the later phase the farm was moved westwards and the buildings reorientated E-W. There were now three buildings (VIII, IX and X), two of which were three-aisled structures. Although traces of wall posts only survive in the main building it is clear that both buildings had curved side-walls. The third building was a rectangular pit hut.

### *The southern activity area*

To the south about 1000 m² were excavated of a large

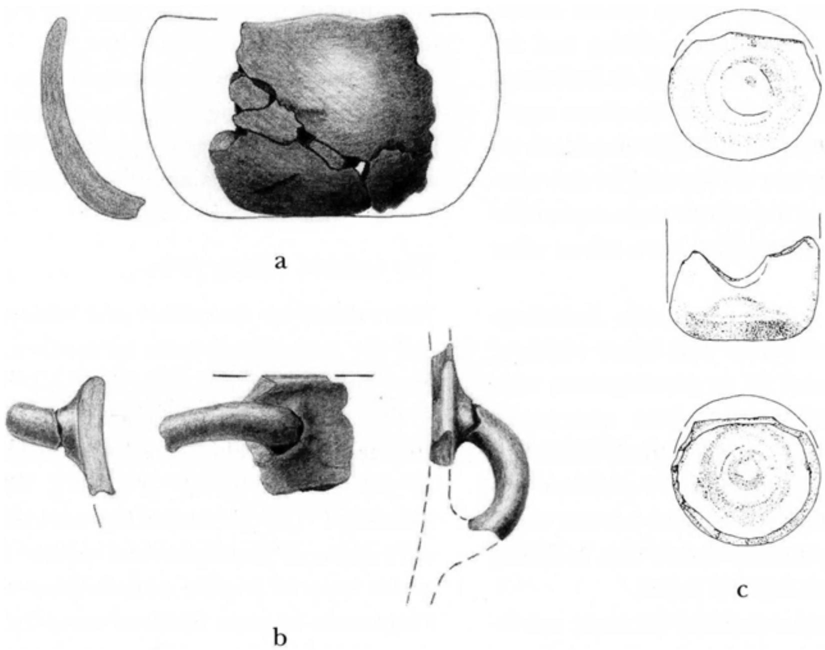



Fig. 11. Hammelev Nørremark. Pottery and glass from the Viking farm. Glass 1:1, pottery 1:3.

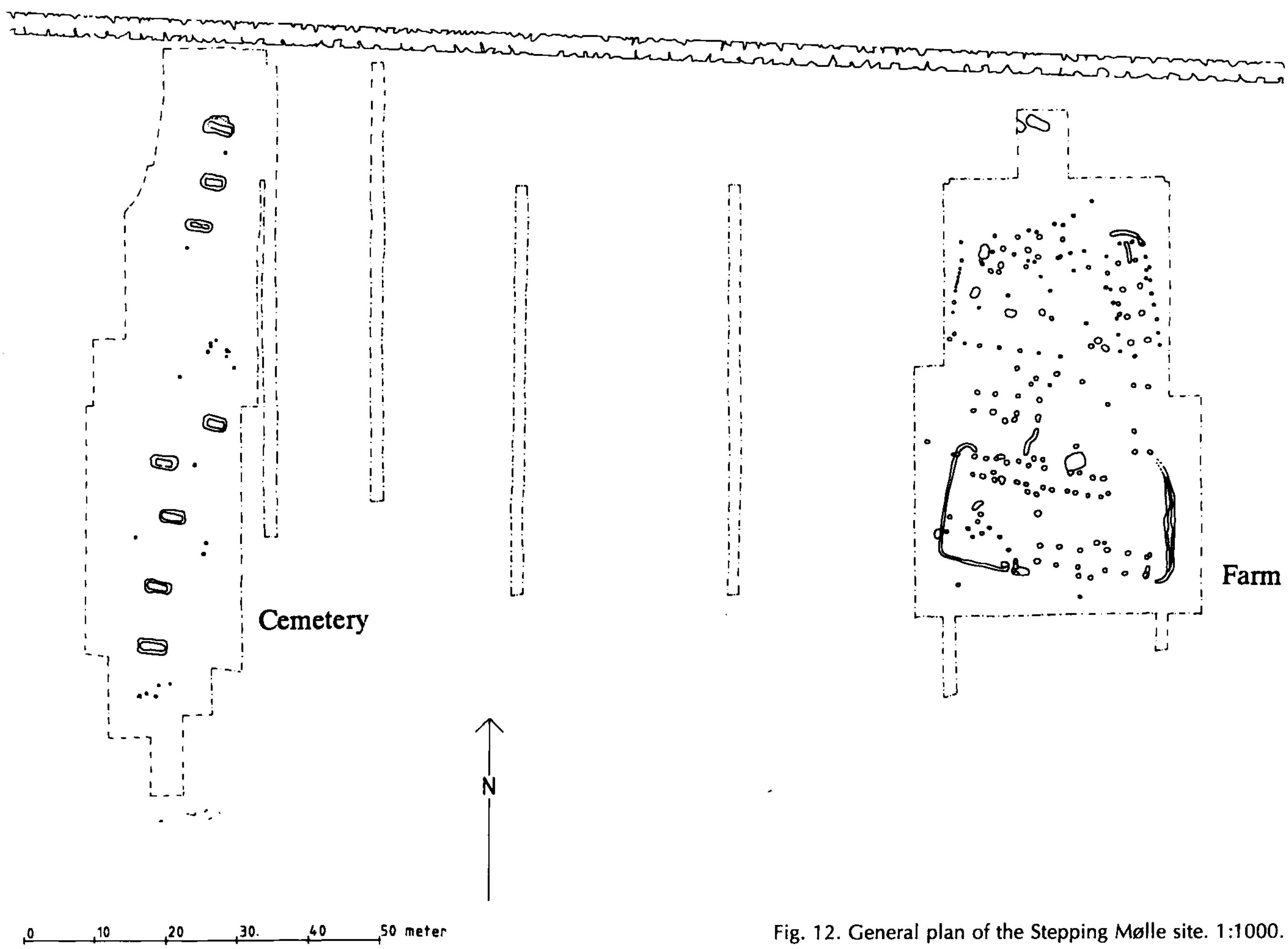



Fig. 12. General plan of the Stepping Mølle site. 1:1000.

activity area with occupation deposit and many clay pits, but no remains of settlement structures (Fig. 2). The pits, which in the main were only test-pitted, date from the Pre-Roman Iron Age.

## STEPPING MØLLE

Close east of the little village of Stepping, 8 km west of Christiansfeld, an area of ca. 2,200 $m^2$ was excavated on account of raw materials exploitation. There were found remains of three farms. Two of them, a "chief's farm" and a smaller one, are datable to the Early Roman Iron Age, while the third can probably be dated to the Late Germanic Iron Age. If this is correct, it is the first farm from this period found in southern Jutland.

In 1984 the National Museum excavated a deep, partially stone-covered inhumation grave 60 m west of the farms. It contained a number of pots contemporary with the farms of the Early Roman Iron Age.

During autumn ploughing in 1991 the farmer encountered stones a good 60 m south of this grave. Haderslev Museum was informed and the area was excavated early in 1992. The cemetery and farmstead both stood on a distinct, elongated ridge of stratified sand and gravel running roughly E-W (Fig. 12). Northwards the surface fell via a terrace down towards Nørreå watercourse and its lush meadows. To the south lay a small wet area, probably a pond that has now dried. The chief's farm was situated at the highest point on the ridge, while the cemetery lay further west on the southern slope, at an altitude 4-5 m lower than the farms.

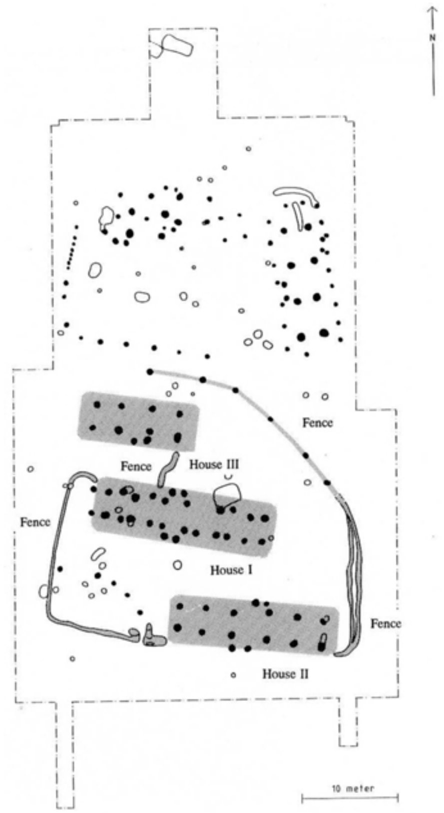



Fig. 13. Stepping Mølle. The chieftain's farm. 1:800.

## *The chieftain's farm*

The farm consisted of longhouses I-III, joined together by palisade fences A1 and A3-5 and post fences A2 and A6 (Fig. 13). Post fence A2 starts north of building II and passes in a curve east of building I, where it joined palisade fence A1. This latter was constructed in two stages. The eastern part is probably the youngest. Palisade fence A1 continues as far as the eastern end of long building III.

Palisade fence A3 departs from the NW corner of building I and continued southwards west of the end of it and then curves over toward building II. Fence A4 starts from the west end of building II and can be followed westwards for 2-2.5 m. Fences A4 and A3 do not join, but leave a southwards facing entrance between their ends, marked by two large internal posts.

Buildings I and III are joined by palisade fence A5, which is slightly sinuous and has no entrance. There were entrances to the farmstead between the northern side of building III and fence A2, where the width was 2.5-3 m, and by the south-facing aperture between fences A3 and A4, opening towards a now dry steam bed down the slope 50-75 m south of the farmstead.

The depths of the six postholes forming fence A2 vary considerably (from 10 to 52 cm), as also indicated by the base levels. If we nevertheless regard them as a single feature, it is because they form a natural continuation of post fence A1 and because there are no other features in the vicinity they could be connected with. For this reason the area was cleaned off by machine at a number of different levels. The distance between the surviving postholes varied from 3.5 to 5.5 m. This does not exclude the possibility of other posts in the fence. The surface soil was up to 50 cm thick, increasing the chance that intermediate postholes had been ploughed away.

Post fence A6 consisted of five postholes of somewhat irregular depth, but with the same fill. The interpretation as fence is not sure. The posts in question could perhaps have formed a little enclosure within the farmstead. Another possibility is that the postholes represent an activity area.

Building I is a roughly E-W orientated three-aisled longhouse constructed in two phases. In the earlier phase it consisted of six pairs of roof-bearing posts. In the middle were two opposed entrances. The length was 19-20 m and the width 5,3-5,5 m. The entrances were marked by double posts and were probably drawn a little inward. No wall posts were preserved, and no evidence could be seen of the replacement of roof-bearing posts.

In the later phase the structure was completely renewed and shifted 1.5 m westwards, but the entrance posts were superimposed on the holes of the first phase. The posts were generally inserted less deeply than before, but the length and breadth were unchanged.

Generally speaking the fill of the postholes of the late phase in the eastern half of the building is describable as burnt debris. The quantity of charcoal and burnt daub decreased westwards.

Building II is a nearly E-W orientated three-aisled longhouse with six pairs of roof-bearing posts. In the middle there are two entrances, which are not quite opposite. The entrances are unlikely to have been drawn inwards. The building was 18 m long and 5 m wide. The entrance posts are in line with the palisade trench which show the maximum possible length of the building. Replacement of roof-bearing posts was not ob-

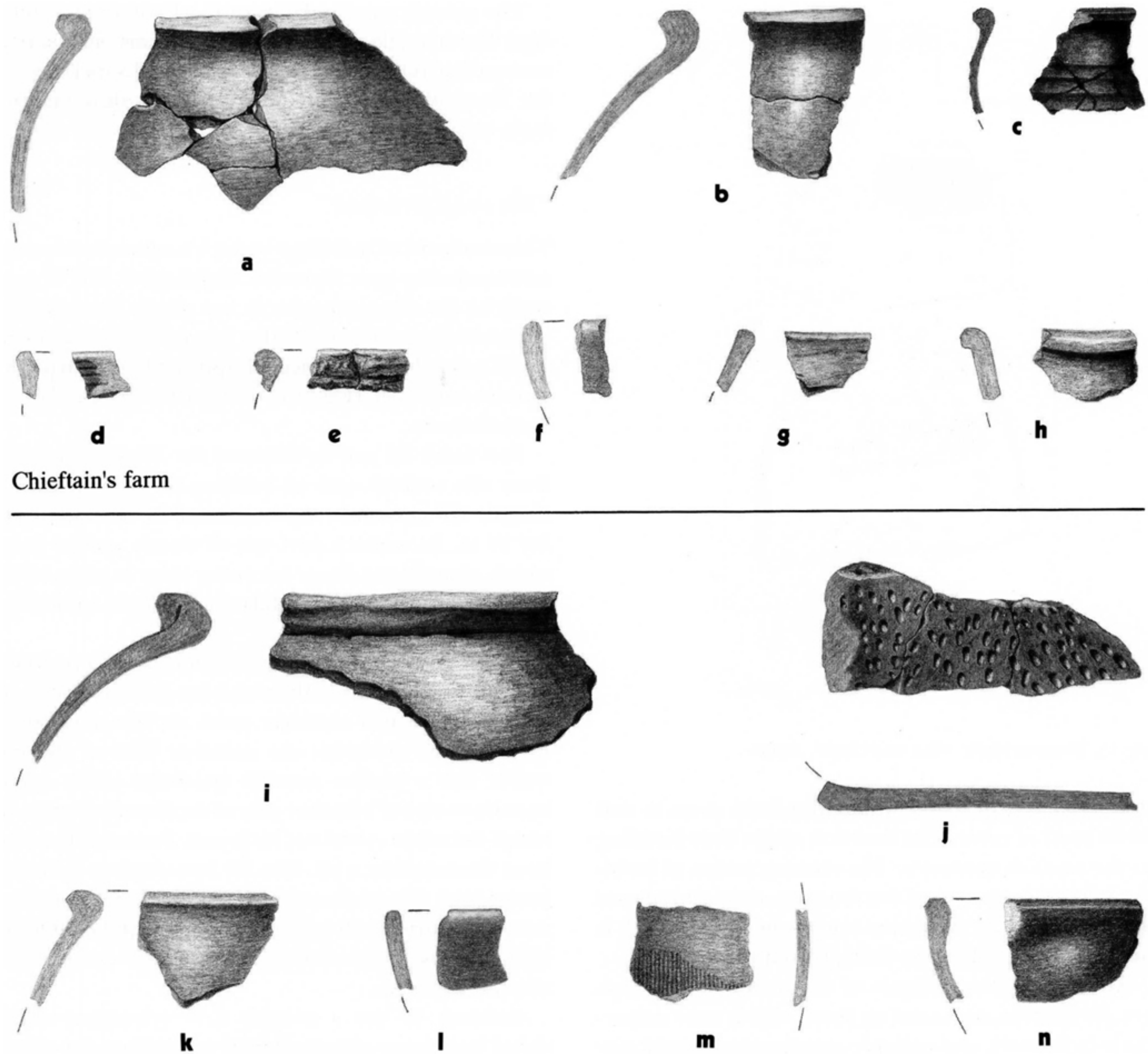



Fig. 14. Stepping Mølle. Pottery from "the chieftain's farm" and "the small farm". 1:3.

served, and wall posts could not be found.

Building III was a roughly E-W orientated three-aisled house consisting of four pairs of roof-bearing posts. In its centre there was a southward-facing entrance, which was probably drawn inward, to judge from palisade fence A5 and the short distance between the door posts and the roof-bearing posts. The building was 12-13 m long and 5 m wide. Replacement of roof-bearing or door posts was not observed.

This farmstead covered altogether 750 m$^2$ and can be described as a chieftain's farm.

Just as at Hammelev Nørremark there is evidence that the buildings served different purposes, but in this case this cannot be supported by phosphate analysis.

Flotation samples from buildings I and II show that seeds and cereal grain were kept in building I, while there were no such finds from building II. This suggests that building I was residential while the southern build-


Fig. 15. Stepping Mølle. "The small farm". 1:800.

ing served as byre. There would have been room to stall 30-50 head of cattle. The function of the little building to the north is unknown. The reconstruction of building I and the renewal of the fence on the east indicate that the use of the farmstead lasted some time, which is further supported by the datings from the cemetery.

The different techniques of the northern and eastern parts of the surrounding fence, which were respectively in bulwark and palisade construction, could suggest that building III was the last constructed, indicating that the farmstead was enlarged in the latest phase.

The sherds from the farm are from bowls with facetted and sometimes thickened rims and larger jars with strongly thickened and facetted rims (Fig. 14). In one case three horizontal grooves could be distinguished. From the palisade trench connecting buildings I and III came a little rim-sherd of a black polished vessel with thickened rim with narrow facets, below which there were three relatively broad horizontal grooves. In the fill overlying sunken building VIII was found a large sherd of a footed beaker.

The pottery can be dated to the Early Roman Iron Age. The strongly thickened, facetted rims imply a first occupation relatively early in the period – perhaps in B1. The finds from the cemetery however show that the main use of the site was in period B2.

*"The small farmstead"*

This consisted of buildings V and VI, which were partly surrounded by post fence B1. Buildings V and VI may really be the same structure in two phases. It cannot be determined which is the older, but probably it is building V, partly because fence B1 appears to start from its western end wall (Fig. 15) and partly because it was burned down.

Post fence B1 can be followed for 16 m southwards from the western end of building V. Then it curves sharply $90^0$ eastwards and continues in that direction for 16 m. Its western part was of closely spaced posts which, though not deep, were very clear in plan, while its southern part was of widely spaced posts, indicating bulwark construction.

Building V was an approximately E-W orientated three-aisled structure with at least two pairs of roof-bearing posts and two entrance posts on the south side. Probably the entrance was indrawn. West of the entrance was a further possible posthole, which could have been one of a further pair of roof-bearing posts, of which the other could not be found. Presumably it had been destroyed by a pit. The fill however was quite different from that of the other postholes, and the outline was very diffuse. In the clear postholes the fill contained burnt debris. The building was at least 9 m long and about 5.5 m wide.

Building VI was a roughly E.W orientated three-aisled longhouse with four pairs of roof-bearing posts. In the middle there were two opposite entrances, which seem to have been indrawn. The building was 12 m long and 5 m wide.

It cannot be exclude that building VI represents a later phase of building V, but except that the two buildings cannot have stood at the same time we have no stratigrapical observations.

The fence bounded a farmyard that was open on the east and measured ca. 16 x 16 m or about 250 $m^2$. When viewing the excavation plan one cannot exclude that building IV may really have been the farm's main building, which is to some extent supported by the pottery

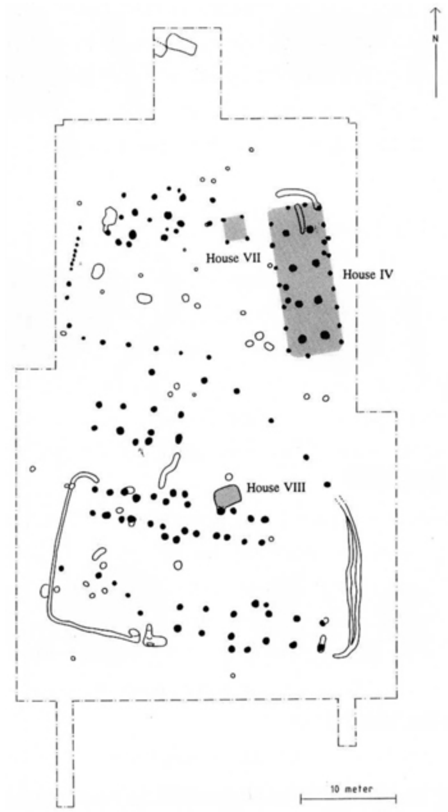



Fig. 16. Stepping Mølle. Farmstead from the Late Germanic period. 1:800.

found in the its postholes. However there are a number of important counterarguments – see below.

The sherds come partly from large vessels with strongly thickened and facetted rims, partly from bowls with thickened, facetted rims. There was also a comb-decorated body sherd (Fig. 14). It seems that this farm was built at the same time as the chief's farm, i.e. early in the Early Roman period, probably B1, and its use continued into B2, despite the fact that the sherds seem as a whole slightly older than those from the chieftain's farm.

If one chooses to regard building IV as a part of the farm, the whole complex could be seen as forerunner of the chief's farm, but that would not harmonize with the grave finds.

### *The farm of the Late Germanic period*

This consisted of long building IV and pit hut VIII, together with the possible granary, VII. There is no unambiguous enclosure (Fig. 16).

Building IV was a ca. N-S orientated three-aisled longhouse. It had four pairs of roof posts. The holes of the wall posts survive almost completely. The side walls were straight and the end walls slightly curved. The average distance between the wall posts was about 2 m. There were indrawn entrances on either side, which were staggered in relation to each other. From the last pair of roof posts as far as the north wall could be observed a trench-like depression, which can be interpreted as a byre drain. There were no other signs of subdivisions in the building, which was 15.5 m long and 5.5 m wide.

Immediately outside the north end of building IV was observed a deep trench following the end of the house. It may be interpreted as a reconstruction of the north end, or as a little fence. Traces of posts were not detected, but close to the building the fill contained much red-burnt clay.

The fill of the roof posts resembled burnt debris, but not so the wall postholes.

Building VII may have been a granary. It consisted of four posts standing roughly in a rectangle measuring 2 x 2.3 m. The interpretation is not sure however, as both fill and depth were irregular. This possible feature was orientated approximately E-W.

Building VIII was a pit hut consisting of a rectangular pit measuring 2.4 x 2.1 m orientated about WSW-ENE. The sides were steep and the bottom flat, but the northern half was about 10 cm deeper than the southern. In a horizontal plane this deepening showed up as a rectangular area measuring 2.41 x 0.9 m. The maximum depth of the pit was 28 cm. There were no other structural features than the pits at each end for the ridge posts. The fill was unstratified and consisted of black-brown humic sand with charcoal. Scattered through this were pottery, daub, calcined bone, and a fragment of a spindle whorl (Fig. 17). In the middle of the pit's southern side was found a beaked fibula (Fig. 18). On the floor of the western half of the pit (Fig. 17) was found a complete spindle whorl.

A certain amount of pottery of Early Roman character was found, usually secondarily burnt. There was a large side of pot with groove ornament and an arched plug handle, typically Early Roman, and large vessels with strongly thickened rims that probably were facetted (Fig. 17).

In fill over the pit hut were found sherds datable to

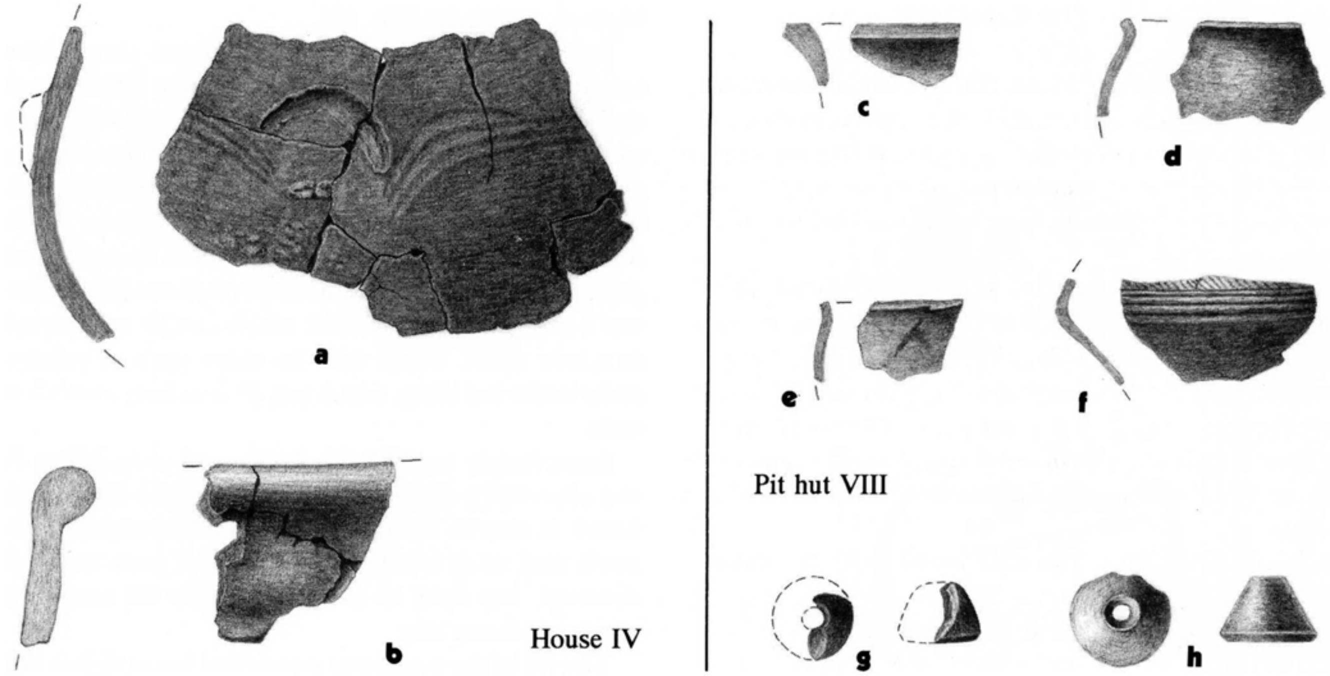



Fig. 17. Stepping Mølle. Pottery from the Late Germanic farmstead house IV and pit hut VIII. 1:3.

the Early Roman period – including a large sherd from a footed beaker, and also sherds from vessels with short outwards curved neck. The transition from neck to upper body was S-shaped with a tendency to be thickened. The sherds are definitely not Early Roman, and do not come from hemispherical vessels. Presumably they are contemporary with the beaked fibula and the two spindle whorls, and therefore date from the Late Germanic period.

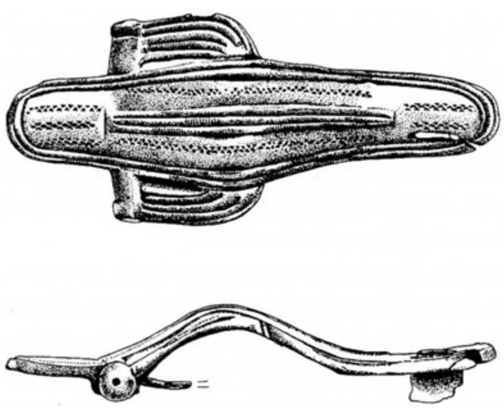


Fig. 18. Stepping Mølle. Beaked fibula from pit hut VIII. 3:4.

If long building IV is regarded as contemporary with the pit hut despite the fact that the pottery from its postholes is of Early Roman character (Fig. 17), this is because of its orientation, the indrawn entrances and their clearly different positions, and because wall posts survive. There is also a negative argument. If long building IV does not belong to the later Germanic period, the pit hut would be strangely isolated. The reason could perhaps be that it was a grave instead, but neither remains of coffin or skeleton were detected, and the fill contained habitation pottery which certainly is not from the Roman period. Another argument is that the index of the span of the roof-bearing posts in relation to the total width of the building falls within the limits set up by D. Mikkelsen for buildings from the later Germanic Iron Age (Mikkelsen, Hvass & Hansen 1991:19f). In dating the structure emphasis is laid more on the building's atypical appearance compare with buildings of the Early Roman period than on the pottery, which may be regarded as contamination. The whole farm is dated by the beaked fibula from the pit hut to the Late Germanic period – probably close of 6th or beginning of 7th century.

## STEPPING MØLLE – THE CEMETERY

The cemetery lay, as said, ca. 60 m W of the settlement (Fig. 12). Its extent was ca. 20 x 90 m, and it consisted of eight large, deep inhumation graves and 19 cremations – 17 urns and two cremation pits. The cemetery is fully excavated and its limits have been established to all sides (Fig. 19).

The farm and cemetery were both placed on a distinct E-W ridge of stratified sandy deposits. Northwards the surface falls via a kind of terrace to Nørreå stream with its fertile meadows. To the south is a small wet area, probably a dried out pond. The chief's farm lay at the highest point of the ridge, while the cemetery lay on its southern slope further west and about 4-5 m lower.

The inhumation graves were found to be exceptionally large – usually around 3.60-70 x 1.70-80 m with depths of about 1 m below the plane of the excavation, indicating 1.3 – 1.4 m under original field surface. One grave was substantially deeper – 1.5 m, or 1.8-1.9 m under the field surface. A second was considerably larger. It lay furthest south and measured 4.2 x 2.1 m.

The eight inhumation graves were all orientated about E-W and lay in a N-S line. Only one grave diverged in being displaced ca. 2.5 m to the east – perhaps because of a large natural depression, that had later been filled up with small and middle-sized field stones stratified in two horizons, in the lower of which was found a small piece of a quern of Mayen basalt.

The graves lay in two groups, a northern with three and a southern with five graves. Within each group the distance between the graves was 5 – 7.5 m. Near grave 245 were found some scattered patches of stones, which when first revealed looked like graves. However further excavation showed that they were stones that had subsided into animal burrows. They are therefore likely to be what is left of a cairn with an original diameter of 10-11 m. Similar remains of cairns were not observed near the other graves, but the relatively large distance between them and their placing in a roughly straight line suggests that they may originally all have been covered in the same way, as is known i.a. at contemporary cemeteries at Hørløkke (Neumann 1978) and Hjemsted (Ethelberg 1986).

With a single exception the graves were covered by large rectangular stone packings, which continued conically down to the bottom of the coffin, sometimes

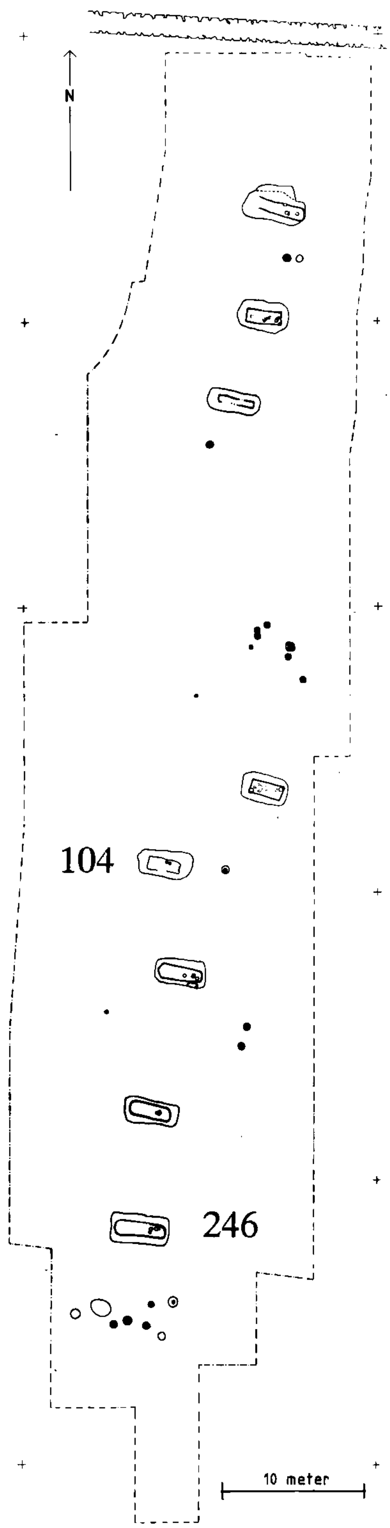



Fig. 19. Stepping Mølle, plan of the cemetery. Marked are the graves 104 and 246. 1:500.

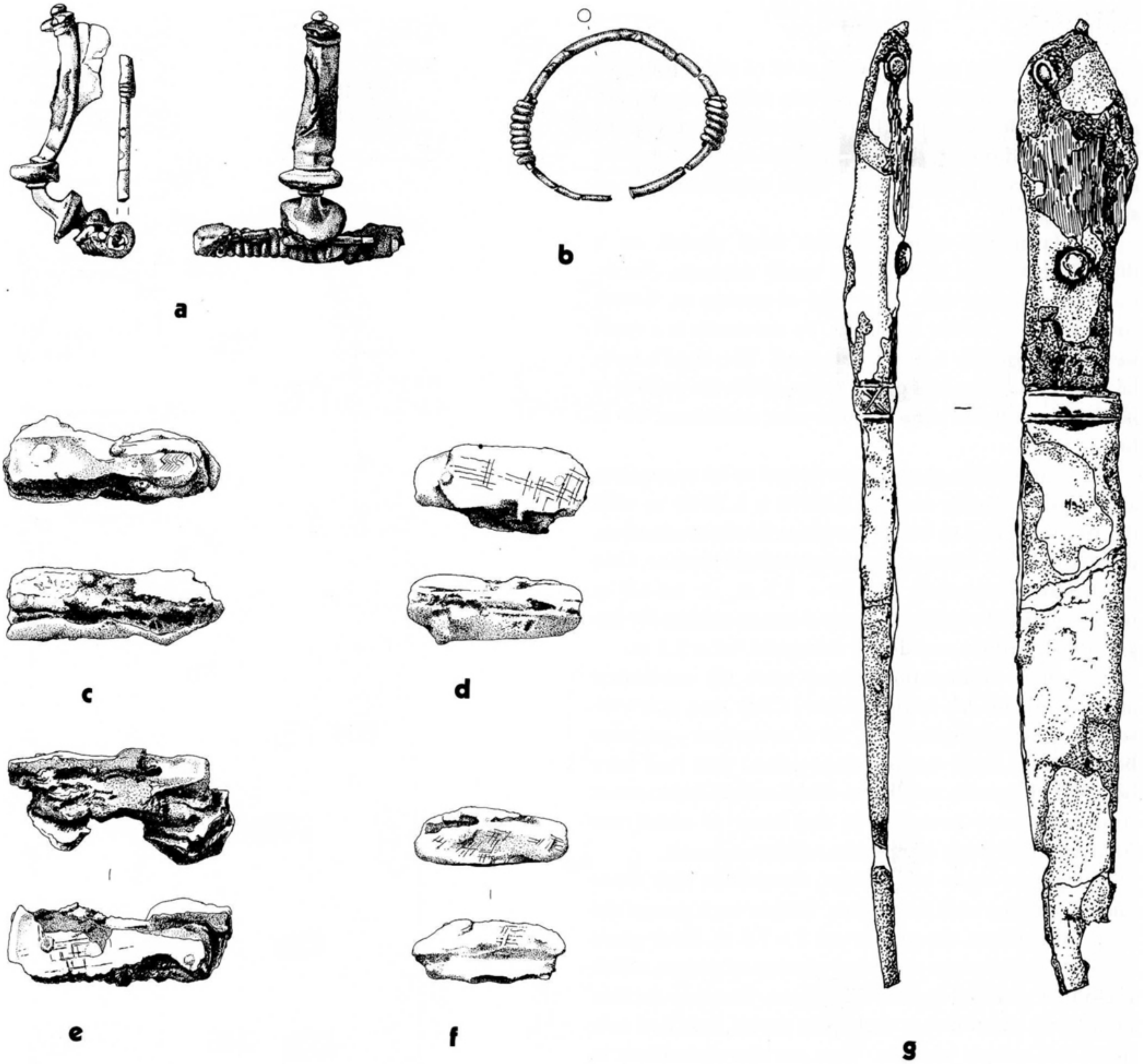



Fig. 20. Stepping Mølle. Equipment from the rich male grave 246: Fibula, knife, scabbard mount? and other mounts. 3:4.

enlarged under the place where the lid had first broken through.

The urn burials were scattered over the whole excavated area, but in two pronounced groups, one of which lay between the two groups of inhumations, while the other lay at the extreme south.

Although some general rules were followed in the layout of the inhumation graves, no two were exactly alike. All the bodies were buried with their head in the west. If there was a table set of pottery it was always at the east. Here the similarities cease. The body could lie on its side or back in a plank or log coffin. The pottery could stand on one side, in the middle, or in the corners. The number of planken and log coffins was alike; the kind of coffin seems not to have been dependent on either status or sex.

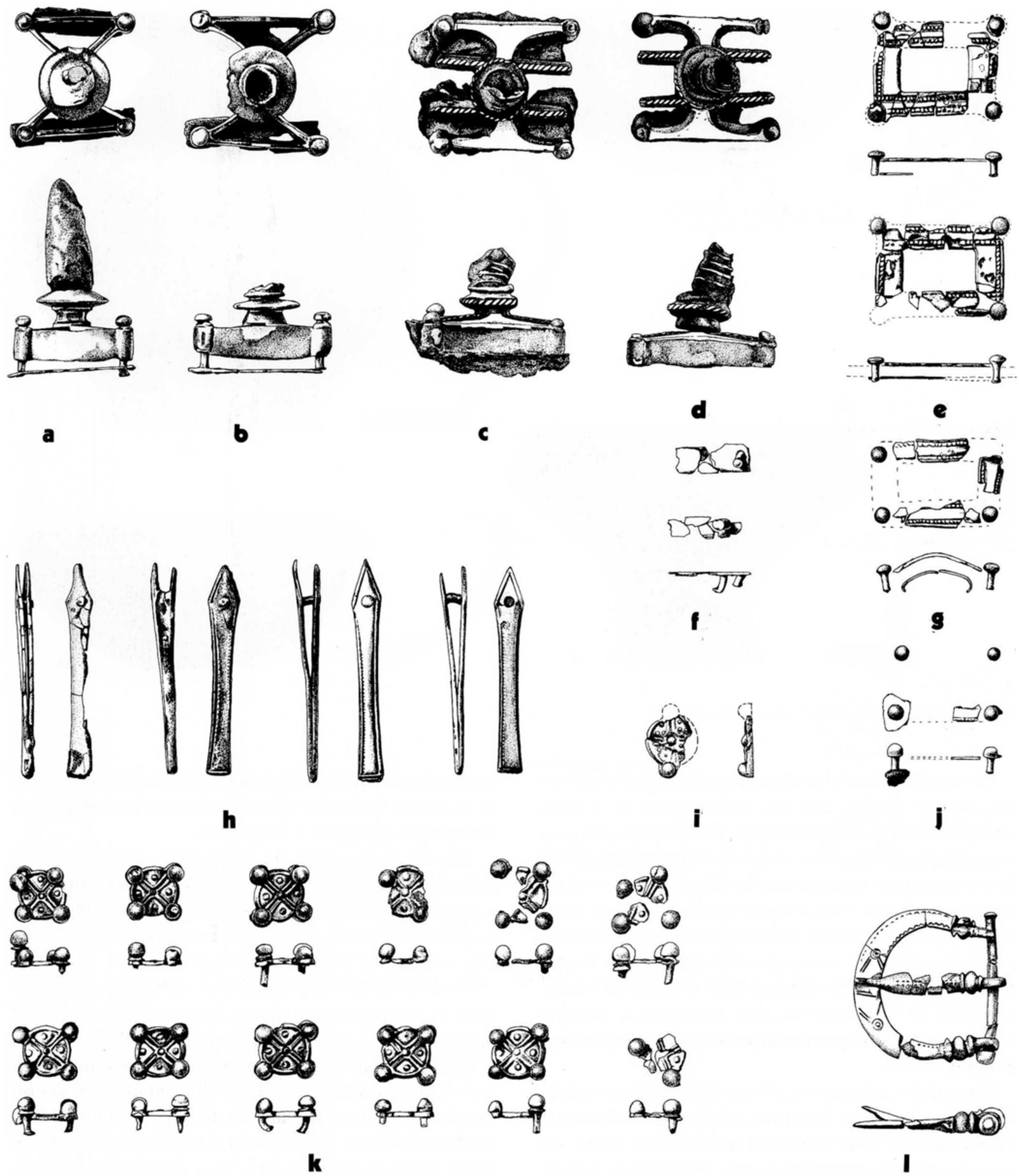



Fig. 21. Stepping Mølle. Equipment from male grave 246: Spurs, strap mounts, strap-ends and buckle. 3:4.

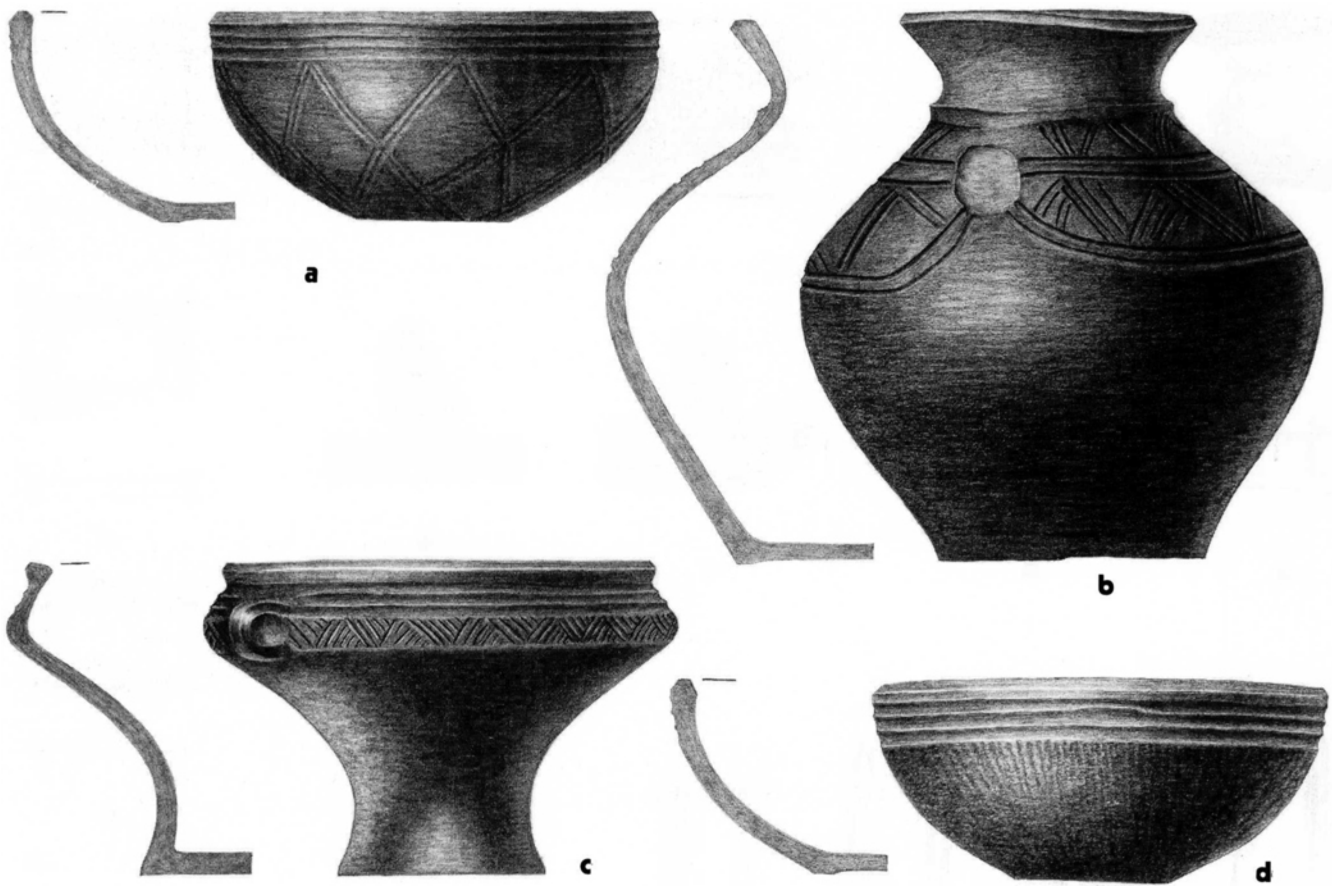



Fig. 22. Stepping Mølle. Pottery from grave 246. 1:3.

The equipment of the inhumations ranged from very rich to very simple, and the same applies at a more moderate level to the urn burials. The richest urns were better equipped than the simplest inhumations, which does not suggest that the choice of grave form was dependent on status – not if status was measured in material terms. The influence of kinship on a person's status is unknown, but it is not impossible that greater importance was attributed to kinship than to material wealth. It should be remembered that inhumation requires considerably greater expenditure of resources than urn cremation does.

From their equipment three inhumations can be determined as male and four as female. Only one is indeterminate. The cremations are harder to judge. Six may cautiously be regarded as male and three as female, while nine are indeterminate. So far it has only been possible to recognize two graves of children. One child was buried in a little log coffin placed beside the coffin of an adult, while the other was buried in a miniature urn placed alongside a larger one.

The 27 graves seem to represent a period of altogether 100-125 years, which corresponds statistically to a population of 8-10 adults as it was not possible to recognize children's graves sufficiently. This would indicate a family of 4-5 adults per farm.

To understand the farms and cemetery better we have to examine more closely the contents of some of the graves.

The richest of the men's grave contained a moulded-bow fibula of bronze with embellishments of precious metal on the bow disc and foot knop; a moulded belt buckle of bronze and other belt mounts; and a pair of silver inlaid stool spurs with four rivet holes and precious metal in the "stools". By the table set, which consisted of four pots, were found the remains of a pair of

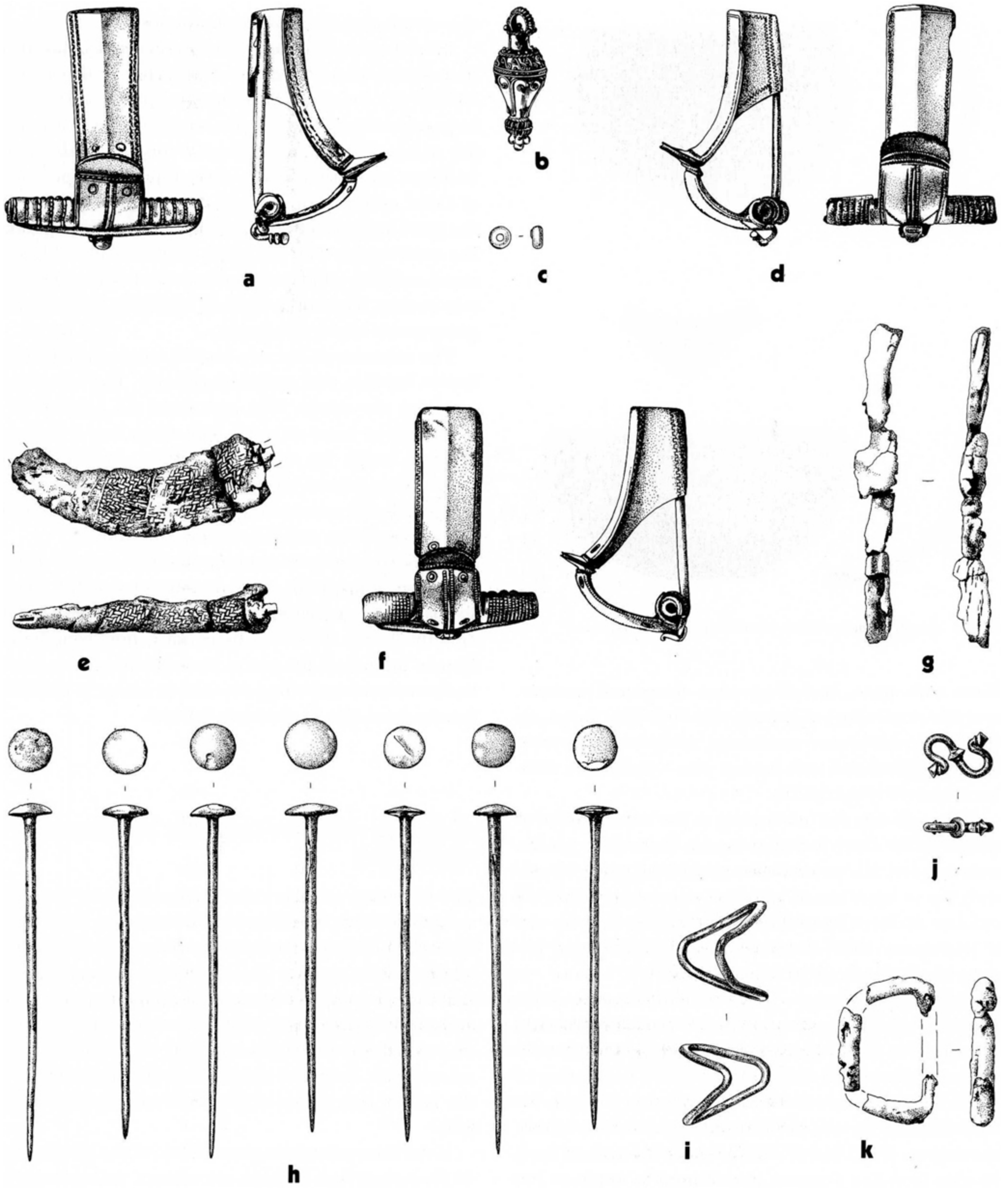



Fig. 23. Stepping Mølle. Equipment from the rich woman's grave 104: Silver fibulae, gold breloque, glass bead, silver pins, iron pin, silver S-clasp, knife, silver finger ring and a buckle. 3:4.

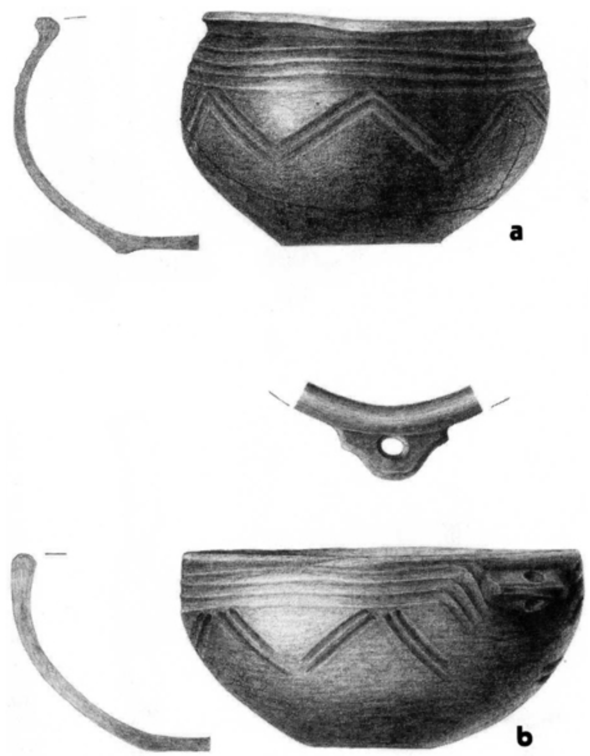



Fig. 24. Stepping Mølle. Pottery from female grave 104. 1:3.

shoes with spurs, including some decorated mounts, and also stool spurs of bronze with four rivet holes, an iron knife with bronze mountings, and parts of a bronze ring wound around with bronze wire – probably a scabbard mound (Figs. 20-22).

Although this did not belong to the richest series of graves in the Over Jerstal group, as there were no Roman imports, it is nevertheless an unusual grave. Graves with two or more sets of spurs are exceedingly rare. We can cite Brokær (Lund Hansen 1987:408), Kastrup urn 2 (Neumann 1957; Lund Hansen 1987:408) and Bodum Mark (Norling-Christensen 1960).

The richest woman's grave contained seven silver hairpins, a gold filigree breloque, four glass beads (two transparent, a dark blue, and two with goldfoil), an S-clasp of silver, three silver fibulae, and a finger ring of silver. The table set consisted of two pottery vessels, beside which lay an iron pin and an iron knife with bronze mountings (Figs. 23-24). This is so far the richest Early Roman Iron Age woman's grave found in southern Jutland. In closed south Jutland women's graves there have not earlier occurred S-clasps or gold breloques, which thus emphasize the grave's special position.

According to Hedeager and Kristiansen's classification of rich women's graves (Hedeager & Kristiansen 1982:114ff) the grave falls into group B as there is no large amber bead and the pin is not of silver or bronze, but of iron. On the other hand it contains both a gold breloque and a remarkable silver finger ring, probably of Celtic origin – an unusual combination which puts the grave at a level immediately under the A group. Like the man's grave this is a grave from the next highest social context, which will be described below as chieftain society. There is a kind of similarity between the grave goods in the two graves.

The contents of the urn burials were normally iron knives, buckles, and sometimes fibulae. Two urns stand out from the others. One contained the remains of a little filigree bead of gold. The other was a weapon grave in which the weapons – shield, spearhead and knife – were placed respectively under and outside the urn. Inside the urn was found a single stool spur of iron with 2 rivet holes and letter-I shaped "stool."

From a preliminary examination the cemetery seems to include finds both from periods B1 and B2. There seems to be good agreement between the grave goods and the farms. However there have not been found Roman imports in the graves. Perhaps this gives a key to the better understanding of social structure in the Early Roman Iron Age in southern Jutland.

## CHIEFTAIN FARMS IN CULTURAL HISTORICAL PERSPECTIVE

The following remarks refer primarily to the Over Jerstal group's area, as defined by H. Neumann (Neumann 1982:68ff), which is basically the present South Jutland administrative county. Recent studies have suggested that the area ought to be expanded slightly to the north and south (Christensen 1993). We should have reservations about the full representativity of the archaeological material. Attention should be called in particular to the lack of rich graves in the south-western part of the area.

If the interpretations given below of the distribution of the richest find contexts are correct, we have now localized 5 out of 12 possible localities, indicating a representativity level of a good 40%, whereas the same figure

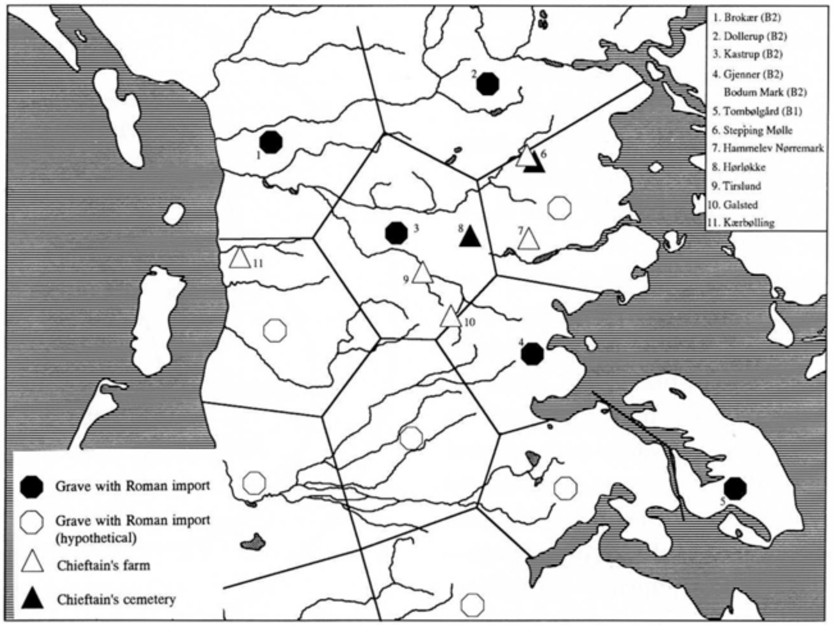



Fig. 25. Distribution of princely and chiefly sites in the Over Jerstal group.

for the big farms lies close below 5%. This may be because the latter features have only recently been recognized (Fig. 25).

On the basis of the graves there can be discerned an outline of the stratification of society into at least four groups. At the top is the prince. By "prince" is meant a person with greater regional power than a chieftain, but less than a king. The medieval connotation of the term should not be allowed to cause confusion.

Characteristic of princely graves are their Roman imports in the form of vessels of bronze or glass. In addition they often also contain gold fingerings, spurs, and sometimes weapons. They are almost exclusively men's graves. Princely graves from the central area of the Over Jerstal group are the following: Dollerup (Ørsnes & Voss 1948), Brokær (Lund Hansen 1987:407, 429), Kastrup (Neumann 1957 and Jacobsen 1975), Gjenner and Bodummark (9) (Norling-Christensen 1960) and Tombølgård (Norling Christensen 1960). These sites all have in common that they contain 1-3 burials. It cannot be determined whether these lay alone or formed part of a larger cemetery of unknown size. The graves are either urn burials or inhumations. The distance between sites is 30-40 km, and, with the exception of the two graves from Tombølgård on Als, they are datable to B2. We do not know how the residence of a prince looked.

The next step down the social ladder was the chieftain. This stratum is indicated by men's graves with silver inlaid spurs, but never weapons, and women's graves with silver hairpins, filigree beads of gold, gold breloques, fibulae of silver or bronze (sometimes with precious metal embellishments). Graves of this type occur at normal cemeteries and seem mainly to be inhumations, though one of the urns from Stepping Mølle contained a squashed filigree bead of gold. Examples of cemeteries of chiefly type are Stepping Mølle and Hørløkke (Neumann 1978).

The Stepping Mølle excavations showed that the chieftains lived in large isolated farms outside the villages. Other examples of this are the chiefly farms at Hammelev Nørremark and Kærbølling, and a large isolated farm was found outside the latest of the Galsted villages. A fifth chiefly farm was located near Tirslund during air reconnaissance in the summer of 1992, and the Hørløkke cemetery must indicate a sixth, cf. above. Judged from the present distance between the closest chiefly contexts it looks as if the chieftains" farms lay at intervals of 8-12 km (10).

There is nothing in the central area of the Over Jerstal group to indicate that graves with silver decorated spurs represent old warriors who were buried without their weapons, as has been suggested (Hedeager & Kristiansen 1982:125). Considering that spurs first appear

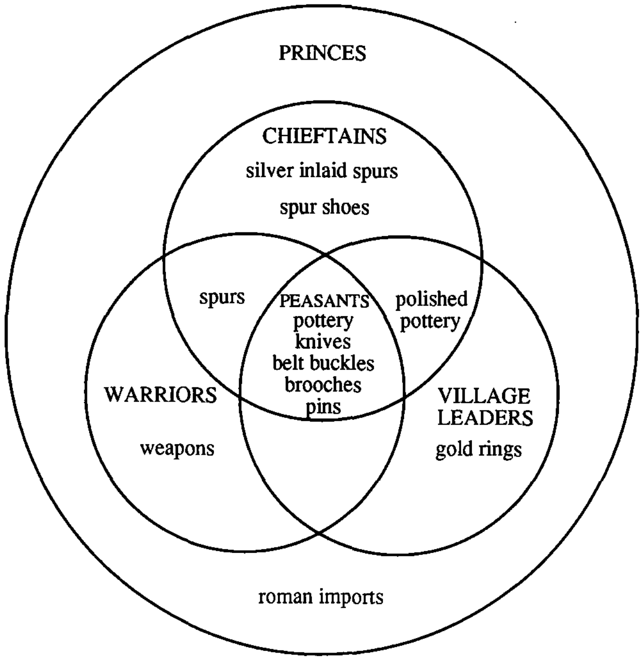



Fig. 26. Model for the social stratification during the Early Roman Iron Age in the Over Jerstal group.

in graves from the end of the Pre-Roman and beginning of the Early Roman period, they ought (especially the luxurious ones) to be regarded as insignia of rank rather than as weapons, as seems for instance to have been the case with the incredibly rich royal grave from Musov in southern Moravia, whose many furnishings included 8 pairs of spurs, two pairs of which were decorated with silver (Böhme 1991).

The next step down the ladder is represented by warrior graves and graves with gold rings. These can with caution be interpreted as the graves of village leaders. Warrior graves, with certain exceptions (11), were always urn cremations. Spurs are not regarded as weapons, and therefore graves with spurs only are not regarded as weapon graves. Weapon graves seem not to occur at cemeteries where there are burials with gold rings. Gold rings are found both in inhumation graves – Ottesbøl (Neergård 1931) and Hjemsted (Ethelberg 1986) – and in urn cremations – Frørup (Christensen 1988) and Galsted (Grøn 1987). In inhumation graves with gold ring(s), black-polished, thin-walled pottery occurs as an integral part of the grave goods. This agrees with the observation that at Hodde this type of pottery was concentrated around the largest farms (Hvass 1985:178). Black-polished pottery however is also regularly found in inhumation graves without gold rings.

Until the end of 1994 it was not possible to excavate any Early Roman period village of the Over Jerstal group in full, including its graves or cemeteries. Nevertheless known discoveries already gave a partial indication of the relationship, warriors *contra* village leaders.

At Hjemsted probably all the urn cemeteries belonging to a village have been found. During excavations in 1977-86 seven sure cemeteries with 4 to 45 urns were recorded; an eighth was found in 1916 during the construction of "Sicherungs-Stellung Nord" (Ethelberg 1988:123). Four of the cemeteries included weapon graves.

The cemeteries were in use for periods of varying duration. At least four however were used simultaneously. Close by there was also excavated a cemetery of the same age consisting mostly of inhumation graves in a row along the course of a road and perhaps covered with mounds. One of these graves contained a gold ring (Ethelberg 1986; 1990).

It can hardly be doubted that these relatively small cemeteries must be interpreted as family graveyards from villages in which there lived both warriors and persons entitled to wear gold rings.

The discoveries at Galsted tell the same story (12). Near the village settlement (Grøn 1987), which was partially excavated in 1980 and at which a small number of urn cremations were found, a larger number of urn cremations and cremations pits were excavated by Neumann in 1941 (Neumann 1982:80f), and by Ethelberg in 1993. They lay in a number of different family graveyards. The urn cremations included weapon graves and a grave with a plain gold ring (not in same family).

The weapon grave from Stepping Mølle shows that warriors could be found not only in the villages, but also at the big chieftains' farms. We still do not know whether warriors lived in the isolated farms. Similarly it is not possible to say whether persons with gold rings lived exclusively in the villages, but on present evidence it seems that the functions of warrior and village leader were distinct, i.e. the military and political leadership of a village were separated. It looks as though warrior graves were most often attached to the villages. It is therefore possible that the distribution of warrior graves agrees with that of the villages, which in that case would have been evenly spread and close together over most of the area of the Over Jerstal group without clear differences between the east and west.

The bottom stratum, the farmers, is represented by family graveyards with only pottery, fibulae, pins, knives, and belt buckles. These cemeteries can either be urn cemeteries, e.g. Hjemsted (Muurholm 1989; Ethelberg 1990) or inhumation cemeteries, e.g. Højgård (13). Also this stratum seems to belong to the villages.

In the Over Jerstal group it is unlikely that large common cemeteries will be found like those of northern Germany and Fyn. One of the largest cemeteries in the area is Drengsted, where nearly 90 graves were recorded (Hansen 1992). It may be pointed out that the isolated chiefly farms do not seem to have been founded with a view to developing into villages.

An attempt has been made at a graphical representation of the suggested social stratification in the Early Roman Iron Age of the Over Jerstal group (Fig. 26).

## FORTIFICATIONS

The last type of feature to mention are enclosures with surrounding ditch. At least two are known from the area of the Over Jerstal group – Trælbanken between Tønder and Skærbæk (Harck 1979) and Favrvrågård near Christiansfeld. They have in common that no structural traces have been found within the enclosure. The role these features played can only be guessed. O. Harck proposes that they were "communal meeting places" rather than defensive works (Harck 1979:40), while H. Andersen suggests they were refuges (Andersen 1992:24). The one thing that is certain is that they formed an integral part of settlement structure in the Early Roman Iron Age.

## CONCLUSIONS

In conclusion it can be said that the portrayal given here of social structure in the Over Jerstal group agrees well with the wider picture drawn by L. Hedeager of the development in the Early Roman Iron Age (Hedeager 1990), and that it also corresponds well with the situation in the area immediately to the north (Mikkelsen 1991). However there seems not to be a level above the graves with Roman imports, which presumably represent society's highest elite, the princes. Whether these lived in villages or in isolated farms is unknown. However we do know that the chieftains lived in large farms outside the villages at intervals of 8-12 km. To each of these large farms was attached a smaller one. There can be little doubt that the inhabitants of the small farm lived in a position of dependency on the chieftain. In the light of the relatively poorly equipped urn burials from Stepping Mølle and Hørløkke it seems likely that their status was lower than that of the ordinary inhabitants of the villages.

The relationship between the chiefs and the villages is unknown, but it is not impossible that the villages were subordinated to them. The chiefs may have exercised their power through the warriors and the persons buried with gold rings.

At the top were the princes. The distribution as known today suggests that a prince ruled over an area 30-40 km across. It can hardly be doubted that the princes were connected through alliances, perhaps in tribal federations. The Over Jerstal group itself may have been an example of a tribal alliance with a uniform political and religious structure.

If we take a short look at settlement pattern in the same area at the beginning of the Late Roman Iron Age, there can be no doubt that a further centralization of power has taken place (Ethelberg 1992). East of the end moraines the country is almost entirely deserted, but in the west population has increased. The number of weapon graves falls drastically. Large fortifications are built, and weapon depositions culminate in the peat bogs. Inhumation burial becomes almost completely dominant, and there is no continuity in the use of the cemeteries from the Early to the Late Roman period. A similar discontinuity can be observed in the location of the richest graves. This must mean that the social system that evolved during the Early Roman Iron Age was upturned at the transition to the Late Roman period (9).

*Translated by David Liversage*

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## NOTES

Drawings: Steen Hendriksen and Jørgen Andersen.

1 Ndr. Ringvej, Haderslev Museum j.nr. 2159, Tystrup parish. Excavated by A.B. Sørensen, I. Bodilsen and P. Ethelberg.
2 Galsted, Haderslev Museum j.nr. 2908, Agerskov parish sb. 157. Excavated by O. Grøn nd P. Ethelberg. See also note 12.
3 Ladegårdsvænget, Haderslev Museum j.nr. 2182, Åstrup parish. Excavated by I. Bodilsen.
4 Hammelev Nørremark, Haderslev Museum j.nr. 2529, Hammelev parish sb.7. Excavated by P. Ethelberg.
5 Kærbølling, Haderslev Museum j.nr. 1622, Rejsby parish sb.22. Excavated by F. Rieck and P. Ethelberg.
6 Stepping Mølle, Haderslev Museum j.nr. 1666, Stepping parish sb.35. Excavated by P. Ethelberg.
7 Stepping Mølle, Haderslev Museum j.nr. 1865, Stepping parish sb.23. Excavated by P. Ethelberg (in 1984 F. Kaul, National Museum, excavated a grave belonging to the cemetery).
8 Favrvrågård, Haderslev Museum j.nr. 1796, Tystrup parish sb.23. Excavated by A.B. Sørensen and L.S. Madsen.
9 In south Jutland the graves from the Late Roman period are no earlier than the beginning of C1b (Ethelberg 1990:111), which means that the Early Roman period must have continued here until the beginning of the 3rd century. This is in agreement with L. Hedeager's dating of the period boundaries (Hedeager 1990:24). Another consequence is that the Bodum mark find, which is normally dated to B2/C1a, has to be regarded as a princely grave from the Early Roman period belonging to the princely horizon of the Over Jerstal group. There is thus no contradiction when imports were found in the grave which, had they had been found in Zealand, would have been assigned to the Later Roman period. This reflects that the development was not synchronous in all parts of the country.
10 The distance to Kastrup and Hørløkke is ca. 8 km. At Byens Mark in the western part of the town of Haderslev there was found an inhumation grave whose contents included a spur (Neumann 1982). At the present moment it cannot be determined whether it is silver inlaid. The grave is dated to the beginning of the 1st century. The site lies slightly less than 6 km from Hammelev Nørremark. If this grave is correctly classified as a chiefly one, it would seem that the distance was sometimes less than the generalization given above of 8-12 km.
11 So far only one cemetery in the territory of the Over Jerstal group is known to have inhumations from the Early Roman Iron Age with weapons, – the cemetery in Gaede's mark in Dover (sb.1, Lintrup parish) (Petersen 1989:36). The explanation may be the site's geographical position in the northern part of the area.
12 The excavation of the Galsted site was resumed in the spring of 1993 owing to deep stone clearing for potato cultivation. It continued in the autumn of 1993 and was completed at the end of 1994. It is the first totally excavated village with its cemetery excavated in the Over Jerstal group.
13 Højgård, Haderslev Museum j.nr. 1706, Gram parish sb.170. Excavated by P. Ethelberg.
14 In the Early Roman period cemeteries are known from the Over Jerstal group with isolated inhumation graves, e.g. Tirslund and Tornumskov (Petersen 1990). There are also localities where cemeteries from both the Early and the Late Roman Iron Age are present, eg. Enderupskov (Haderslev Museum j.nr. 1053, Gram parish sb.107, unpublished, excavated by H. Neumann, H. Lausen, E. Jørgensen, F. Rieck, and S. Wiell) and Rødding Nord (Haderslev Museum j.nr. 2422, Rødding parish sb. 24, unpublished, excavated by Ethelberg). These, however, do not reflect continuity but rather the re-use of the sites in question.

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Journal of Danish Archaeology vol. 11, 1992-93, pp 136 – 149

# *Brandstrup III.*

## Axe and Taper from two Viking Age Chamber Graves

by METTE IVERSEN and BJARNE H. NIELSEN

In 1953 P.V. Glob and J. Lavrsen excavated a richly appointed Viking Age equestrian grave (Brandstrup I) on Ejner Kjær's farm at Brandstrup near Rødkjærsbro, 10 km SE of Viborg (Lavrsen 1960, 1971). The locality, in a moraine landscape of hills and deeply eroded valleys, is in Vindum Parish, Middelsom District (fig. 1).

In 1990, Viborg Stiftsmuseum was called to the same farm in Brandstrup, because Kjær had encountered numerous stones while grubbing one of his fields. They lay on a hilltop, at a spot where in dry summers there were a couple of distinct square patches with enhanced growth. The new site lies 300 m north of the equestrian grave and is separated from it by meadowland (1).

The hill consists of pure clay and has steep sides, and a top plateau measuring c. 20 x 25 m. The plateau was completely excavated, whereas practical and financial considerations restricted us to driving sounding-trenches down over the hillside.

In the central part of the 625 sq.m. large area, two bole coffin graves from the Late Roman Iron Age, an undated grave from the Iron Age or Viking Age, two chamber graves from the Viking Age, some undated structures, and a couple of modern disturbances, were found (fig. 2).

In the following, only the Viking Age graves will be treated; the Iron Age graves are presented in another context (Iversen & Nielsen 1996).

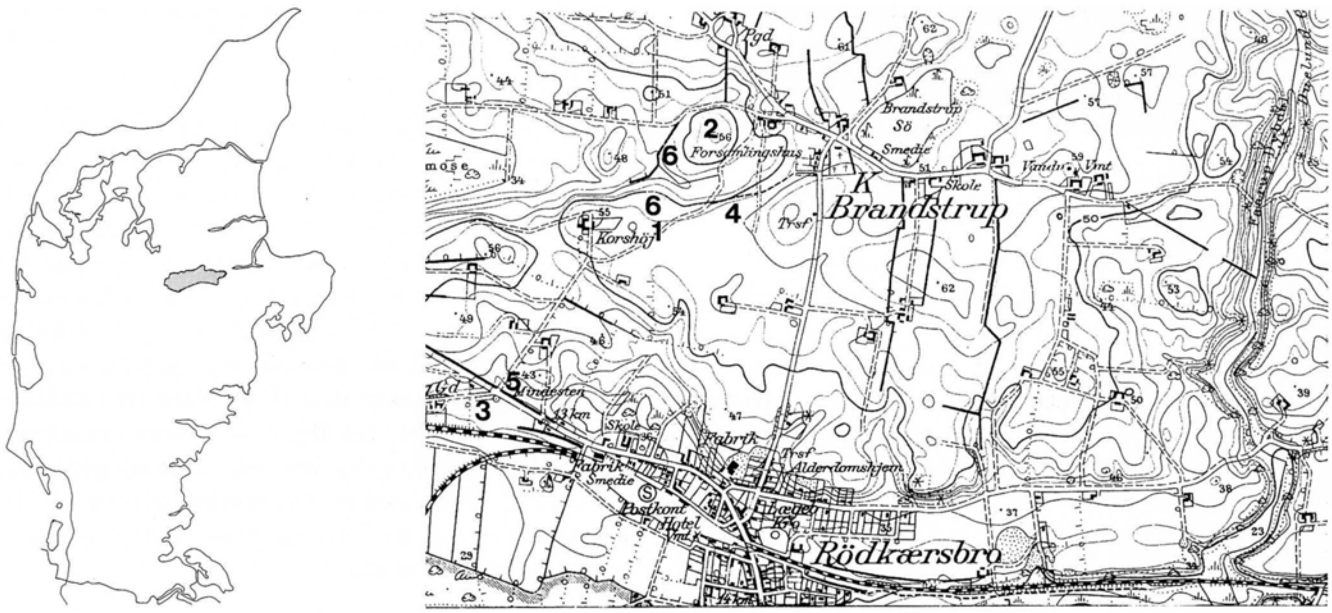


Fig. 1. Map of Denmark with Middelsom District and Brandstrup marked. Detail 1:25,000. 1, Brandstrup I; 2, Brandstrup III; 3, Faldborg Church ruin; 4, Viking Age farm; 5, Germanic Iron Age farm; 6, Early Medieval house ruin. Reproduced by permission of *Kort og Matrikelstyrelsen* no. A.404/85.

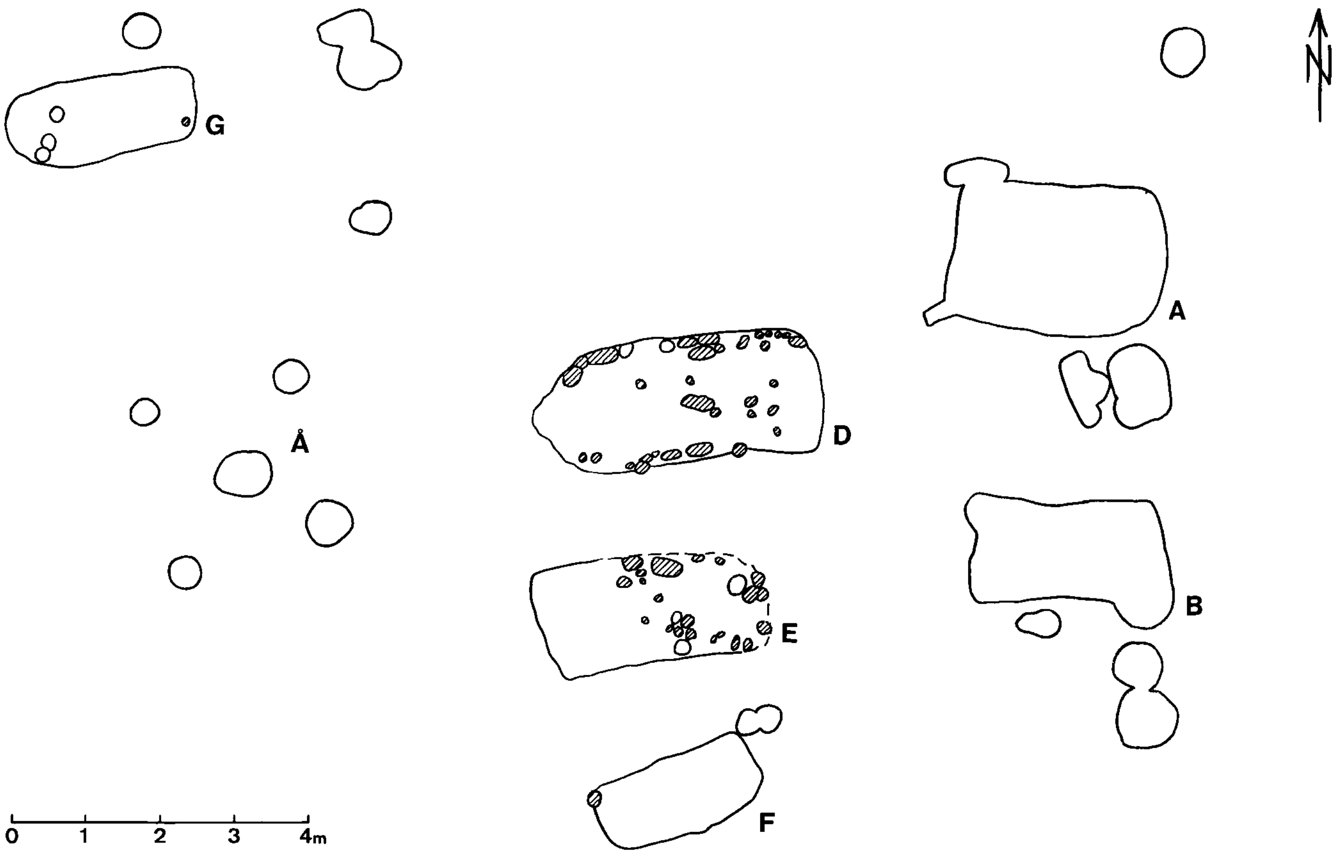


Fig. 2. Plan of the cemetery. A and B: Viking Age chamber graves; D and E: bole coffin graves from the Late Roman Iron Age; F: modern excavation (or empty grave); G: plank coffin with an undated iron knife; Å: undated structure. 1:200.

## THE GRAVES

The two chamber graves lay side by side, 2 m apart, and were oriented E-W.

In the fill of the northern grave there were occasional traces of turf construction, whereas the fill in the southern grave, which was not set so deeply in the subsoil, was quite uniform, but otherwise of the same dark colour and character. Over the first, grave A, a barrow must have been raised, which the second, grave B, was later set into. The barrow must have completely disappeared a century ago, for it is not even registered as a vestige in the National Museum's parish perambulation of the 1880s, but there is nevertheless a remembrance of it, because there is a story that the hill sometimes rose on pillars and that pixies danced under it. Ejner Kjær was also warned by his grandfather not to go near the hill, because it could be dangerous (2).

There is nothing to suggest that a barrow was raised in connection with the older burials at the site. It cannot be determined whether the chamber graves respect these burials by chance or there was a marking which lasted 600 years, the vegetation perhaps revealing the position of excavations and stone settings. There was no difference in the nature of the fill and the location of the erosion layer in the two Iron Age graves, and one must therefore assume that they either lay outside – which is not possible (cf. fig. 2) – or were completely covered by, the Viking Age barrow, which consequently had a radius of at least 8 m. The absence of stones at the west end of one of the Iron Age graves is due to a modern superficial disturbance.

### *The chamber graves*

*Grave A* was visible in the subsoil surface as a blackish

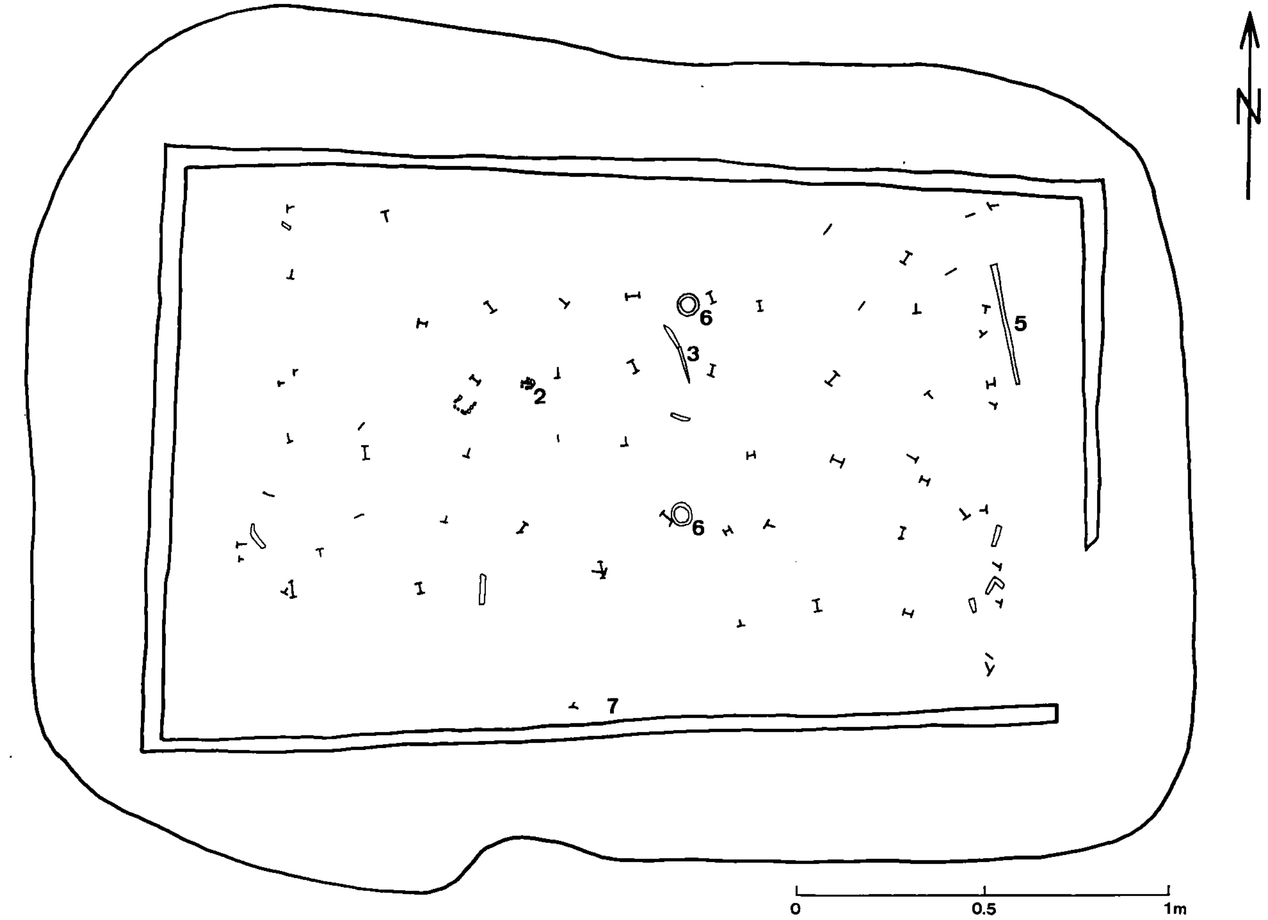


Fig. 3. Grave A. Plan of floor level with all finds marked. 1: teeth; 2: glass beads and silver object; 3: iron knife; 4: whetstone; 5: wax taper; 6: carrying rings; 7: chamber walls. The plan also shows iron fittings, rivets, nails and nail tips. 1:20.

brown rectangular patch measuring 2.80 x 1.90 m.

The actual chamber was slightly trapezoid and had inside dimensions of 2.40-2.45 x 1.50-1.35 m, the east end being the narrower; it was set c. 65 cm into the subsoil (fig. 3-4).

The walls could be followed as dark stripes of decomposed wood from the base and 30 cm up, and at the west end the lower 6 cm of the wood was so well preserved that it could be seen to be a plank (3). The horizontal wall planks rested directly on the floor of the grave, and in only a few places were there traces of a shallow groove in the subsoil clay. There were no nails or fittings in the wall line, and the plank marks were too indistinct to reveal how the corners of the chamber were joined. Up to a height of c. 40 cm over the floor, the interval between the chamber wall and the grave-pit wall was filled up with subsoil clay (with the exception of part of the south wall, where the innermost 10 cm were apparently grass turfs). Above this, the fill was the same inside and outside the chamber wall, namely dark grey fill with a few stripes and lenses of the nature of grass turf (barrow fill). Whether the chamber itself merely reached the top edge of the clay packing, or was higher, could not be ascertained.

Nails and rivets on the floor of the chamber showed that a wagon body was used as a coffin. This stood along the north wall, slightly askew. The east end was, however, parallel to the east end of the chamber. This wagon body was 1.90 m long, and the width was about 1 m, but cannot be given precisely, since no unambiguous edge or corner fittings were found.

There were traces neither of a lid over the wagon body, nor a roof over the chamber, but the latter at least must have been closed.

Bones and a little bone substance showed that the grave occupant lay head to the west. At the breast was a cluster of beads and a silver(?) coin in connection with a small piece of skin, probably from a purse or bag. At the waist lay an iron knife and a whetstone. Just outside the east end of the wagon body lay a wax taper. Of the wagon body, rivets, nails, fittings and two iron rings were preserved.

Two metres south of grave A was a similar blackish-brown rectangular area, which also proved to contain a chamber grave, *grave B* (fig. 5).

The chamber was rectangular with inside measurements of 2.20 x 1.15 m; it was set only 35 cm into the subsoil. As in grave A, there was between the grave pit and the chamber wall a 10-20 cm wide strip of disturbed subsoil clay.

A mere 2 cm down, the planks in the chamber wall were already sporadically visible, and in the bottom part of the chamber the stripes of decomposed wood were sharply defined against the grave fill and subsoil clay. The chamber was constructed of horizontal planks set

Fig. 4. Grave A. To the left is the wax taper on a soil pillar ready to be taken up as a mount. The plank at the west end is seen to the far right. In the foreground to the right is a strip of subsoil clay that was placed over the chamber floor, perhaps to support the wagon body. The walls of the chamber are most distinct to the right of the section. Viewed from the north.

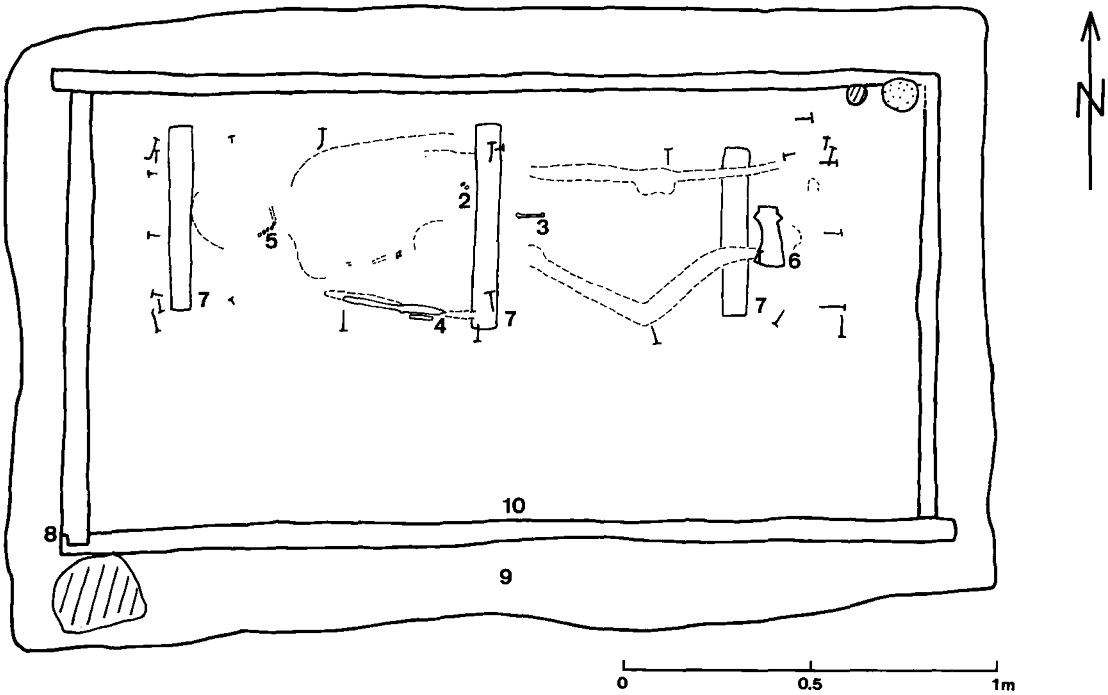


Fig. 5. Grave B. Plan of floor level with all finds marked. 1, bronze ring (for sliding fastener); 2, disintegrated bronze; 3, strap end; 4, iron knife and whetstone; 5, teeth; 6, iron axe; 7, traces of transverse planks under the coffin; 8, chamber wall joint; 9, clay packing; 10, chamber wall. The plan also shows nails, bone traces and stones. 1:20.

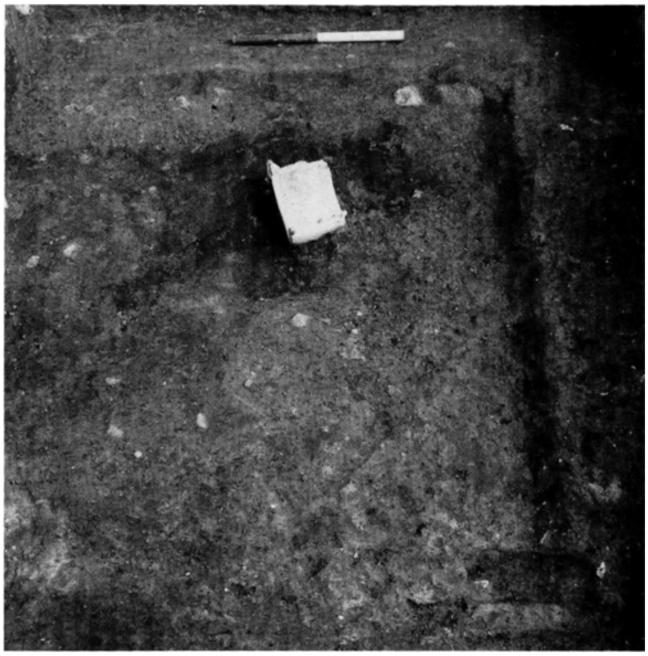

Fig. 6. Grave B. East end of the grave at floor level with traces of the chamber's plank walls and in the background the mount with the axe. To the left the outstretched left leg and bent right leg of the body are seen as dark stripes. Viewed from the S.

on edge, and in the NE and SE corners the side planks were seen to have continued some few centimetres beyond the end planks (fig. 6). Along the north wall, a rectangular soil mark measuring 1.85 x 0.65 m with nails at the edge revealed the position of the coffin. This had stood on 3 transverse planks measuring c. 50 x 5 cm, pressed a short way into the subsoil clay. There were no clear traces of a lid to the coffin, although some of the nails lay so that they could have belonged to one, whereas planks covering the chamber were evident in the section as a thin stripe of decomposed wood 10-20 cm over the floor.

Teeth and bone mass of the occupant were still preserved, the body lying head to the west, left leg outstretched and right leg bent; the height was at least 1.68 cm.

At breast height there was an iron knife near the right arm and close by the end of the tang a whetstone, at the breast fragments of bronze fittings with a feather attached to the corrosion product, at the waist fragments of a bronze ring, in the region of the thigh a strap end, and at the feet an axe with the edge pointing south.

There was no turf structure in the fill over the chamber cover, probably due to the grave being set into the barrow raised over grave A; this also explains the shallowness of the grave.

Wagon body burials are normally womens' graves, and the cluster of beads on the breast of the deceased confirms that grave A contains a woman. Ordinary coffins can, on the other hand, not be used to establish the sex of the occupant, and in the case of grave B it is therefore the grave goods, weapons, which indicate that it is a man's grave.

### *The finds from grave A*

*Iron knife* (978E198) (fig. 7) with silver inlaid blade and silver winding on the shaft.

The knife was taken up as a mount and is known only from radiographs, being so poorly preserved that it cannot be freed. It is c. 18 cm long, with a c. 7 cm long blade and a c. 3 cm long tang; the handle is c. 11 cm long. The tang is offset from the blade, which is angled near the point.

The blade is decorated on either side with two rows of silver dots in panels delimited by thin silver wire. The winding around the handle is in three groups: at the top three broad bands, in the middle two broad bands, and near the blade three broad bands separated by two narrow ones. The broad bands consist of 8-10 windings, the narrow of three. Along the back of the handle there is a 2-ply silver wire.

Knives with silver winding on the handle are fairly common in well-appointed men's and women's graves (Müller-Wille 1987:58 with refs.), whereas inlay in the blade is very unusual. A knife from the Bogøvej cemetery on the island of Langeland (Grøn *et al.* 1994:130, 162f. & fig. 137) and a knife from the PK Bank in Lund (Nilsson 1976 fig. 196) are the only ones otherwise known from Viking Age Denmark, and there are apparently none in the rich Norwegian and Swedish Viking Age finds (4).

The special character of this knife emphasizes that the dead woman was a person of rank, and it cannot be her social background, but other circumstances, that determine the otherwise meagre furnishings in this grave.

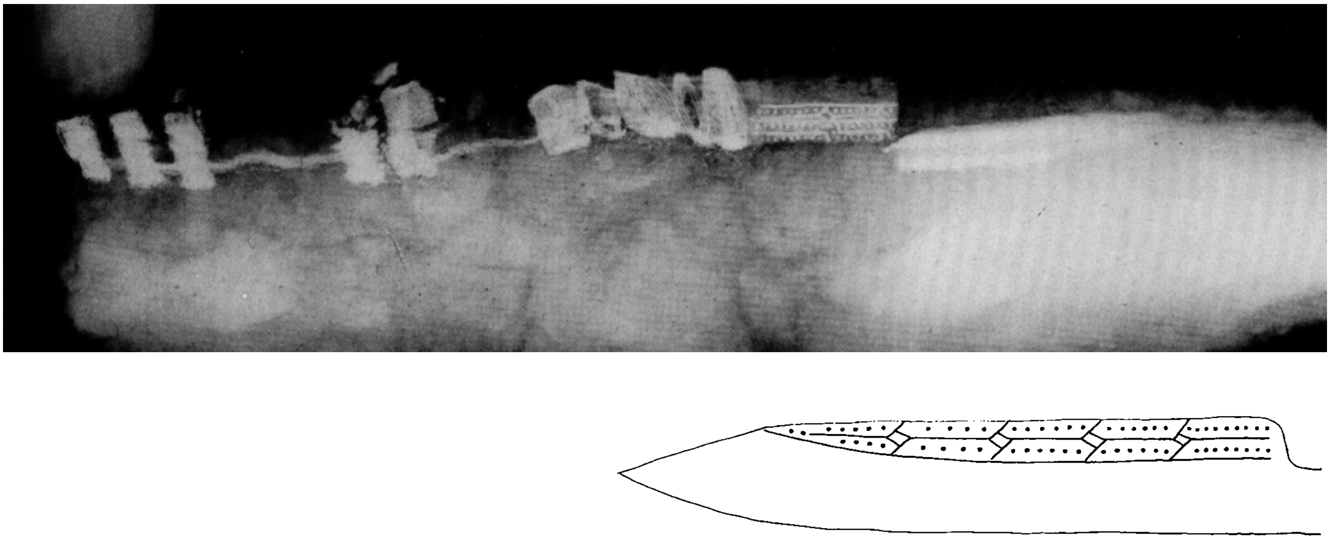

Fig. 7. Grave A. Roentgenogram and drawing of knife with silver inlay.

*Whetstone* (978E202) (fig. 8), which lay with the knife, is of so-called purple slate (5).

It is rectangular to square in section and tapers towards the end, perhaps due to heavy wear. The tip must have broken off at an early stage due to a fault in the material. At the top there is a large hourglass-shaped suspension hole. Length 63 mm, width and thickness 95 x 60 mm at the top and 60 x 70 mm in the middle.

The other finds from the wagon body lay in the breast region and were taken up as a mount (fig. 9). This proved to contain *skin, a circular silver object* (978E127), *8 beads* (978E205-210 and 978E139) and *coffin beetles.*

The skin is too decomposed to decide whether it was fur or leather. It is probably the remains of a small bag or purse holding the beads and the silver object.

In the Birka graves, 57 bags and purses of skin have been found, 12 of them of a simple type without metal fittings, etc. (Gräslund 1984; Arbman 1940, 1943). Most of the bags or purses of the simple type (and also of the total material) have contained coins. Some of them contained weights, and bronze buttons, beads or mirror fragments have also been found.

Skin bags are rare in Danish graves – doubtless because they are preserved only if they have been in contact with metal, and coins and weights are not a part of the normal grave goods here.

In Stengade grave BØ were found near the female occupant's upper arm a leather bag with two spindle whorls, a seam smoother, two lumps of amber and a bronze box that contained bullace pits, an iron rivet, two glass beads and a glass sherd (Skaarup 1976:91ff.).

In Stengade CC a snippet of cloth or skin containing 15 Arabic coins was found (one of them unstamped) under the chin of the male occupant, and in front of the woman in grave AV was an Anglo-Saxon coin wrapped in "some open-weave cloth, which was probably the remains of a small purse" (Kromann 1976).

Coin finds in graves are just as unusual as skin bags;

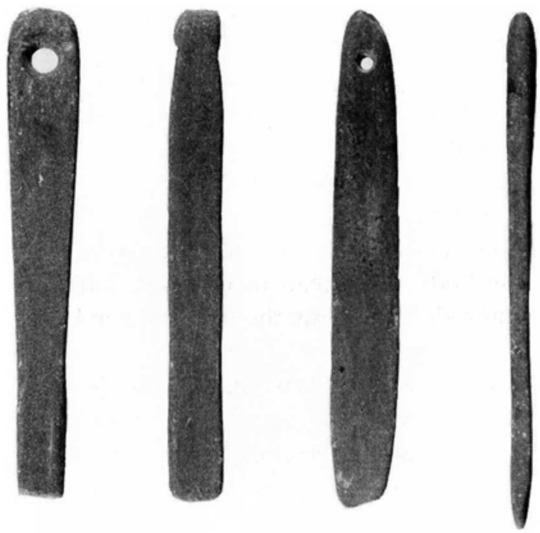

Fig. 8. Whetstones from graves A and B. 1:1.

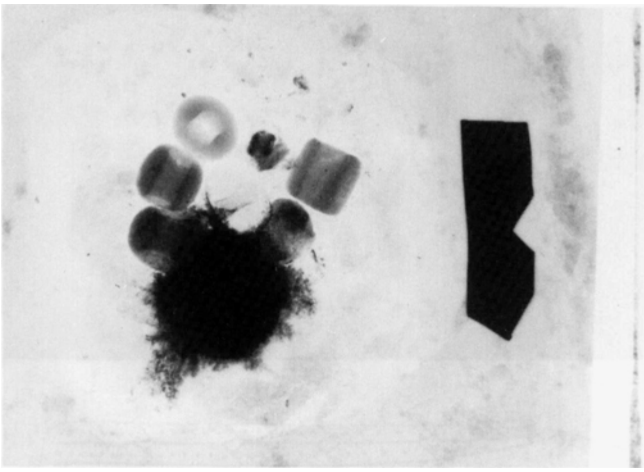

Fig. 9. Roentgenogram with beads and ?coin.

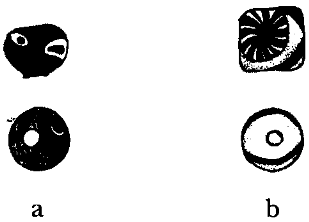


Fig. 10. Grave A. Mosaic beads. 1:1. Mohan S. Arulanandam del.

Fig. 11. Grave A. Coffin beetles (*Rhizophagus parallelocollis*).

Kromann states that apart from the Stengade graves, only five Danish graves are known that contain coins (6). One of these graves in particular is interesting in this connection: in the equestrian grave at Brandstrup, three Hedeby half-bracteates were found, so the custom of furnishing the dead with coins was well known here. The coins in Brandstrup I were likewise at breast height, but there were no traces of a bag, whereas a little iron adhered to one of them.

Many coins in a grave are usually considered to be a burial gift with the same function as other grave goods, whereas a single coin or fragment is often interpreted as a Charon's coin (despite the fact that in the Viking Age it was not placed in the mouth but usually on the breast or in front of the face) (Gräslund 1967; Kromann 1976; Müller-Wille 1976). In the Stengade cemetery, both types of deposition are represented, and the same may apply in Brandstrup (7).

The *circular silver object* has a diameter of c. 1.7 cm but is so corroded that it cannot be extracted from the mount, and the X-ray pictures unfortunately do not help us to a better identification, for there are no traces of suspension hole, eyelet, coin stamp or other decoration.

The radiographs have been shown to conservator Birthe Gottlieb of the National Museum, Copenhagen, and to Anne-Sofie Gräslund, University of Uppsala, both of whom considered the object to be a coin. Anne Kromann of The Royal Collection of Coins and Medals, Copenhagen, has also informed me that it is by no means unusual for the stamp on a coin to be invisible in an X-ray picture.

Based on these expert pronouncements (and the presence of an unstamped coin among the Stengade coins), and on the Nordic comparanda, the most likely interpretation of a circular, flat silver object in a skin bag on the breast of a corpse is that it is a coin.

Under the skin and silver coin lay *8 beads*: A rounded bead with hourglass-shaped perforation; a ring-shaped bead of blue translucent glass; a barrel-shaped bead of semi-translucent glass; a barrel-shaped bead of orange opaque glass; a barrel-shaped bead of brownish-red opaque glass; a round bead of brownish-red opaque glass with three mosaic eyes in brownish-red, white and blue (fig. 10a); a cylindrical bead of greyish-white opaque glass with two crossing trails in brownish-red and two mosaic eyes in reddish-brown opaque glass with white trailing (fig. 10b). One small bead was particularly distinct on the radiograph, but was destroyed during the excavation of the mount; it was probably of silver foil.

In the west Scandinavian area, it is very common to find even in well-appointed women's graves only a few beads; graves with more than ten pieces are rare (Müller-Wille 1987:55 with refs.; Voss 1991). The beads may lie near the wrist or waist, but usually lie in the breast region and are called bead necklaces (e.g. Skaarup 1976; Müller-Wille 1987). Else Roesdahl remarks on the beads in the Fyrkat graves that "... there were never so many in a grave that they could have made up a necklace. They have doubtless been linked with a short string and thus formed a little pendant ... In other cases the beads may in theory have been inside a now vanished container" (1977:139; translated).

Thanks to the preserving metal salts from the silver(?) coin we know that the Brandstrup woman did not have the eight beads in a string around her neck, but in a little skin bag lying on her breast. Might this not also have applied to some of the other small clusters of beads in Viking Age graves?

The corrosion layer from the silver coin contained, besides skin remains, a large number of small beetles, *Rhizophagus parallelocollis*, "coffin beetles" (fig. 11). These are found in rotten and mouldy wood, in compost, and in coffins, where they are thought to live on the fats of the body, and they have been observed in huge swarms in churchyards. A thousand years ago, some of these beetles must have got into the chamber – perhaps with the planks of which it is constructed, or they were attracted by the smell of the corpse. Here they flourished and multiplied, and the beetles that ended their days on the breast near the silver coin became impregnated and have been preserved to the present-day (Skytte 1992).

Outside the wagon body, on the floor between its east end and the east end of the chamber, lay a *wax taper* (978E80) (fig. 12). Length 29.5 cm, diameter at base (the northern end) c. 1.8 cm, at the top c. 0.9 cm.

The taper has been formed by rolling up a 2 mm thick sheet of beeswax with thin slaty structure. It is hollow, but without traces of a wick. The half that lay uppermost in the grave is missing, and the two breaks are old (not an excavation artefact!). One edge is distinctly wavy on the lower 4-5 cm, as after gnawing by a mouse. Before the chamber was filled with earth it thus

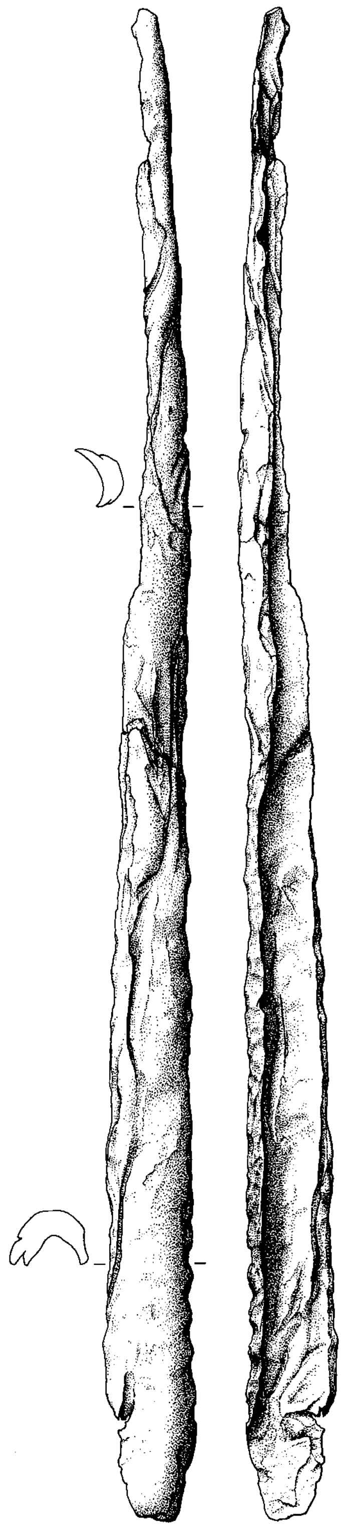

Fig. 12. Grave A. Wax taper. 2:3. Orla Svendsen del.

sheltered a small rodent. The taper is earthy-brown like an old root and quite nondescript in appearance. It is not unlikely that tapers of Brandstrup type have been overlooked in other Viking graves, for since 1868 the Mammen candle, which is of an entirely different calibre, has been *the* example of a Viking Age candle which everyone knew.

The Mammen candle is 57 cm long, 8-10 cm wide, compact and made of rolled-up thick wax sheets, i.e. quite different from the Brandstrup specimen (Leth-Larsen 1991).

Two pieces of a taper of at least 7 cm in length and 2 cm in thickness, with a c. 0.6 cm thick wick hole, come from the North Barrow at Jelling, where it was found *over* the burial chamber, beside the broach in the roof. The taper is C14-dated, and there is a strong likelihood that it comes from the period 970-1015, i.e. it cannot belong to the burial, but might have been placed there by Harold Bluetooth when he had the chamber opened in order to move Gorm (Krogh 1993:233ff.) (9).

During examination of the grave goods from the chamber grave at Søllested, Anne Pedersen has recently identified a further wax taper from the Viking Age. It is 13 cm long, 2-4 cm thick and compact, with a 6 mm wide wick hole. As in the Brandstrup taper, the wax is clearly laminated (10).

Close parallels to the Brandstrup taper are thus not present in the meagre Danish material and not at all in the rest of Scandinavia, but are present in the area of the Rus'. The tapers from settlement layers from the late 10th century in Novgorod, among other places, and from contemporary graves in i.a. Gnëzdovo, closely resemble the Brandstrup taper (11). As an example, those in graves C-301 and C-306 in Gnëzdovo, which contained 11 and 12 tapers respectively, were like the Brandstrup taper as thick as a finger, hollow, made of thin rolled-up wax sheets up to 25 cm long, and placed at the east end. Both the burial custom and the grave goods in these Rus' graves are in accordance with Scandinavian graves, and the dendrodating of grave C-306 to 979 lies close to that of the Mammen grave (Avdusin & Puškina 1988; Harald Andersen 1991).

As long as tapers are so unusual in Nordic context, one is tempted to rely heavily on the few parallels that are found. Whether the Brandstrup taper was actually imported from the Rus' can hardly be decided (12), but that it like the taper (and gold spangles) from Mammen is an indication of eastern contact is a reasonable assumption (Iversen & Näsman 1991).

On the Continent, wax tapers had been known for centuries, and it is not relevant to bring this extensive material into the discussion; a single parallel should be mentioned, however: at the Alemannic cemetery of Oberflacht from the 6th-7th century, 3 wax tapers and 9 wooden candlesticks that were either for wax tapers or bowls with burning oil have been found. All the candlesticks were placed like the Brandstrup taper, outside the coffin at the foot end, while the position of the tapers is not known (Paulsen 1992:130ff.).

To the wagon body itself belonged 2 *rings* of iron with an outer diameter of c. 6 cm (978E188 and 978E199); at least 6 *rectangular iron fittings*; at least 20 *rivets*, a few of which may be measured (the plate is lozenge-shaped and measures c. 3.3 x 2.6 cm, and the distance between head and plate is c. 3.1 cm); at least 50 *rivet fragments or nails* with a usual length of 2.4 cm and a usual head diameter of 1.7 cm. On some of the rivets and nails, wood is preserved. The iron parts lie in four rather neat longitudinal rows at intervals of 20 cm (fig. 3), and the wagon body must thus have been made of five planks about 20 cm wide. The rings lay in the two upper rows, slightly east of the centre; on each side of the body there was thus a ring near the junction of the upper and lower plank.

The assemblage corresponds exactly to what one sees in the other wagon body graves – a grave form that may be linked with the 10th century's wealthy women in the Danish area (Müller-Wille 1987:26ff with refs.; Voss 1991; find list in Näsman 1991a appendix 4).

Finally it should be mentioned that there was an impression of a feather on a rivet, so there must have been an eiderdown or pillow in the wagon body.

Scattered in the grave fill, a few undated sherds have been found.

### *The finds from grave B*

*Iron knife* (978E203), highly corroded and covered by a thick layer of rust and wood, with an 11 cm long offset tang and a c. 10 cm long blade with slightly arched back.

*Whetstone* (978E204) (fig. 8) of so-called purple slate (5). The whetstone is very flat and worn thin, and tapers

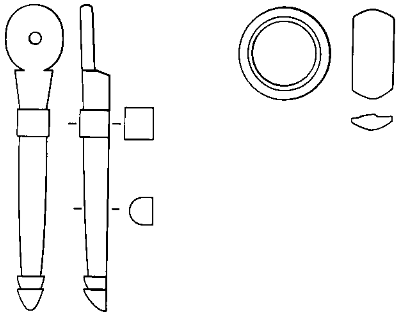

Fig. 13. Grave B. Sketch of strap end and ring from sliding fastener. 1:1. Orla Svendsen del.

towards the top where it has a small hourglass-shaped suspension hole. Length 65 mm, greatest width 9 mm, thickness 2-4 mm.

*Axe-head of iron* (978E88) with remains of wooden shaft, of Petersen type H(K). The axe is likewise highly corroded, and it cannot be discerned whether it had shaft-hole flanges. The blade is slightly splayed along the lower edge and in all 18.5 cm long with an edge length of c. 10.5 cm. The neck face is flat and measures 4 x 4 cm, and the shaft-hole rounded triangular.

Knife and whetstone are the commonest equipment in 10th century men's graves, nor is the axe rare (Näsman 1991a with refs.). The position – knife and whetstone by the arm and axe by the foot with the shaft upwards – is likewise normal, so judging by the grave goods the occupant cannot be considered a prominent person.

Small fragments of double *bronze foil* (978E66), found near the breast, are perhaps from a strap chape.

*Stave-shaped strap end* (978E98) (fig. 13). Length 4.0 cm, thickness 3-5 mm. It is highly corroded, but the shape can nevertheless be discerned. In section it is round on top and flat below. The tip is profiled. Below the notched top, which is circular and with a rivet-hole, there is a heavy fillet.

Small *bronze fragments from a ring-shaped object* (978E164) (fig. 13) with a diameter slightly under 2 cm and height c. 0.5 cm. The inside of the ring has had a small angular bead, and the outside was roof-shaped.

Considering that the fragments were found at waist height, and the strap end near the pelvis, an identification as belt-ring in sliding fastener seems reasonable (cf. for example, the sets with ring-shaped strap end and rings of the same size and almost the same shape in Stengade grave DW, Dover grave 132 and Oldenburg graves 17 and 19 (Skaarup 1976:105 & 270; Petersen 1989:50f.; Gabriel 1989:224ff.; see also Iversen & Näsman 1991:52f. and Grøn *et al.* 1994:124).

Sliding fasteners may be considered the accoutrements of a fine dress, and among the not so numerous finds there are also several that derive from very rich graves. The Brandstrup piece seems very insignificant, however, like the rest of the grave goods, but the association of grave B with the neighbouring grave A, and perhaps also with the equestrian grave Brandstrup I, does make it likely that the deceased held a certain position in society – the interpretation of the belt type as a possible indication of rank is thus still open.

From the coffin itself come at least 35 *iron nails.* The length varies between 5.1 amd 7.4 cm, with a usual length of 6.3 cm. The heads are between 1.5 and 2.4 cm in diameter, usually 1.8 cm. Remains of wood are seen on many of the nails.

Finally, it should be remarked that remains of feathers show that the deceased had an eiderdown or pillow.

Scattered in the grave fill a few undated sherds were found.

## DATING

Grave A falls within the group of rich graves from the last third of the 10th century, which is characterized by a pagan grave form (chamber in a barrow), but only a few grave goods, which may have a Christian character. A securely dated representative is the Mammen grave from 970/971. Many of the wagon body graves (e.g. Roesdahl 1971, 1977; Voss 1991) belong to this group.

Grave A and the Mammen grave have certain very unusual features in common, which are considered to be the result of Christian influence. The use of wax tapers is normally held to indicate Christianity (Gräslund 1991; Leth-Larsen 1991). In the late 10th century, however, when paganism was gradually replaced by Christianity, it is naturally an open question whether the person buried with a wax taper was himself a convinced Christian, or whether it is the belief of the surviving relatives which is reflected (Iversen & Näsman 1991). It should, though, also be remarked that Peter Paulsen in his discussion of the significance of tapers lays emphasis on the link with pre-Christian folklore and does not plead the presence of tapers or candlesticks in the Oberflacht graves as an indication of Christianity (Paulsen 1992: 130ff). Also the trapezoid shape of the two chambers, the east end being the narrower, is a feature that may reflect Christian influence (Gräslund 1991:207), and the position of the taper to the east increases the strength of the symbolism.

The finds in grave B cannot be dated more closely than to the 10th century, but as the grave is stratigraphically later than grave A, it must also have been established in the last third of the 10th century. This accords with the type of grave – a chamber grave with only an axe, not a whole set of weapons (in contrast to the equestrian grave Brandstrup I), i.e. a very finely appointed grave with modest grave-goods – which first and foremost belongs to the end of the 10th century, when the influence of Christianity limited the weapon trappings (cf. Näsman 1991a).

The difference in date between grave A and grave B cannot be determined precisely, but it is hardly very large, and it is tempting to believe that the two interred persons were of the same generation – husband and wife.

## CONCLUDING REMARKS

Graves A and B are later in date than the equestrian grave Brandstrup I, which is dated to the first half/ middle of the 10th century. Considering that Brandstrup I and III lie in a field on the same farm, it seems likely that it is a question of two generations of the same family, i.e. the rider who lay 300 m away is the father or grandfather of one of the spouses. The next generation was presumably completely Christian, so their graves will probably never be found.

Where the magnate farm belonging to these graves was situated, we do not know (13). The graves lie 700 and 1000 m NNW of the Romanesque Faldborg Church (fig. 1), which was demolished in 1655, after the parish had been amalgamated with Vindum Parish in 1653. At this point of time there were no large farms in Faldborg Parish.

A mere 2-3 km east of the Brandstrup cemetery is

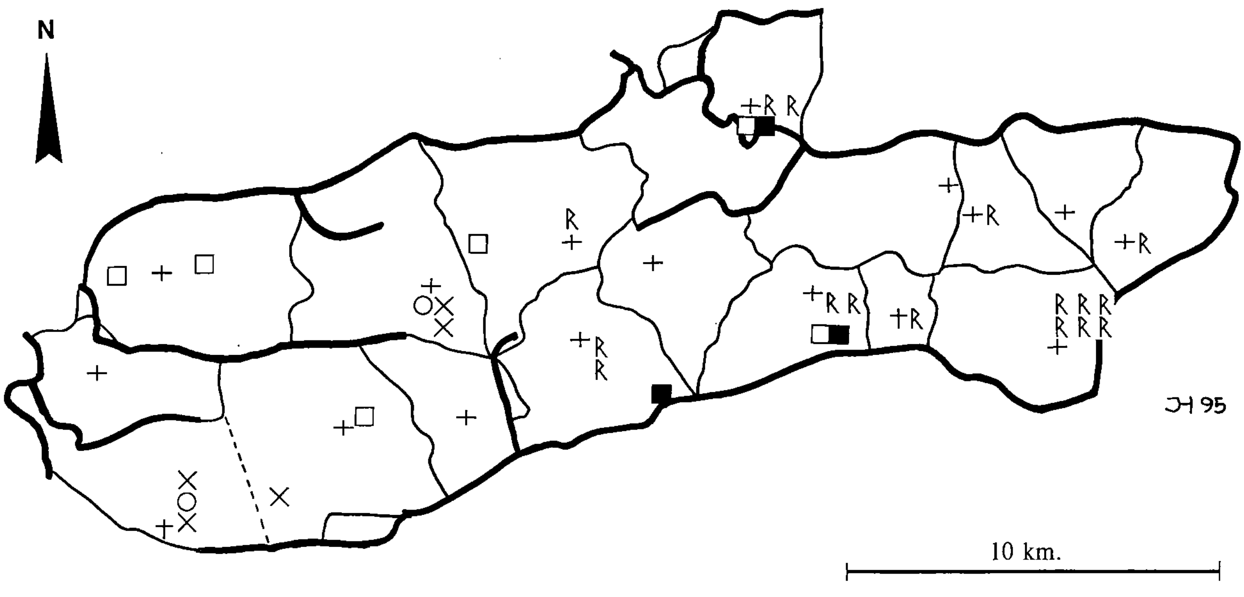


Fig. 14. Middelsom district. – parish boundary; + Romanesque church; † church ruin; X Viking Age chamber grave or hoard; R runestone; ■ Medieval castle mound; □ later home farm; O Viking Age settlement; ▬ river.

Fårup, Vindum Parish, where in a barrow a woman's grave with gold-worked costume bands, a silver-wound knife and down pillows was found in the last century. Brøndsted's dating of the grave to the latter half of the 10th century is still valid (1936 no. 36), and the deceased has thus lived at the same time as the Brandstrup clan.

8 km to the NE lies Mammen, Mammen Parish, with both the hoard with gilt bronze fittings for a set of collars, caskets, etc., in Jelling style (Näsman 1991b), and the chieftain's grave from 970/971 with the silver-inlaid axe in Mammen style, the fine costume, wax candle, etc. (Iversen *et al.* (eds.) 1991).

In three contiguous parishes there is thus evidence of the presence of magnates in the latter half of the 10th century, and in Brandstrup the clan may be followed back to the first half of the 10th century.

The parishes of Faldborg, Vindum and Mammen are all in Middelsom District, which comprises 17 parishes, 15 of which are bordered by the large navigable rivers Nørreå, Gudenå and Tangeå. Only the two most westerly parishes, Sdr. Rind and Faldborg, lie on small tributaries. With respect to communication, Middelsom District is ideally situated in the centre of Jutland and adjoining Viborg where a thing had presumably already been established in the 10th century and at least from the 11th century (Nielsen 1973).

The three sites with distinguished finds in the westernmost part of Middelsom District correspond to 16 Viking Age (Jelling and post-Jelling) and one Romanesque runestone from 8 parishes in the central and eastern part of the district (fig. 14) (Moltke 1985; Stoklund 1991; Iversen *et al.* (eds.) 1991:9 fig. 3).

In most of the parishes in the district there are thus finds (graves or runestones), which point directly to the presence of magnate clans in the latter half of the 10th century, and a patent future research objective is to trace the contemporaneous magnate farms.

A well from c. 963 (Iversen 1993), a house site from the late 10th century, and the presumably coeval hoard, all in the immediate vicinity of Mammen Church (Iversen 1991:27, figs. 3-5) hint that it is perhaps in the vicinity of the churches that we should be looking (see for example, the magnate farm at Lisbjerg, Jeppesen & Madsen 1991, and at Tamdrup, Schiørring 1991; Hvass *et al.* 1991), and the same indication is perhaps given by many of the runestones found in or near churches (Skjern 1, V. Velling, Ø. Velling, Grensten, Langå 4-5-6, Torup, Sdr. Vinge 2 and Lee) (14).

The three Medieval castle mounds, Skjern in the valley of Nørreå, and Kellinghøl and Ulstrup on the Gudenå, should not be overlooked either; for example the Skjern 2 stone was found during the demolition of Skjern Castle and the Sdr. Vinge 1 stone comes from Ulstrup.

Finally, an investigation around the Late Medieval and subsequent home farms can perhaps also yield pertinent information (*cf.* Riddersporre 1989). The future will presumably show whether the wealthy Middelsom District can support the assumption that the magnate clans of the Viking Age made a mark lasting well into the following centuries, not merely in the form of graves and runestones, but also with a tradition-bound site continuity from magnate farm to church (a possibility already aired by Olsen 1966 *passim.* And if the clear pattern with rich grave finds or runestones in practically all the parishes of Middelsom District can also be demonstrated elsewhere in Denmark, it also reveals something of the social structure in Viking Age Denmark.

*Translated by Peter Crabb*

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NOTES

This article was submitted in June, 1993, with a few additions in January 1995.

1 Brandstrup I is registered at Forhistorisk Museum, Moesgård, under file no. FHM 336, Brandstrup III at Viborg Stiftsmuseum under file no. 978E. The Brandstrup III excavation was financed by the State Antiquary and carried out by Inge Kjær Kristensen and the present authors.

2 Farmer Ejner Kjær heard these two stories in his childhood in the 1920s. They are not recorded in Dansk Folkemindesamling.

3 The plank was so fragmented that a dendrochronological analysis can give only a *terminus post quem* dating. The specimen contained 70 annual rings and was felled after 919. The analysis was performed by Carsten Sønderby, Wormianum.

4 Knives with silver inlay have been discussed with Ingmar Jansson, University of Stockholm; Henriette Lyngstrøm, University of Copenhagen; and Bjarne Lønborg, Odense Bys Museer, Bevaringsafdelingen.

5 The material was identified by Head of Department Søren Floris, Geological Museum: "Both 978E202 and 978E204 consist of purplish-brown metasiltstone (slightly metamorphosed very fine-grained quartz sandstone) with a considerable content of muscovite mica, linear structure, very small black grains and very thin quartz veins. The stones may be referred to a group of Viking Age whetstones of so-called purple slate of uncertain provenance (perhaps from West Norway). *Såvel 978E202 som 978E204 består af violetbrun metasiltsten (let omdannet meget finkornet kvartssandsten) med betydeligt indhold af muskovitglimmer, stænglet (lineær) struktur, meget små sorte korn og meget tynde kvartsgange.Stenene kan henføres til en gruppe vikingetids hvæssesten af såkaldt violet skifer af uvis proveniens (måske fra Vestnorge).* (Hald 1991; Myrvoll 1991)." (Letter of 9.6.1993).

6 Two new finds from Langeland have been published in Grøn *et al.* 1994:134f.

7 The material from Brandstrup is too meagre to contribute to a discussion as to whether there are two kinds of deposition or just one.

8 The wax has been identified microscopically and by gas chromatography by Jens Glastrup, Preservation Department of the National Museum.

9 A diverging opinion is presented by Harald Andersen (1995).

10 The information on the taper has been placed at my disposal by Anne Pedersen and will be published by her in: "Søllested – nye oplysninger om et velkendt fund", Aarbøger for nordisk Oldkyndighed og Historie 1994 (in prep.).

11 When Tamara Puškina, University of Moscow, during a visit to Viborg in August 1991 was shown the Brandstrup taper, she said that it completely resembled those she herself has excavated in among other places Gnëzdovo.

12 A sample from the Mammen taper has been unsuccessfully subjected to pollen analysis with a view to establishing the provenance (Iversen & Näsman 1991:61).

13 Occasioned by road-building, excavations were undertaken in 1994 between the equestrian grave and the meadows. Remains were found of at least two enclosed Viking Age farms, but apart from some pit-houses, traces of building were very poorly preserved; there is, however, nothing to suggest that one of them was a magnate farm.

14 During excavations in 1994 just north and east of Faldborg Church, traces of Bronze Age structures and a single house from the Early Middle Ages were found.

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# Debate

## Emergence of the Single Grave Culture

### - a Regional Perspective

by HUGO H. SØRENSEN

In the 8th volume of this Journal K. Kristiansen re-initiated the debate on the issue of migration in the Middle Neolithic. The ensuing discussions have re-focussed attention on the development of Middle Neolithic societies, but they have not however led to a shift of position in favour of explanations viewing migration as an important or triggering factor.

In the following discussion a local example from East Jutland is used to illustrate the complexity of the evidence at the time of emergence of the Single Grave Culture (SGC). In East Jutland three of the traditionally defined archaeological culture groups are represented and they are supplemented by a number of finds, that can be seen as a parallel to the Scanian Stävie group. The basic archaeological evidence from the research area lacks much in detail but can contribute by showing some distinct local developments which I believe to be typical of the transition from the Middle Neolithic A to B (MNA, MNB) as defined by P.O. Nielsen (1979).

As C. Damm and L. Larsson have pointed out in their articles in the 10th volume of this Journal, the common traits ascribed to the Single Grave and Corded Ware Cultures across parts of Europe could be seen as expressions of complex social and economic changes in the Neolithic societies rather than the result of migrations.

Whether or not the distinct Single Grave Culture groups in Central and West Jutland represent a migrating population cannot be judged on the basis of the evidence presented here. The problems involved in answering this question on the basis of Danish finds have recently been exellently dealt with by C.J. Becker (1992).

### *Chronology*

In the late seventies and the early eighties the $^{14}C$ chronology seemed to confirm the idea of a succession from Funnel Beaker Culture (TRB) to SGC with Pitted Ware Culture (PWC) placed parallel to the early SGC.

If we calculate averages from uncalibrated dates there is a marked difference between the late TRB on the one side and the PWC, SGC on the other (table 1). Only dates from late TRB phase V in Denmark, excluding Bornholm, and from the Under Grave Period of the SGC are used. The averages reached here more or less conform to the ones used by L. Larsson (1993, 205). The dated material and its context is however very different in the three groups. The TRB and PWC dates are all from settlements and predominantly from short-lived material. In contrast the SGC dates are all from oak charcoal from graves. The oak might have had a considerable age at the time of deposition. The geographical context also varies considerably, the TRB dat-

| | | Material | | | | | Context | |
|---|---|---|---|---|---|---|---|---|
| | Avg. BP | Charcoal | Wood | Seashell | Bone | Other | Grave | Settle-ment |
| Funnel Beaker Culture (TRB) | 4227,5 | 5 | 2 | 2 | 3 | 1 | - | 12 |
| Pitted Ware Culture (PWC) | 4114,3 | - | - | 14 | 7 | - | - | 21 |
| Early Single Grave Culture (SGC) | 4105,7 | 15 | - | - | - | - | 15 | - |

Table 1. Averages of $^{14}C$-dates from the three Danish culture groups and a schematic account for dated material and context. Compiled mainly from datings published in Malmros & Tauber 1977, Tauber 1986, Davidsen 1975, Rasmussen 1986 and in *Arkæologiske Udgravninger i Danmark* 1986 onwards.

ings covering most of the country, while the dates of the early SGC are limited to Central and West Jutland and the PWC datings all come from the Kainsbakke settlement and its nearest surroundings (L.W. Rasmussen 1986 and 1991).

To evaluate further the posibilities of using the $^{14}$C-dates we must also address the issue of calibration. If we apply the calibration curves of Pearson et al. (1986a, 1986b) aided by one of the PC-based graphics programmes it is quite clear, that the $^{14}$C-dates from this period can be stretched considerably to serve what ever idea of cultural development one may favour (e.g. T. Madsen 1990). The subtle chronological problems involved in the interpretation of short term local change cannot be solved using radiocarbon dates alone.

Stratigraphical evidence relating to the transition from MNA to MNB is restricted to very few sites. In Central Jutland early SGC burials follow late TRB-settlements (H.Rostholm 1977) and in East Jutland the coastal settlement Kalvø offers the only published stratigraphy where middle SGC material is found on top of late TRB finds (S.H.Andersen 1983).

With the exception of Bornholm, there are still no $^{14}$C-dates of SGC material and no stratigraphical evidence from the Danish islands, which leaves us relying on typological parallels in the surrounding areas as the major source of information.

The chronological framework of the following presentation is a combination of the traditional cultural entities and a phase comprised mainly of artefacts regarded as later than the beginning of the SGC. The late TRB and the PWC respectively are defined on the basis of settlement finds while the early SGC is defined on the basis of grave finds. The non-SGC early MNB-phase is mainly linked to P.O. Nielsens (1979) definition of thick-butted flint axes of type B (B-axes) and a number of characteristics associated with this group of thick-butted flint axes as proposed by C. Damm (1989; 1991; 1993). The dating of the thick-butted B-axes to MNB is accepted here, but it still remains unclear whether or not the chronological implications of this typology are valid for the whole of Denmark. The regional variation of thick-butted A-axes from late TRB sites with ceramics has already been pointed out by K. Davidsen (1978, 126ff). C.Damms detection of the large number of thick-butted axes with so called B-axe attributes in stonepacking graves might also be part of a regional tradition.

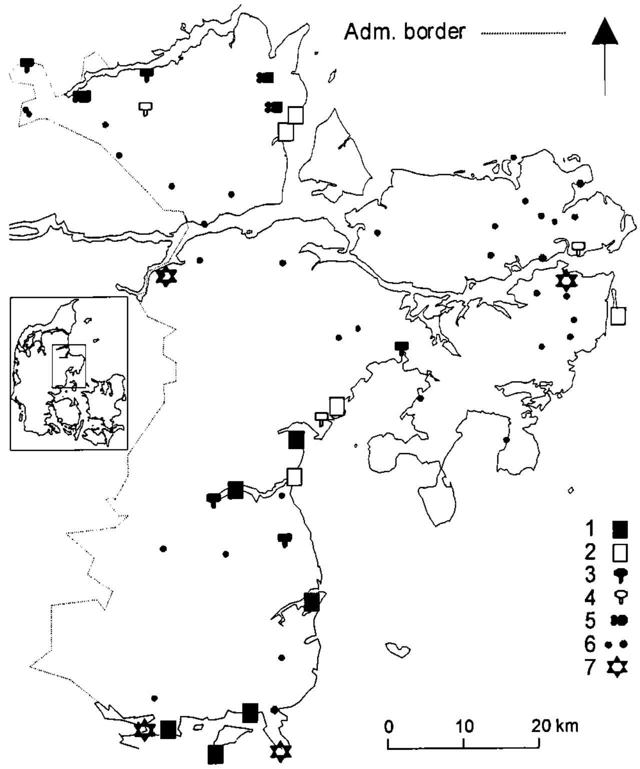


Fig. 1. Late TRB. 1: settlement with late TRB ceramics; 2: settlement with heavy thick-butted A-type axe ; 3: megalith with late TRB ceramics; 4: megalithic grave with heavy thick-butted A-type axe ; 5: stone packing grave with heavy thick-butted A-type axe; 6: single find of respectively one and two heavy thick-butted A-type axes; 7: Single find of battle axes of Ebbesen's type C2. Inset: map illustrating the research area.

The SGC is divided in two parts using P.V. Glob's (1945) battle axe typology so that the early part is represented by battle axe types A – F and the later part is represented by types G – L.

### *The case of East Jutland*

The following examples from my work on material from East Jutland (H.H. Sørensen 1992) are chosen to illustrate the complexity of material patterning at the transition from MNA to B. The distribution maps are based on finds registered at local museums and at the National Museum up until June 1991 (1).

The coastline shown on the maps approximates the Neolithic coastline. The approximation is based mainly on older maps by A. Jessen (1920) and a new survey by K.S. Petersen (1985). The surveys are supplemented by

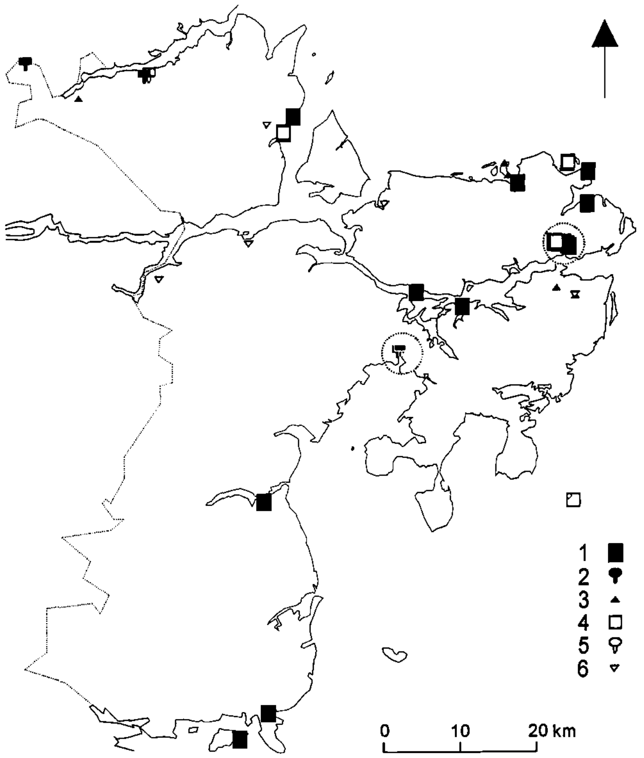


Fig. 2. Pitted Ware Culture. 1: settlement with A-arrow; 2: megalith with A-arrow; 3: single find of A-arrow; 4: settlement with B-arrow; 5: megalithic grave with B-arrow; 6: single find of B-arrow. Circles arround settlements at Kainsbakke and megalithic grave at Åkærslund, both with PWC-ceramics.

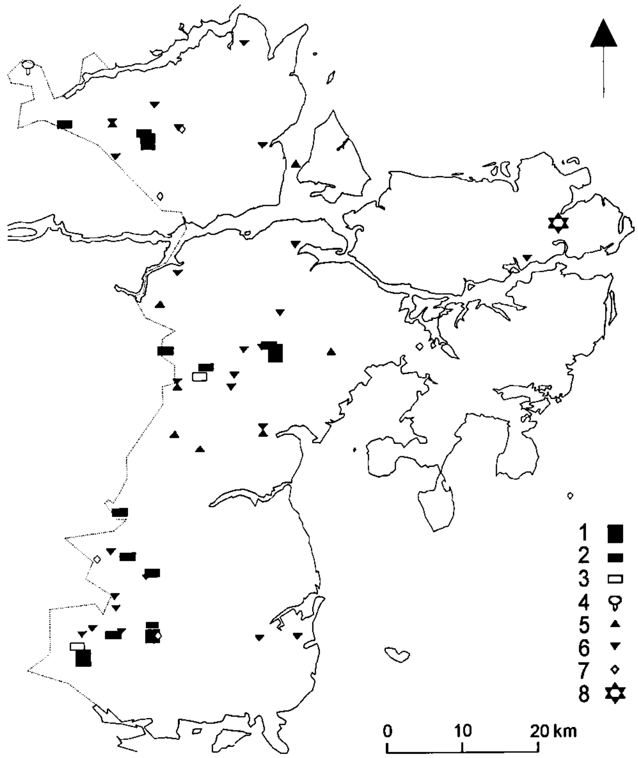


Fig. 3. Early Single Grave Culture. 1: settlement with corded beaker; 2: grave with early battleaxe type A-F; 3: grave with early corded beaker; 4: megalithic grave with early corded beaker; 5: single find of battle axes type A-C; 6: Single find of battle axes type D-F; 7: Single find of early corded beaker; 8: Bog find of amphora.

a number of smaller investigations and indications from archaeological records. The whole research area could be characterized as coastal in the Middle Neolithic as no part of it was more than 17 kilometres away from the coast. However, there are very clear differences between the development at the coast and "inland" in the westernmost part of the research area.

The topography and soils vary within the research area. The southern and central part generally comprises hilly moraine with heavy clay soils. The northernmost 10 to 15 kilometres is hilly moraine consisting mainly of sand and gravel. In the eastern area, Djursland, the topography varies from a hilly mixed moraine in the southern part, to a plain of sand and gravel in the northern part. The most significant consequence of these differences is seen in the post-depositional effect of later land use with earlier and heavier destruction of features in the areas with heavy soils, mainly in the central and southern parts (E. Baudou 1985).

In the presentation of the different phases of the development I will briefly present the archaeological and typological definitions and then comment on the distribution and context of each phase as they are shown on the maps. As several of these phases cannot be seen as absolute, closed entities the following will include a discussion of the assumptions applied to arrive at the chosen pictures of each phase and a general interpretation of the development.

The late TRB can be identified mainly by ceramics as defined by C.J. Becker (1955) and K. Davidsen (1978). Also thick-butted A-axes (P.O. Nielsen 1979) and battle-axes of the late TRB type C2 (K.Ebbesen 1975, 182ff) are used as diagnostic artefacts even if they are not restricted to contexts with late TRB-ceramics (L. Kaelas 1957, 118ff).

The settlements and burials that can be ascribed to the late TRB by ceramics are well represented in the southern coastal areas, but are not found on Djursland,

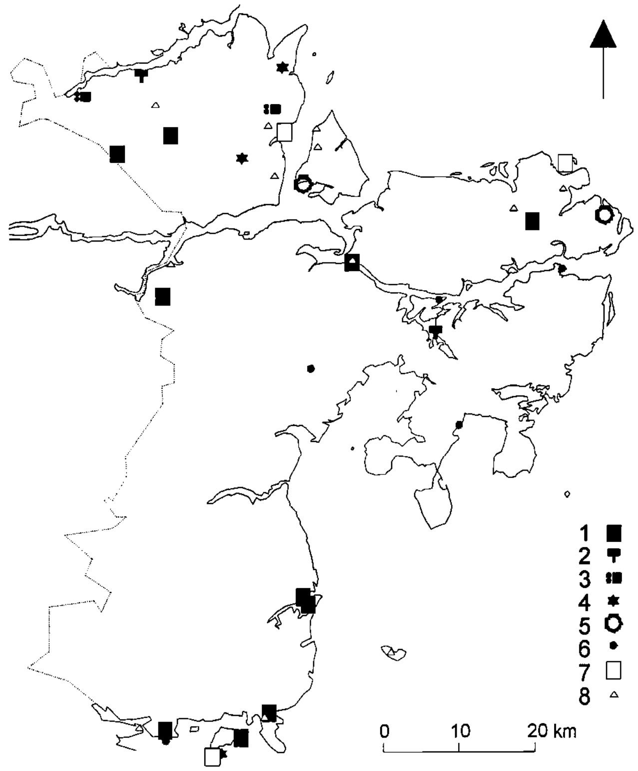


Fig. 4. Hypothetical early MNB. 1: settlement with B-axe; 2: megalithic grave with B-axe; 3: stone packing grave with B-axe; 4: hoard with B-axe; 5: single find of hollow-ground axe; 6: single find of flint gouges with B-axe affinities; 7: settlement with C-arrow; 8: single find of C-arrow.

where only a few sherds of typical ceramics have been found in settlements and graves (fig. 1). The settlements are generally very large and located near the coast (T. Madsen 1982) or near larger wetland areas. In the southern part of the area the burials are placed in megalithic graves, while both megaliths and stone packing graves are used in the northern part. The distribution of single finds of heavy thick-butted A-axes shows a concentration along the coast, but indicates some use of inland areas. A few battle-axes of the late TRB type C2 are found as single finds in shallow water along the coast, but not in graves. Amber beads shaped as double edged battle axes are however numerous in some of the megaliths, but are not plotted here.

If we restrict the definition of the late TRB to sites or areas with finds of the diagnostic ceramics, the many thick-butted A-axes found on Djursland can not be ascribed to this culture only as there are only few finds of late TRB ceramics in that area (P. Eriksen 1985, 58) and as the thick-butted A-axes are also typical of the finds from the large PWC-site at Kainsbakke (L.W.Rasmussen 1991).

The PWC in Denmark is identified by the typical ceramics and the arrow-heads of type A (C.J. Becker 1951), referred to here as A-arrows. These two components are found together in the sealed context at Kainsbakke. The B-type arrow-heads are slightly more worked than the A-type and are here included with the PWC although they have not been found in sealed context with PWC-ceramics. The distribution of these types is shown on fig. 2.

PWC-ceramics are known mainly from the Kainsbakke settlement and from a few excavated settlements around it. They are supplemented by one vessel from a megalithic grave in the south-westernmost part of Djursland (K. Ebbesen 1978, figure 31:1). The A-arrows are distributed at settlements, in megaliths and as single finds along the coast, also outside the area where PWC-ceramics are found. In the research area settlements with PWC-artefacts are generally large and located at or very near the coast just like the late TRB settlements further south.

The early SGC-graves are all primary or secondary graves in mounds located inland (fig. 3) mainly near one of the major concentrations of SGC finds in the eastern part of Central Jutland and also in the north-western part of the research area (P.V. Glob 1945, fig. 115). The single finds of early SGC battle-axes show a wider distribution. A few of these are deposited in the sea exactly as battle axes of the late TRB. This depositional practice of early SGC battle axes is also known from the Danish islands (A.H. Andersen 1986). An amphora ascribed to the early part of SGC comes from the Veggerslev bog find in North East Djursland (C.J. Becker 1948, fig. 14), where typical graves of the early SGC are not known. Settlement material from the early SGC is found in and under some of the burial mounds inland and at one small site in the south-westernmost part of the research area, also an inland site. The settlements of the SGC are small or maybe spread over larger areas (S. Hvass 1978) and sherds can easily be mistaken as belonging to the Iron Age. As a consequence we still do not have any detailed knowledge of the settlement pattern, only an impression of smaller settlements spread out in the landscape.

Asuming that the PWC element can *fill* the late TRB and parts of early MNB on Djursland there is still a *vac-*

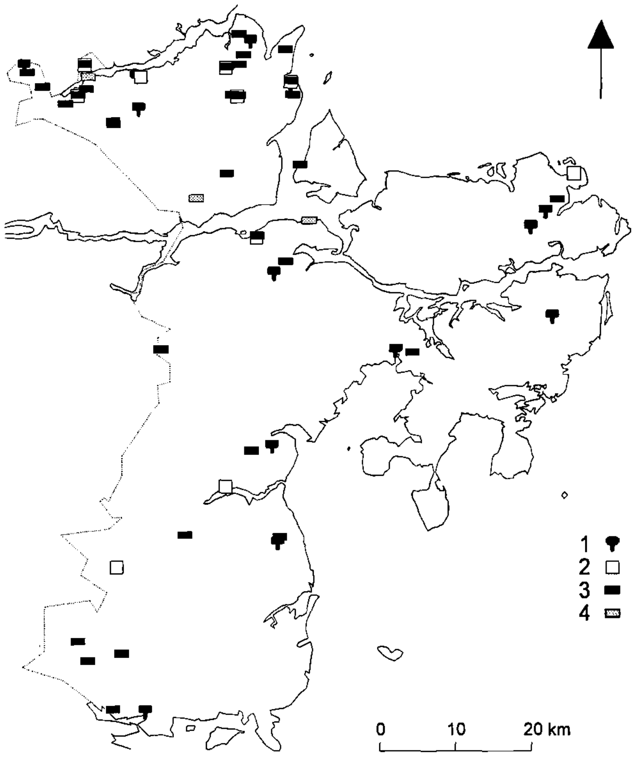


Fig. 5. Grave finds from late MNB. 1: megalithic grave; 2: grave cist; 3: single graves and small stone cists; 4: undetermined grave type.

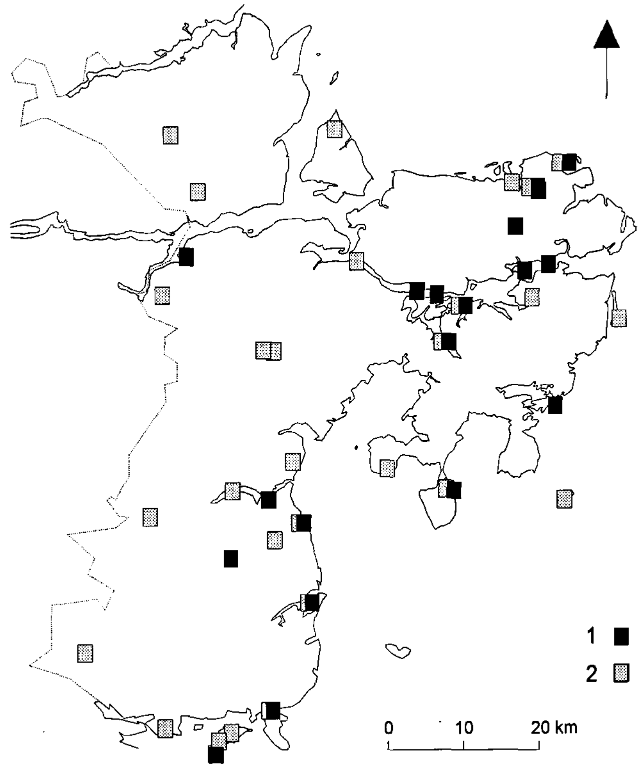


Fig. 6. Late and undateable SGC settlements. 1: late SGC with finds of D-arrows, ceramics and battle axes; 2: undatable SGC with ceramics and thick butted axes of SGC-type.

*uum* in the early MNB especially in the southern coastal areas. Here we could look for some mix of TRB, PWC and possibly even use of SGC symbols like the early SGC battle axes deposited in the sea. In figure 4 some possible finds have been mapped together to give an idea of my constructed phase that might be a parallel to the Scanian Stävie group (L. Larsson 1986; 1993). No local ceramic tradition can be isolated to represent this phase. Thick-butted axes of type B, and axes showing similar technical details, are here considered B-axes (P.O. Nielsen 1979; C. Damm 1989; 1993) and also arrow-heads of type C are placed in this phase as argued by C. Damm (op. cit.). A small group of finely crafted thick-butted adzes with a hollow edge that appears to be secondarily worked on thick-butted axes of type B (C.J. Becker 1974, fig. 18), and so called middle-bladed axes with hollow-ground sides (C.J. Becker 1974, 164ff), can also be associated with the early MNB's non-SGC phase.

The map on figure 5 of this *constructed* assemblage shows a rather varied picture with marked differences within the research area. In the southern part the settlements with heavy thick-butted B-axes are located at the coast supplemented by a single hoard. In the northern part of the area, B-axes are found in both settlements and graves and they are are not bound to the coast. The two rare and well worked hollow-edged axe types were found as single finds in water. With the exception of one, which was found in a lake, all the axes were found in the sea. This last group of finds must have had a function linked to a depositional practice that corresponds to the use of TRB battle axes and the few SGC battle axes found at the coast.

In the later part of the MNB the picture is quite different. The SGC grave finds are now much more varied. They are also found at the coast where most of the finds are from secondary depositions in or at megalithic graves, supplemented by a few other grave types placed in newly built barrows. Inland, the graves are placed in older SGC mounds. New grave cists with a collective function are constructed as primary graves in the north-

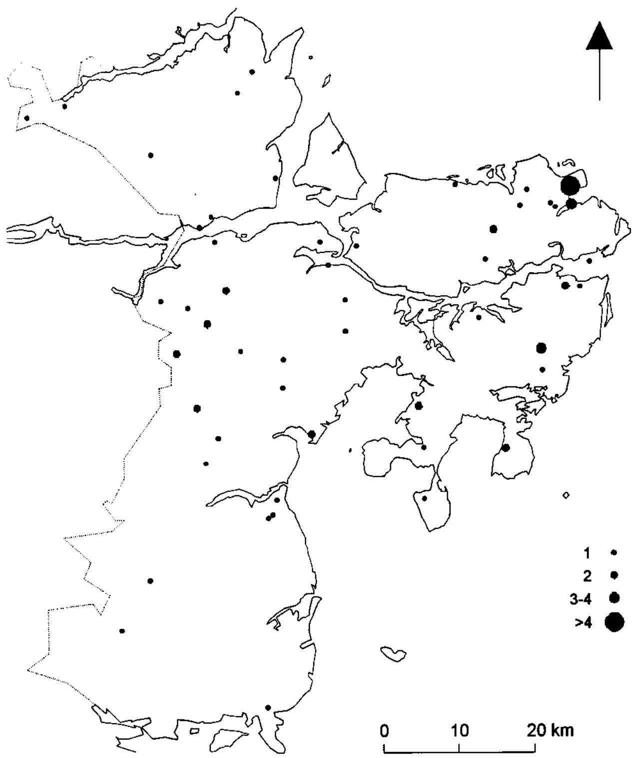


Fig. 7. Single finds of heavy thick butted B-axes.

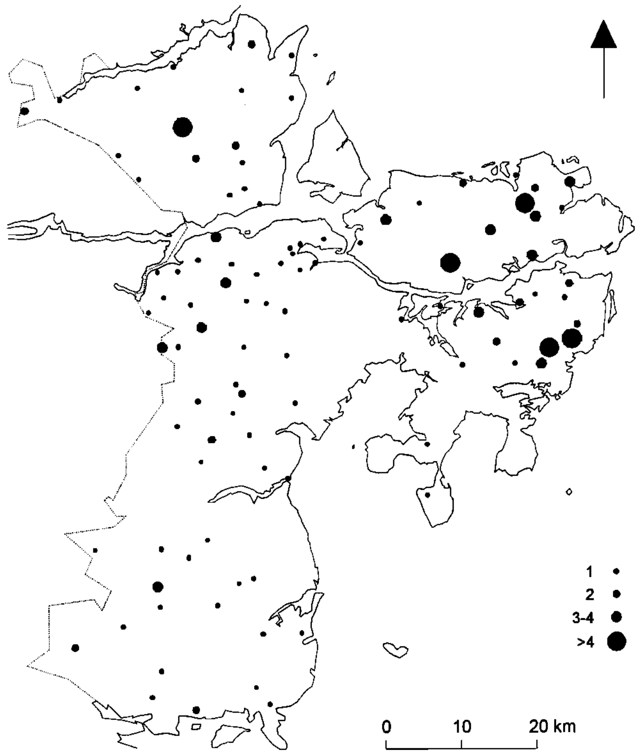


Fig. 8. Single finds of heavy thick butted flint axes of SGC-type.

ern part of the research area. On Djursland, no new mounds were erected until the early part of the Late Neolithic.

With two exceptions the well dated late SGC settlements are located at the coast as shown on figure 6. They are dated by ceramics, D-arrowheads, tongued wedges (P.V. Glob 1945, 122ff) and by a few later battle axes. To supplement this picture the settlements with finds of SGC-type thick-butted axes and SGC ceramics, which have no precise dating within the SGC, are mapped together.

Because much of the research has been concentrated in the coastal areas and at restricted areas around barrows inland and moreover has been very intense, for example on Djursland, the picture presented above is somewhat biased.

To get an impression of land use in the areas with few excavations the distribution of single found thick-butted axes can be applied. The maps indicate the number of axes found. Most important, however, is the pattern of their distribution. The very different formation processes affecting the archaeological records have resulted in an over-representation of single finds on Djursland and in the central part of the research area. However, the many flint axes from Djursland may also be seen as a consequence of the easily accessible flint resources in that area.

The single found A-axes shown on figure 1 are not very numerous and are not found at all in inland areas in the southern part of the research area. The single finds of thick-butted B-axes have a wider distribution in the central part of the area with a fair number of finds inland and many on Djursland, see figure 7. With the SGC thick-butted axe-type mapped in figure 8, a greater part of the inland areas shows many finds. Together with the East Danish SGC adze-type mapped in figure 9 these axes represent the SGC axe tradition, which also covers part of the Late Neolithic. Even if the use of single finds is problematic, these examples do support the impression of a general expansion of land use to cover both coastal and inland areas more or less equally in the later part of the Middle Neolithic.

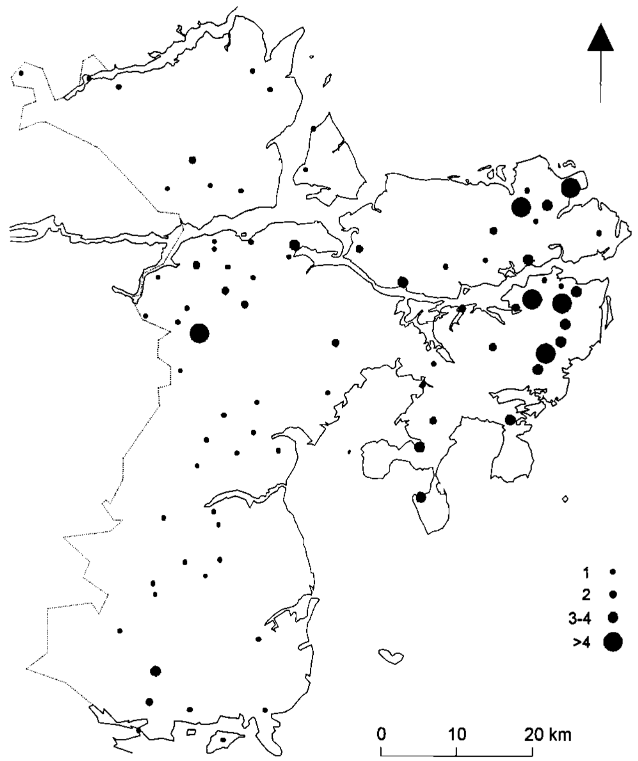


Fig. 9. Single finds of heavy thick butted adxes with hollow edge of late SGC-type.

*Conclusion*

In my opinion the distributions presented here do not represent clearly defined cultural entities, as we do not have a complete framework to define such entities. Sealed contexts are scarce and never cover a wider range of social aspects within each culture group. As already stated our traditionally defined culture groups are either based mainly on settlements or on graves. Moreover the traditionally defined entities do not always match the finds, as the artefacts considered diagnostic are frequently found in other contexts. I believe that this more diffuse picture is not only a result of purely formal problems but also an effect of a very active use of material culture (C. Damm 1993; L. Larsson 1993, 206).

In many aspects the development in East Jutland can be compared with the contemporaneous Scanian situation as described by L. Larsson (op. cit.). In Scania, TRB ceramic traditions are mixed with PWC flint technology in the coastal area while an opposing tradition, the Battle Axe Culture, is adopted first inland before being adopted or accepted later in the coastal area. In East Jutland as in Scania this general development shows some remarkable local differences.

An adoption of the West Swedish PWC tradition in ceramics and in flint technology takes place on Djursland, while only the flint technology is adopted along the coast further south. In the inland areas of Jutland the SGC evolves with a clear emphasis on the individual in graves that might have had its root in an alternative or opposing tradition within the TRB societies as proposed by C. Damm (1991). One of the closest possible TRB-parallels to the SGC grave tradition has been published recently (K.Christensen 1990). Here we are clearly facing single burials in a round mound but in an indisputable Middle Neolithic TRB context on the island of Zealand.

In the later part of MNB the marked differences between SGC- and the TRB-traditions have changed towards a somewhat more homogenious material culture, but with a varied burial tradition that does show some distinct local variations.

As this short presentation has shown, the development in East Jutland cannot easily be described in the framework of the traditionally defined archaeological culture groups. In our interpretations we must accept interaction between the different material traditions, that is the social groups we superimpose on the archaeologically defined material groupings. It has already been pointed out that the finer chronological problems involved cannot yet be solved using Danish evidence. It may last a long time before the chronology is sufficiently refined to shed light on the local developments. In my oppinion, they are the key to a better understanding of the cultural development at the transition from MNA to MNB in Northern Europe.

NOTE

The area covers the old counties of Randers and Århus and the two districts Hjelmslev and Voer of the old county of Skanderborg (see K. Kristiansen (ed.) 1985, Appendix 1-2). No references to the individual finds are given here. I would like to express my gratitude for help and advice received at the museums. The English text of this paper was corrected by David Robinson.

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# Reviews

*Climate Change and Human Impact on the Landscape. Studies in palaeoecology and environmental archaeology.* Edited by F. M. Chambers. Chapman & Hall, London 1993. 303 pages with an appendix, numerous figures and tables. ISBN 0 412 46200 1.

As the subtitle indicates a bouquet of articles have been collected about nature and the interaction between man and his environment in the past. Dr. F.M. Chambers from the Environmental Research Unit at Keele University in England has skilfully managed to compose a both diverse and colourful book to mark the retirement of Professor A.G. Smith – one of the leading researchers in Holocene palaeoecology. The volume includes invited reviews and research case studies, providing the connecting link with the scientific interests of Professor Smith. Reading the book one has the feeling that his inspiring interests for the past has significantly influenced many colleagues in their interpretation of biological processes and other evidence for human modification of the natural environment.

The twenty six contributors are internationally renowned scientists and the topics discussed have their geographical origin in the British Isles, but papers from overseas or with a global scope are also to be found. Primary results are few and main efforts have been given to presenting reviews and case studies. The geographically restricted case studies are balanced by review articles giving an international status for modern progress in topics covered by the book title. The text is aimed at researchers and experienced students looking for up-to-date knowledge about our past.

The book is divided into four parts with the titles: Precision and Accuracy in Studies of Climatic Change and Human Impact; Climatic Change on the Landscape; Evidence for Human Impact; and Climatic Change and Human Impact: Relationship and Interaction. Each part includes a short introduction by the editor followed by 4-8 articles of normally 10-15 pages each.

**Part one.** The first article by H.J.B. Birks gives a review of Professor Smith's contribution to vegetational history and palaeoecology. Smith was controversial in some of his opinions. Thus, he suggested that the early Holocene expansion of Hazel pollen may have resulted from mesolithic disturbances and its remarkable early abundance represented a "fire climax". Mesolithic people also facilitated the establishment of Alder in mid-Holocene times by widespread destruction of forest cover. Birks personal reflections are included and it is clear to the reader, that the author does not agree with all of Smith's ideas! However Smith's 1970-review of the possible influence of mesolithic and neolithic people on British vegetation remains one of the most stimulating (– and controversial!) articles written about Holocene vegetational history in the British Isles in the last two decades. Also his concepts on inertia and threshold related to post-glacial habitat changes are highly relevant today although presented almost thirty years ago.

F. Oldfield considers in his paper the structures and modes of reasoning that have been prevalent in Quaternary studies over the last few decades. The implications of problem definition and research development are explored and some of their possible strengths and weaknesses are mentioned. The paper gives a philosophical approach to our current research studies, which most often deal with methodology and results. This chapter deserves to be read in the morning, when one is open minded!

J.R. Pilcher discusses the use of radiocarbon dates and how they have been handled over the years. He also shows a modern approach to radiocarbon dating allowing palynology to make its contribution in a world where precise calendar timescales are increasingly important. The fruitful collaboration of tree-ring research and radiocarbon studies have enabled radiocarbon dates to be calibrated into calendar years. A calibration table of radiocarbon ages is given in an appendix to facilitate this processing.

Pilcher claims that the routine radiocarbon dates available from most laboratories have inaccuracies that only allow the calendar date to be specified to the nearest half millennium and attempts to interpret time differences or real ages closer than 500 years by conventional dates are simply not valid (p. 28). He bases his conclusions on results obtained from the international intercalibration studies where wood samples of known age were dated by numerous laboratories. The test dating did not fare well, and the test results show the state of dating quality of the various laboratories. However, they do not discredit the radiocarbon method as claimed by Pilcher (p. 27). If so high-precision dating and wiggle matching would not be possible. His message to us all is clear: choose your dating laboratory with care!

The tree-ring analysts tell us that there are no major problems with the methodology of oak dendrochronology. Precise calendar dates are obtained on a routine basis in northern Europe and they provide a chronological basis for many archaeological studies, as mentioned by M.G.L. Baillie in his paper: Great Oaks from little Acorns. He demonstrates the interaction that is possible between precise tree-ring dates and historical information, and mentions also the limitations on chronological interpretation, even when exact dates are available.

**Part two** deals with the climate as reflected in organic deposits. Mires have been used as sources of proxy climatic data for a century or more. Jeff Blackford examines in his chronicle of peat stratigraphy work the climatic division of the post-glacial. He evaluates with authority recent research and demonstrates that methodological and technological advances have led to progressively more accurate results on development of the palaeoclimate. He also suggests a strategy for future studies of climatic change from peat.

An important paper has been written by Richard Bradshaw, who considers the relationship between vegetation and its response to climate. Human activity also played a role in the dynamics of temperate forest types and the relative importance of climatic and human factors have for a long time been the subject of intense debate. Case studies are presented taken from areas with low (North America) as well as with high (Western Europe) human impact on the environment.

J. John Lowe discusses the climate in early and mid-Holocene Scotland. He reviews the problems of using palaeobotanical data to evaluate climatic conditions during these periods, and mentions that changes in climate can be fairly well defined, but the scale of climatic variations is much more difficult to determine.

Finally, John A. Matthews presents his experiences from Norway on age determination of palaeosols excavated from beneath young moraines. He emphasizes in particular the complex nature of soil organic matter and the importance of sample pretreatment.

**Part tree** is devoted to evidence for human impact and commences with a global review by D. Walker and G. Singh of the first palynological evidence for human disturbances. They illuminate that significant human impact on major investigated regions of the world may pre- date the Holocene. Such broad compilations are rarely seen and may help to understand long-distance interactions in a more comprehensive way.

I.G. Simmon reviews competently the Mesolithic in the British Isles and mentions that evidence for human-induced vegetational changes is patchy for the early Mesolithic, whereas impact on vegetation is obvious by the end of the period. Forests were clearly not an unbroken blanket and burning was widespread. The contribution of domestic fires to the charcoal rain reminds us that even a low-density population is likely to have used or created open areas. The transition period from a dominantly hunter-gatherer culture to agriculture is illuminated with examples of fine resolution pollen analysis of peat.

The theme of fire and the influence of mesolithic activity on vegetational change is further discussed by Chris Caseldine and Jackie Hatton, based on palaeobotanical evidence from blanket peat in south-west Britain. The results clearly implicate mesolithic communities and their use of the high moorland.

A very useful and clearly presented review of the models of mid-Holocene forest farming for north-west Europe has been compiled by Kevin J. Edwards. The well-known landnam model (Iversen), the leaf-fodder model (Troels-Smith), the expansion-regression model (formalized by Berglund) and the forest-utilization model (Göransson) are presented and critically evaluated. Surely this paper will have the interest of students working in environmental archaeology.

Patricia E.J. Wiltshire and Kevin J. Edwards discuss early farming management in their paper on prehistoric impact on vegetation. Palynological results from a riverine site in central England are presented covering the last 7000 radiocarbon years. The fossil record for cultivation may be the earliest yet found for the British Isles.

Two other case studies from Wales by M.J.C. Walker and from Ireland by Karen Molloy and Michael O'Connell also illustrate the current practice in palaeoecology and environmental archaeology. Both studies deal with human activity, and especially the detailed description of spatial landscape development in westernmost Ireland is impressive.

**Part four.** The balance between human impact and the effect of climate on our landscapes has been debated over the years and the last four papers in the book give clear lessons to those interested in the relationship and interaction between man, landscape and climate.

Brian Huntley mentions the rapid early Holocene migration and high abundance of Hazel in north-west Europe and presents hypotheses to account for this unique phase in the Quaternary. He suggests that the palaeoenvironment, and especially the climate at that time, also had a unique character favouring especially this species, whereas man played a intermediary role. However, the last word on Hazel has not yet been spoken!

Special attention has been devoted to the study of mires by the papers of Peter D. Moore on the origin of blanket mires of the British Isles, by Keith E. Barber, Lisa Dumayne and Rob

Stoneman on ombrotrophic mires in northern Britain, and by Barry G. Warner on floating bogs in North America.

Forest clearance and modifications of upland hydrology have earlier been suggested to be of importance in the initiation of blanket mires and new evidence from outside the British Isles support this hypothesis. Moore supplements his previous papers on this topic and especially the demonstration of metachronous origin of blanket mires due to relative human impact on the landscape and local topography is of importance.

The paper by Barber *et al.* shows the potential of ombrotrophic mires as a source for reconstructing environmental changes, both natural and cultural. Bogs in the Anglo-Scottish Borders are investigated and they reflect how human impact on the landscape can be connected to well-known historical events during the Roman occupation period. We can expect more interesting results from their investigations!

The final chapter by the editor, F.M. Champers, draws the themes of the book together and emphasizes developments in techniques and problems not covered by the previous papers. The editor's valuable comments concentrate the subject matter of the book and place it in a late-Quaternary perspective.

The book reflects the interests of Professor A.G. Smith, to whom it is dedicated. Therefore problems relating to early and mid-Holocene vegetational development have been given special attention, whereas information on later prehistory and medieval times is limited. Although the papers cover a wide range of topics, a certain overlap cannot be avoided. Thus, the success of Hazel in early Holocene vegetation has been analyzed by several authors; the fate of Pine, the asynchronous colonization of Alder in different parts of the British Isles and the detection of early farming are other themes commonly mentioned. The editor has sensationally managed to arrange the various contributions in such a way that this overlap is perceived mostly as an advantage of the book, because the same problem is discussed from various angles. Each paper is tightly constructed, but in the scientific content some diversity in the use of radiocarbon dates is obvious, although the editor's notes focus on dating conventions. Having read Pilcher's warning paper on the dating quality of the various radiocarbon laboratories in test dating, it is strange to see how accurate the radiocarbon dates are interpreted by several authors. Expressions like "estimated dates are rounded to the nearest five years" (p. 163) can be found although the age-depth curve is based on only three radiocarbon dates in a profile covering 7000 radiocarbon years! Similarly, it is inappropriate to show calibrated ages (1 range) to an accuracy of a single year (table 16.1). Many scientists have not realized that radiocarbon dates are only working calculations, which have to be calibrated into calendar years before interpretation. Calibration tables are available, and we have to make use of them, although the calibration results are far more difficult to handle than uncalibrated dates. The book clearly shows that we have to treat our radiocarbon dates more seriously, a point also made in the book by Pilcher.

Another comment concerns the use of cereal or cereal-type pollen as an indicator of crop cultivation (cf. chapter 14, 15, 16, and 19); some wild grass species (e.g. *Glyceria fluitans* and *Agropyron repens*) have pollen of *Hordeum*-type, which cannot be distinguished on the basis of size from cultivated *Hordeum* or *Triticum monococcum*, if only a few pollen grains are found. Accordingly, it is important to identify cereal-type pollen in more detail – which is possible – especially when examining early farming by the way of pollen analysis. These comments do not detract from my positive impression of this valuable book, which is highly recommended to the readers of Journal of Danish Archaeology.

Bent Aaby

*The Cultural Landscape during 6000 Years in Southern Sweden – the Ystad Project.* Edited by B.E.Berglund. 495 pp., 220 figures and maps, 4 plates, 39 tables. Copenhagen: Munksgaard (Ecological Bulletins 41, 1991).

Lund University is a melting pot, initiating large multidisciplinary projects and producing equally large books. "Handbook of Holocene Palaeoecology and Palaeohydrology" (editor B. E. Berglund, 869 pages) appeared first, and now we are presented the results of another interdisciplinary research project – The Ystad Project – published in three volumes. One of these "The Cultural Landscape during 6000 Years in Southern Sweden" is a book of almost 600 pages. It is devoted to studies of the interaction of society and landscape in a historical perspective involving more than 20 researchers. Both discipline and enthusiasm have been needed to coordinate this extended six year project, which began in 1982, and to publish the final synthesis while the results are still fresh in the mind. The team of scientists at Lund and their colleagues have achieved their goal successfully.

The reference frame of the project was the Ystad region lying on the fertile till of southern Sweden. It furnished study material for researchers into human geography, palaeoecology, plant ecology, archaeology and history. The interaction between man and environment in the past was studied on a sub-regional scale in the areas of Köpinge, Bjäresjö, Krageholm and Rommele, each representing different examples of landscape development and settlement history.

The book is organised into a small number of main chapters, each divided into a long series of subchapters with the author(s) indicated. The very compartmentalised organisation hampers continuous reading and an overview may get lost in details. However, it helps the reader to find specific items of interest, and this is probably the way the book will be used by most scientists.

I recommend beginning with the first and last chapters, which present the working ideas of the project and the synthesis of obtained results. The main emphasis, however, is placed on the chapters dealing documentation, with information from the four areas arranged pragmatically according to geography, chronological period and research discipline.

The book is well designed with numerous illustrations including many maps and pollen diagrams, many of which are in colour. Sometimes, however, it is difficult to locate the investigation sites. For example, the map showing the main investigation site in the Bjäresjö area is shown on page 35 (Figure 12) of the chapter – and with a different spelling (Bjersjöholm) than in the pollen diagram (figure 1, Bjärsjöholm). Basic information should be given at the beginning of the chapter together with a map showing the location of the investigation area within the Ystad region. Similarly, more photographs would facilitate the description of the area concerned; only four pictures illustrate the Ystad region.

The palaeoecological studies are mainly based on deposits from smaller and medium sized lakes and the chief method employed is pollen analysis. Accordingly, the results produced contribute general information from areas of 1-5 km in radius. Studies of small hollow sites or terrestrial soils have not been included in the project.

Farming practice in the Late Mesolithic is a hot question – even after completion of the Ystad project! Pollen indicators of open habitats are seen from the Köpinge area. They may be interpreted as showing minor human influence related to husbandry. However, such openings could also be related to settlements of hunter-gatherers along the coast (p. 110). Neolithic farmers clearly influenced the forest vegetation from 3000 BC onwards (all dates are in uncalibrated radiocarbon years) and openings were created with shifting fields and pastures. Settlement concentration and woodland regeneration occurred about 2600 BC with the expansion of broadleaved trees. Coppicing with arable cultivation and animal husbandry was found mainly near the coast. Gradual deforestation and settlement expansion was demonstrated in the period 1800-800 BC. The widespread coppicing favoured hazel at the expanse of elm, ash and lime. After minor oscillations in landscape use a large-scale expansion of settlement area took place at the beginning of Late Bronze Age, and permanent fields were present in a landscape dominated by grassland. This distinct change is supposed to be associated with innovation and restructuring of agriculture. The development in the inland areas was dominated by deforestation and an expanding pasture landscape containing wood-pastures. The concentration of settlement around 200 BC in the coastal areas and some hummocky landscapes of the inland, facilitated the spread of forest vegetation in marginal areas. Especially beech and hornbeam were favoured by this agglomeration of settlements. After AD 700 the infield-outland landscape was definitively consolidated, and the productivity of the permanent fields was maintained by addition of manure. The diversity between infields and outlands facilitated the development of different biological communities and habitats. The biological diversity was great and reached its height in the village landscape of the Middle Ages around AD 1200. The subsequent periods are also thoroughly debated and human geographers and historians in particular, contribute important information.

In the interpretation of landscape development the former concept of expansion-stagnation seems to be substituted by expansion-concentration. It signals that the quantitative description of landscape development based on pollen analysis – which has its roots in the 1970s – has developed into a modern approach in which social processes, cultural ecology, production models and nutrient cycling are more integrated as driving elements in landscape development. This is just one of the many advances resulting from the project.

The palaeoecological investigations also illuminate varying and sometimes opposing trends in landscape development in closely adjacent areas ( the Krageholssjö- and Bussjösjö-areas). Similar results have been obtained from Denmark, emphasizing the importance of varying landscape structure on a sub-regional scale. The varying intensity of human impact and exploitation of natural resources in different parts of the Ystad region are also reflected in the vegetational diversity according to rarefaction analysis of pollen counts and in deposition of charcoal particles.

The amount and diversity of the results and information produced by the project deserve acknowledgement, especially in the light of the ample spin-offs – student training, doctoral theses and other scientific publications (a list of project papers is given in the book on pp. 482-487).

The palaeoecological reconstructions are based primarily on investigations of lake deposits, and in regions with carbonate-rich bedrock, like the Ystad region, radiocarbon dates from lake sediments tend to be too old. Therefore dating is based on pollen-stratigraphical correlation to the radiocarbon dated sequence from Ageröds Mosse. Cross correlation may be problematic as Ageröds Mosse is located in a different geomorphological region, almost 50 km from Ystad. It is necessary to exercise caution with regard to zonation and correlation of the various records; new methods for extracting terrestrial material from the lakes for AMS dating are under development.

These remarks do not detract from the fact that this book on the cultural landscape of southern Scania in Sweden is a milestone of modern research in a wide range of related disciplines. Both students and their teachers can learn from it, and hopefully the book will stimulate the initiation of many comparable projects in the years to come.

Bent Aaby

J.L. Davidson & A.S. Henshall: *The Chambered Cairns of Orkney.* Edinburgh University Press, Edinburgh 1989. 198 pp.

J.L. Davidson and A.S. Henshall: *The Chambered Cairns of Caithness.* Edinburgh University Press, Edinburgh 1991. 177 pp.

*Vessels for the Ancestors. Essays on the Neolithic of Britain and Ireland in honour of Audrey Henshall.* Edited by Niall Sharples & Alison Sheridan, Edinburgh University Press, Edinburgh 1992. 366 pp.

In 1963 and in 1972 Audrey Henshall published her two corpus volumes on the Scottish megalithic tombs. This was an enormous task considering the quality of documentation, the excellent plan drawings and the large general chapters. With these two huge volumes Scotland became the country with the best published record of megalithic tombs, only to be compared with the work of the Leisners on Spain and Portugal.

But now it has happened again. Together with J.L. Davidson, A. Henshall has commenced a new series of corpus volumes on Scottish megalithic tombs with the volumes on Orkney (1989) and Caithness (1991). The volumes share the high quality with the former ones. They consist of a part covering the different topics related to the megalithic tombs, and a catalogue section dealing thoroughly with each site separately.

One could perhaps ask whether it should be necessary to bring out large corpus volumes on the same matter so relatively shortly after the first ones. But the archaeological material has increased within this short span of time, particularly in Orkney. Here, the number of known megalithic sites have increased from sixty to eighty-one, Quanterness and Isbister have by excavation and publication become key sites, and now the existence of true megalithic art in Orkney is indisputable. For anyone with interest in the Neolithic period, Orkney must be regarded as the true "Mecca"; nowhere, apart from Orkney, do we find such a diversity and quality of data: Neolithic houses almost fully preserved, the many megalithic tombs with well preserved human skeletal remains, and with a large pottery material compared with what is seen elsewhere on the British Isles and Ireland, "closed" local landscapes yielding possibilities of linking the setting of the tombs with different agricultural potentials, and so forth. Seen in this light, the volumes provides a welcome updating of evidence.

The two present handsome volumes have the advantage that they can be used not only by the specialist, but also by the interested layman or tourist. Unfortunately, the prize will limit this use.

It is indeed a favourable task to review an opus of a quality almost impossible to comment or critizise. Perhaps we are missing discussions of the latest interpretative research on the dynamics and development of the Orcadian Neolithic society – a sort of synthesis, and expression of opinion on works by for instance N. Sharples and C. Richards. The aim of this type of corpus work, however, is to present evidence, not to balance various interpretative models.

Actually, Davidson & Henshall, in a number of cases, go further than just presenting the bare archaeological data. Noteworthy is their critical assessment of recent studies by Renfrew and Chesterman of the human bone material from the megalithic tombs of Orkney. The evidence for excarnation prior to the final interment in the megalithic tombs of Orkney and Scotland is certainly not so unquestionable as suggested by Renfrew, and the two recorded examples from Orkney (Quanterness and Isbister) seem to be the exception rather than the rule. Davidson and Henshall states: "Indeed the variations on the procedures at Quanterness with cists and full length inhumation besides the apparently disorganised "bonespreads" mixed with stones, are a warning that the situation is probably very complex". The pages dealing with the human bone material is even more than such a critical assessment, giving a fine account of the problems of interpreting human skeletal remains. Also the Caithness volume deals with this material, though not so thoroughly as the Orkney volume.

The Scottish achievement is indeed worthy of serving as a model for what should be done in any other European country with megalithic tombs. Particularly in Denmark such a task seems impossible however, simply because of the sheer quantity of material. It is a somehow unrecognized fact that Denmark as a country possesses the highest density of megalithic tombs found anywhere in Europe (around 7500 are known of which around 2500 are preserved; close to 600 known from Scotland), and with by far the largest amounts of finds. While the drawings of the find material from the relatively rich Orkney tombs cover 11 pages in the present volume, the drawings of finds from one single Danish parish (or single tomb) alone would in many cases exceed the size of this volume! This example illustrates the limitations of such corpus works; only in certain countries or regions will it be possible to find the resources necessary. We shall probably never see very many full corpus publications of different archaeological find categories in a comparable and high standard covering larger parts of Europe. We might perhaps here find a task for cultural policies of the EU??

As mentioned above, the volumes by Davidson & Henshall are corpus publications, only to a certain extent dealing with more general discussions. This lack (which should not be considered as a lack for this kind of publication) is remedied by the book "Vessels for the Ancestors" containing 23 essays on the Neolithic of Britain and Ireland in honour of Audrey Henshall. Even though this book deals with the Neolithic of Britain and Ireland, the focus is on Scotland, thus being an excellent supplement to the volumes by Davidson & Henshall. The essays cover a large number of topics, both related to megalithic tombs as such and other find categories of the Neolithic. Only one, though important aspect, has unfortunately not been adequately focused here, namely the stone-circles.

It will not be possible here to mention all the articles, only to make some few comments, particularly as to papers on the megalithic tombs.

The introduction by A. Sheridan and N. Sharples is much more than just an introduction, giving the reader a very thorough review of the current state of knowledge of the Scottish Neolithic.

The constructional or architectural details of megalithic tombs have often been neglected, although in The British Isles and Ireland there seem to be a somewhat better tradition for research in Neolithic engineering than generally in continental Europe. The stimulating article by J. Barber on this matter is a brilliant example of this tradition, giving a lot of fascinating clues as to the complexity of megalithic tomb construction and the problems of engineering which Neolithic man faced. For instance we learn that the simplicity of corbelling is more apparent than real. The inner line of the corbelling must in order to create a high and substantial construction curve in a true parabolic way. The author also points out that the megalith builders should not be viewed as imminent mathematicians knowing the formular of a parable; by skilled craftsmanship using a rule-of-thumb it is possible to create a parabolic vertical section of a chamber just by means of a pole, a string, and a weighted piece!

The article by R. Mercer is dealing with the evidence of multi-period-construction of Scottish megalitithic tombs. The author suggests that the general accepted development, where smaller round cairns are regarded as being the primary feature, often enlarged by horned long cairns, should be reversed: it is the round cairns which should be considered as being a later addition to the long ones. However, this hypotheses does not seem to be in accordance with the archaeological data from among others J.X.W.P. Corcoran's thorough excavations, and many of the sites which R. Mercer uses are unexcavated sites actually giving no positive clues to any assessment of sequence. For instance R. Mercer allows himself to draw conclusions as to a constructional sequence from the unexcavated long cairn Staney Hill in Orkney. I would not allow myself to draw any such conclusions as to chamber sequence from the scattered stones which break through this ruined grass covered cairn.

Even though R. Mercer tells us that cairns like South Yarrows South in Caithness (CAT 55) are associated with earlier and later monuments to make up cumulative monumental complexes he does not exemplify this further. The chamber of this long cairn seems itself to be of multi-period construction; the outer segment of the passage related to the hornwork is not lying on the axis of the inner part of the passage and the chamber, thus suggesting that the horns are a later addition together with this outer part. This observation, however, is not in accordance with Mercers hypothesis. When speaking of monumental complexes it should be noted, that the outer part of the chamber of South Yarrows South points directly to a free standing stone on the ridge on the other side of the valley, while the central line of the nearby standing stone alignments of Hill o' Many Staines points directly at this long cairn. Thus, these monuments around South Yarrows Farm form one of the finest examples of Neolithic landscape architecture with a complex chronological interrelationship.

C. Richards presents a stimulating and unorthodox paper, partly dealing with the symbolic function of megalithic tombs in a structuralistic perspective. He states correctly that the many typological studies of the megalithic tombs seem to hinder the appreciation of the primary architectural function. But of course, when we try to understand their architectural/symbolic function, then to some extent it is a matter of interpretation, and ultimately a matter of personal taste of the individual scientist. However, it is refreshing to read a paper, which consider megalithic tombs not just as typological objects to be ordered, but as true expressions of well structured religiousity.

An article by G.D. Barclay on the Late Neolithic Clava tombs and the ring cairns does not seem to bring very much new, apart from including a couple of Early Neolithic non-megalithic tombs such as Pitnacree into the discussion of the origin of the Clava tombs. However, a tomb such as Pitnacree, seems too distant in time from the Clava cairns, belonging to quite another tradition, to be of any relevance for these.

In the following paper by I. Kinnes, Pitnacree is found in proper company together with all other known non-megalithic mortuary sites of Scotland. The paper contains a brief corpus of the sites, and a welcome survey of their data, since the works by Henshall and Davidson do not deal with non-megalithic tombs. It becomes apparent that also in Scotland we find a well-established tradition for these tombs; they should not any more be considered as rare exceptions. The paper thus clearly affirm that the megalithic chambered tombs represent only one part of the spectrum of Neolithic mortuary practise. Moreover it becomes clear that even though a round cairn-long cairn succession can be demonstrated at a number of multi-period megalithic tombs, some of the non-megalithic burial structures are covered by early long cairns, thus creating a rather complex situation.

The next paper, by J.G. Scott, is also devoted to non-megalithic tombs, but covers all Britain and Ireland. It thoroughly deals with one of the most intriguing and annoying problems of these structures: What do the axial postholes of the tombs actually represent? Do they reflect tent-shaped mortuary houses or posts pulled up or burned? Scott offers yet another solution: The posts may represent mortuary platforms where the dead bodies were exposed.

The article by G. Eogan describes similarities and differences between Scottish and Irish passage tombs, and some interesting parallels of development of ritual complexes are noted. G. Cooney deals in his paper thoroughly with the skeletal remains from Irish megalithic tombs. A proper survey of the burial practises of Neolithic Ireland has hitherto been missing, and its very welcome to be acquainted with this material as an important aspect of ritual, rather than just being a body of measurable information mostly for use for physical anthropologists. The following paper, by J. Thomas, also gives new clues to understand the significance of rituals, here dealing with aspects of megalithic art of Ireland.

R. Bradlay, once again, bring up an elegantly formulated paper providing new insights, here dealing with rock carvings and particularly with the secondary re-use of Scottish cup-marked and ring-and-cupmarked stones in burial context, giving clues to changes of "message" of rock carvings when in differential use: "Symbols that may once have been addressed to the wider world were turned around and directed towards the dead person".

Then follows a number of important artefact studies – welcome surveys of particular classes of objects such as the carved stone balls, axeheads, maceheads, the almost neglected coarse stone artifacts from Orkney, Neolithic pottery from SE-Scotland, and an analyses of the shape of Neolithic pottery of Southern England. Many of these studies can be regarded as fine "classical" studies, for instance the study by A. Sheridan of the stone and flint axeheads from Scotland. A. MacSween presents new and important evidence as to the understanding and interpretation of the grooved ware problem presenting one of the few grooved ware sites in Britain with stratigraphical evidence properly studied. Her analyses seems to reveal that grooved ware (in Orkney) does not emerge out of "nothing", but ought to be considered as a development of local pottery tradition (but probably under influence from elsewhere). Her study also permits her to suggest that the absence of grooved ware in certain Orkney megalithic should be considered as a chronological testimony of tomb use rather than a geographical one.

Finally, the book contains two regional studies, the one by I. Armit dealing with the Hebridean Neolithic being of greatest significance. Here the rather neglected but obviously important settlement material from this area is being thoroughly examined, and its range and variety being appreciated. The paper also contains a survey of the results of the recently excavated site *Eilean Domhnuill* in North Uist, which surely must be regarded as ranking among the major Neolithic sites of Britain. It is situated on a small islet in a loch, and it was formerly thought to be the remains of an Iron Age island broch or dun. The excavations have revealed that the settlement of exclusively Neolithic date consists of a small number of houses defined by a palisade with a carefully stone built revetment, an elaborate entrance, and a wooden (and later) stone built causeway leading to the islet. The houses are wooden or partially stone built structures, creating a complex stratigraphical sequence of eleven phases of three major "episodes". In the latest phase we find two conjoined stone-built houses, the houses from Knap of Howar, Papa Westray, Orkney, yielding the closest parallels. However, as the author points out the location of the two sites are very different; it would be unwise just to regard Eilean Domhnuill as a "Skara Brae" of the Hebredies, but to judge it in its own right. The excavation have also yielded a large number of pottery sherds providing a vast material for chronological studies. No doubt that Eilean Domhnuill will become a "classical" site in the Neolithic of Northern Europe.

The final paper by N.M. Sharples presents an interesting though rather curious theory on aspects of regionalisation in the Scottish Neolithic. It seems to revivify some of the now abandoned notions of "Secondary Neolithic" and "Mesolithic survival" or adaptations, though clad in more modern phrases. Partly based upon material from Orkney it is argued that the areas with the most prominent burial or ritual sites are those areas where a "mesolithic survival" is to be found, and that the more loose social structures and open minds of a "mesolithic" population would facilitate the creation of large monuments such as Maes Howe and Stennes. In other words it is argued that the resident "Mesolithic survivors" became more "Neolithic" than the Neolithic colonists, because the latter were more stabile and "locked" in their social structure and behaviour. Thus, areas of Scotland with the highest density of the most elaborate Neolithic monuments (such as the Clyde tombs of Argyll, Bute, Islay and Arran, the stone circles of Machrie Moor, the stone circles of Callanish) should be considered as core areas of "Mesolithic survival". When dealing with these matters in this rather controversial way, one should expect to find at least some reflections upon the character of the primary Neolithisation process. – After all, it is our very assessments and theories as to this process, which result in such a line of arguments as presented here.

However, we do not find any "backbone" of such reflections in this article. Only by reading the phrase "Neolithic colonisation of Britain" do we find a hint of the underlying assumptions as to the nature of the primary Neolithisation, while others could as well have been considered when dealing with these complex problems. Another assumption seems to be, that marine resources were not of any considerable importance to a "true" Neolithic population, and yet another loose assumption is the presumption that the Mesolithic hunter- gatherers had their stronghold on the Orkney Mainland, when we still have no documentation as to the settlement patten of the possible Mesolithic inhabitants of Orkney.

In *Antiquity*, some years ago, Glyn Daniel expressed the opinion that many articles occurring in Festschrifts are articles that perhaps could not be printed elsewhere – articles which have been lying more or less rejected for years in the archaeologist's drawers. But this is certainly not the case for this book made in honour of Audrey Henshall's achievements. All are publications in their own right providing an excellent up-to-date testimony of the high standard of Neolithic research in Scotland and Britain. It covers a large range of approaches, including both pure artifact studies with catalogues, and a number of interesting and stimulating discussive articles, a few of these of a refreshingly provocative kind providing "fresh flesh" for the "hungry" rewiever.

No doubt, the reader with just these three important books in his hand will gain a comprehensive knowledge of the Neolithic and the megalithic tombs of Scotland, further helped by the introduction in "Vessels for the Ancestors" and the literature lists.

Flemming Kaul

Viggo Nielsen: *Jernalderens Pløjning. Store Vildmose* (Iron Age Ploughing – Store Vildmose). Vendsyssel Historiske Museum, Hjørring 1993. 220 pp. 112 figs. 17 plates. English summary.

We can now welcome Viggo Nielsen's monograph on the extensive investigations into prehistoric cultivation carried out in 1967-72, the final publication of which has been awaited with lively interest ever since the appearance of the preliminary reports (of which the most recent was in vol. 5 of the present periodical, 1986). The excavation and preparation of the final report has taken place in exemplary collaboration between a number of archaeologists, ethnologists and scientists, and has received considerable technical and specialist support from Vendsyssel Historical Museum in Hjørring. Although the book appears with one author, it is made quite clear who is responsible for the different sections. The publication is a handsome one, thanks to generous financial support, which is a great advantage especially for the many technically demanding illustrations.

Store Vildmose bog is geologically and botanically an unusual area in southern Vendsyssel, a raised bog covering 60 km$^2$. which slowly overgrew a bay of the Limfjord after post-Litorina isostatic readjustment had cut it off and drained it. The introduction is based on Bent Aaby and his colleagues" recent study of the bog's developed from raised seabed first to a waterlogged and partially forested wilderness, and then gradually during the Bronze Age to a raised bog, which extended itself gradually northwards and westwards from an originally restricted area in the south, until in the Middle Ages it finally filled the whole plain. The expansion of the bog from ca. 1500 B.C. to ca. 700 A.D. has been successfully illustrated, but after this it continued to expand, as already said.

In recent times, especially after 1921, nature came under pressure from big farming and drainage projects. As the peat subsided, Iron Age burial mounds appeared, and were excavated first by the National Museum, and later mainly by Vendsyssel Historical Museum. It was archaeologists from the latter that first noticed that there were traces of older ploughing under some of the mounds. Trial excavation showed that in the northern margin of the bog, near Grishøjgård Krat, undisturbed ploughing traces could be followed for what was a huge area for archaeologists. Ca. 200 hectares was acquired by the Ministry of Cultural Affairs for research, and "limited" excavations were carried out by Viggo Nielsen. After five years about 4,500 m$^2$ had been carefully excavated. This seemed only to be a small part of the original ploughed area, but it was sufficient to give a full idea of prehistoric ploughing both as a whole and in details.

Normally plough marks are difficult to date, but good luck provided two important pieces of evidence. A pit was found containing pottery from the earliest phase of the Pre-Roman Iron Age, which had been ploughed over. A tall, alas now shattered stone was found with abundant sherds of pots in the surrounding hollow, which had been broken against it as a ritual act. Here the author points to Anne Preisler's (unpublished) excavation results and some other parallels. The pottery was important for dating the entire excavation, for the hollow surrounding the stone was visibly later than the plough marks. The conclusion is: ploughing in the excavated area took place after c. 400 B.C. but before c. 200 B.C.

Traces of ard cultivation have long been known, especially from the Early Iron Age, but usually only in small areas. We known two types of pattern which the implement leaves on the underlying deposit if conditions are favourable. They either make a grid, i.e. are traces of ploughing in different directions, or else they take the form of bunches of parallel marks following field boundaries. These would be marked by tangible remains (field banks). At Grishøjgård both forms of ploughing were present, and it was for the first time possible to expose entire fields. Within the excavated area there were three complete and parts of ten adjacent plots. The boundaries between them were, as said, indicated by strips of parallel ploughing, which are ca. 1.5 m wide, but surprisingly enough in most cases there was no room for the boundary bank or lynchet. Field boundaries of the latter kinds could only be found in a few places. It was also apparent that the boundaries between the fields were not permanent, but were sometimes moved. These observations are important, for they show that individual fields cannot be judged from the traces that would have been found in primeval heath or seen from the air in present cultivated land. This has made somewhat problematical earlier attempts to arrive at units of measurement or social order from field banks.

The author has made another important discovery about ploughing technology. The criss-cross ploughing proceeds directly towards the field boundaries, where the plough must have been lifted and turned to start the next furrow. The belts with the many marks parallel with the boundaries, must then be a final stage whose purpose was to level out the area where preceding activities had disturbed the surface.

As can be expected the individual furrows have also been carefully and critically examined. Despite the contrast in colour with the underlying pale sand, it was impossible to follow a single ploughing for more than a short distance. The ploughshares were of wood and became rapidly worn, leading to marks of different shapes, sometimes narrow and pointed, sometimes broad and rounded. Experiments have shown that it makes an important difference whether the plough is held vertically or obliquely during work. Despite all the possible sources of error it is the author's opinion that two different types of plough were used. One resembled the one from Døstrup, the other had a more arrow-shaped share, and was a type of ard that is also known from a number of peatbog discoveries.

Only the most important conclusions can be discussed here that were arrived at from the study and are so excellently documented in text and illustration. We may mention the 17 photographic plates, each covering 20 x 20 m, which were compiled from vertical photographs of 5 x 5 m squares and are published at a scale of 1:100.

The author confines himself to what has actually been found and wisely avoids the tempting questions others might have put with so large and new a material as point of departure. The cultivation of these very large, but marginal areas came to an abrupt end after at most 2-3 centuries. It is indeed intimated that the cause could be climatic, but the sources say nothing about underlying social relations and settlement conditions. No contemporary farms or villages have been found, and nothing can be said of the fate of the many people that were forced out in the Early Pre-Roman Iron Age into the marginal areas, presumably because all the better land was already under cultivation. It is regarded as a positive aspect of the work that it says nothing that cannot be documented.

Nevertheless after the book's central part dealing with the Early Iron Age fields and their cultivation, there follow two large chapters that supplement the subject. First the author gives an account of the remains from later settlement found in the same part of Vildmosen. Here and close by about 600 years later there was place for a collection of burial structures in the form of small sod-built mounds, overlying poor cremation burials and surrounded by a stone kerb. About 85 such mounds are known to have existed. Some were excavated at the end of the last century and later, and a few are now under protection order, but more are destroyed. They lie in groups, some in the bog, where the peat gradually hid them, and some on the higher surrounding ground. They indicate a new colonization, which also was short-lived. There was also a single occupation site with the remains of at least ten large houses, which were excavated in 1978-80 near Stavad (T. Dehn, Antikvariske Studier 5, 1982) and were from the same time as the burial mounds. This site lay ca. 2.5 km NW of where the edge of the bog was at the time. It has not been possible to show whether they had cultivated land attached to them.

The author includes an up-to-date catalogue with plans and illustrations, with the emphasis on the latest excavated finds. This section confirms earlier expectations that these and other graves from eastern Vendsyssel were closely related to discoveries in southern Norway. For the subject of the book however it is their relationship to the bog that is of importance. Within its borders they were constructed directly on the thin sandy soil that had been cultivated in the Early Iron Age. Without doubt there had been a 600 year interruption in human activity. Changes in the natural environment must again be the explanation.

The last main chapter in the book deals with another important aspect of prehistoric ard cultivation in Denmark and Schleswig. This is the increasing number of traces clearly shown by the careful excavation of Bronze Age, and to an increasing extent Neolithic, burial structures. Both in Denmark and in neighbouring countries there has been much discussion of their significance. Around 1960 researchers made the two suggestions either that the reason for the ploughing could be purely practical, ie. to cut sods for use as building material, or that the ploughing was ceremonial and connected with burial ritual. Since then doubt has been growing whether the ploughing and the construction of the barrow really were connected. Most recently Henrik Thrane has argued on the basis of ca. 170 occurrences that virtually all ard marks of this type came from field cultivation earlier than the mound, but in certain cases ritual ploughing could not be ruled out (JDA 8, 1989). Our author goes a step further, and after examining the entire material concludes that there is no proof of contemporaneity of burial and ploughing at any site known so far, adding that a large and not properly treated body of information relating to ploughing throughout the whole Neolithic and Bronze Age is available and not properly studied. However this material is relevant and important for the book's subject, and could have given a domestic background to the Vildmose investigations. An example is the traces under the large Period V barrow published by Thrane (Lusehøj ved Voldtofte. Fynske Studier XI-II, Odense 1984, 114ff). This shows among other things the reconstruction of an area where three field plots meet (fig. 106). This is the only parallel known by me to the observation at Vildmose that some of the fields lie so close together that there was no space between them for a dividing bank. The author seems not to have made use of this observation. Other discoveries in Denmark of plough marks connected with Early Iron Age field banks or fragments of contemporary fields are similar treated. The publications are indeed mentioned in short accounts of earlier research, but the material is not used for a closer analysis of the central problems of the book; one of them however is mentioned in detail in an earlier report (JDA 5, 1986, 208).

Perhaps the reviewer would have found these more interesting than the author's many references to the descriptions of the classical authors, and his ethnographical knowledge of ploughing under quite different geographical, social and technological conditions than those which the economically pressed people of Vendsyssel had to cope with. This might lead one to enquire whether the remains at Grishøjgård were typical of their time, or whether their marginal situation made them exceptional in detail. The author of the book would have had no difficulty in replying to these objections, and seen in the context of such an important and detailed publication in an area of particular present interest in Danish archaeology, they are only questions of detail. It is uncertain whether there ever again will be the possibility of carrying through so comprehensive and successful a study of the subject. (Translated by David Liversage)

C.J. Becker

Martin Carver (ed.): *The Age of Sutton Hoo: the seventh century in north-western Europe.* Woodbridge 1992. 406pp.

In 1989, a conference was held in York in connexion with the 50th anniversary of the discovery of the rich ship burial at Sutton Hoo. The theme of the conference was the formation of the early kingdoms of north-western Europe, and it had a further goal of influencing and encouraging the new work that has gone on at Sutton Hoo under the direction of Martin Carver since 1983, with excavations in the years 1986-92. With this publication of the conference proceedings, Carver gives a brief, interim summary of the results of the excavations.

With the new excavations, 12 barrows in all have now been investigated. As well as the famous ship grave (mound 1) there is a second ship burial with an inhumation with weapons in a chamber beneath the ship (mound 2); a cremation with weapons in a dug-out boat or wooden tray (mound 3); 5 cremations in bronze vessels (mounds 4, 5, 6, 7 and 18); an inhumation in a chamber grave (mound 14); an inhumation with weapons beside a horse grave (mound 17); and a child's inhumation grave with weapons (mound 20). Several of the barrows, unfortunately, were "excavated" at an early date, probably in the 19th century, though traces of quite rich grave furnishings still survive. Seven mounds have deliberately been left untouched.

Besides the barrow burials, 2 cremations and 2 inhumations with less splendid furnishing were found. There were also a total of 39 quite unusual inhumation graves in two groups, in which three-quarters of the deceased had been decapitated, hanged or abused, were lying with their hands tied behind them or had been thrown prone into the grave. One of them was buried with an ard in a "ploughing" posture; otherwise the burials were without normal grave goods. One group was associated with mound 5, the second surrounded a "natural" feature that is interpreted as the root of a tree. You have to be very determinedly sceptical not to believe that these are examples of human sacrifice, in large numbers and of barbaric character.

According to the provisional datings, the first grave (mound 17) dates to around the middle of the 6th century or a little later, and burial continued for a few generations, with the two ship burials of the early 7th century perhaps being the last.

The barrow burials at Sutton Hoo are thus not just the visible and aristocratic part of a larger and more democratic cemetery: the whole cemetery, with its associated "sacrificial" graves is a thorough manifestation of power. This stands in contrast to the ship burial from Snape, also in Suffolk, which may have been just as richly furnished as several of the Sutton Hoo graves. This was excavated in 1862, and was well recorded by the standards of the time, but unfortunately it had already been robbed. There were several barrows at the site, and new excavations, that are presented by William Filmer-Sankey, show that they were added to an existing, more common cemetery.

The new excavations have actually provided an opportunity for older finds and problems to be reviewed and re-assessed. The rich ship burial from Sutton Hoo has, indeed, been compared time and again with Scandinavian finds, especially the Central Swedish ship burials at Vendel and Valsgärde, on the basis of both the burial form and specific similarities in the grave goods. It is also, then, of great interest for a Scandinavian to see what we can learn from the new excavations, as well as from the processes of state-formation in Anglo-Saxon England, where indeed there are better historical sources to shed light on the process than with the Scandinavian Migration Period. At the same time, this volume shows how very interested our British colleagues are in the current Scandinavian research on the "Tribe to State" problem. The interest in "the Swedish connexion" persists, but it is clearly modified in the direction of a wider Scandinavian connexion, perhaps indeed towards a Danish connexion above all. This shift is dramatically illustrated by John Hines, who in a footnote faces up to the fact that his discussion of stylistic connexions in the Later Germanic Period may be left out of place by Karen Høilund Nielsen's current re-assessment of the course of innovation in Scandinavia.

The local context of Sutton Hoo is dealt with by Christopher Scull and John Newman. How and when the Anglo-Saxon settlement actually took place is still, in fact, a lasting problem: as a military invasion in the mid-5th century or as a more peaceful influx of civilian groups over a longer period – perhaps as a mixture of the two. It is also unclear how the post-Roman population of Britain was organized after the Roman army had left, and how far the Anglo-Saxons were able to (or actually did) take over existing social structures. Scull emphasizes that we must never forget that the invaders were no disorganized barbarians: they came from hierarchical societies that were able to control fairly large territories as, for instance, the bog finds show. He argues for an invasion around the middle of the 5th century or a little earlier, and believes that the sparse historical records render the existence of an East Anglian kingdom in the second half of the 6th century probable, though it is not clear how extensive it was or whether it arose from the integration of smaller units, corresponding, for instance, to the later counties of Norfolk and Suffolk.

We thus have to recognize that we cannot draw direct conclusions about Scandinavia from the Anglo-Saxon situation. There was no local development over a long period as in Scandinavia but rather a quite different and acute situation: the invading Germanic peoples met a society in being that they had to take account of and, perhaps, take over; they could not simply transfer their native social system, nor, as they later did in Iceland, were they free to form a big chiefs' Utopia.

Anglo-Saxon settlement in East Anglia is distributed, in general terms, on the same pattern as the Romano-British, with the bulk of settlement along the rivers, though actual local continuity is difficult to demonstrate. This is further shown by the settlement-archaeological project in Suffolk which John Newman reports on. There is a very clear falling off of finds, though in fact one that starts as early as the second half of the 4th century, before the invasions. Settlement recovers in the 6th century, and extends again to the inland clays that had been abandoned in the meanwhile. An extensive settlement covering several hectares has been identified at Rendlesham, north of Sutton Hoo, where Bede locates a royal site. By the way, it is good to see that it has proved possible to co-operate profitably with responsible metal-detector enthusiasts in East Anglia too.

Continuity in settlement pattern can, of course, be governed in some measure by the natural environment etc., but it also poses the question of what actually happened to the Romano-British population in the areas which became Anglo-Saxon. Was it completely, or partly, expelled? Did it adopt the artefact-types and burial practices of the newcomers, or is it archaeologically "invisible", either because it was suppressed and impoverished or because its traces cannot be distinguished from Late Roman finds? The authors offer only cautious answers.

In religion and politics, the Anglo-Saxon kingdoms were in a situation that does not occur in Scandinavia before the Viking Period, with a Frankish kingdom that claimed, with varying degrees of realism, overlordship over parts of England, especially Kent (Ian Wood). Here too, religion and politics went hand in hand, an issue that is discussed by, amongst others, Helen Geake and Jane Stevenson. The Christian mission was largely directed at the social elite, and a king's acceptance or rejection of Christianity was a direct sign of his position in relation to the Franks. Even in the 7th and 8th centuries Christianity seems to have been weak in the general population, and several Christian kings were killed by the pagans in the 7th century. The very ostentatious pagan burials i.a. at Sutton Hoo, with rich grave goods and with human sacrifices (to which Geake is able to cite further Anglo-Saxon parallels) must thus also be viewed as political statements, with the cultivation of the connexion with pagan Scandinavia being a counter to the Franks. Elsewhere in the book, however, Edward James notes that the situation was really not so simple: Frankish graves can contain rich grave goods quite a long time after the conversion to Christianity and the Kentish social elite seems to have begun to raise burial mounds at the same as it became Christian. This may depend upon a need to mark one's status in a volatile political situation, at a period before the building of stone churches took on this function.

Sam Newton finds an odder expression of "the Scandinavian connexion" in the genealogy of King Ælfwald of East Anglia, which apparently was written around 725. Two of the names of his early (and most likely mythical) ancestors also occur as the names of Danish kings in the poem *Beowulf*, the events of which in fact are situated in Scandinavia and which Newton believes was written in an Anglian kingdom at about the same time as the genealogy. It certainly needs further investigation to show that there is a case here of a definite connexion, but it would certainly be intriguing and significant if Danish kings could have the same value for legitimizing a ruler as Woden and Caesar, who head the genealogy.

Tania M. Dickinson and George Speake provide a provisional report on a burial mound at Asthall in Oxfordshire. The barrow is now 17 m. in diameter and 2.4 m. high but was probably once larger. The centre of the barrow was excavated by a "gentleman amateur" in the 1920's and the information on his excavation is poor. It appears, however, that the barrow covered a primary cremation with a cremation layer up to 15 cm. thick and 6 m. in diameter. There are severely burnt remains of rich grave goods from the first half of the 7th century, including a small silver vessel, at least two bronze vessels, an imported Merovingian pot, pressed bronze foil with animal ornament from a (?)drinking horn, several strap mounts, a gaming die and pieces and horse and cattle bones. Some postholes may have belonged to a structure (a mortuary house?) on the site, and "largish "charred" timber" is mentioned though the information is, as noted, obscure. The large barrows at Uppsala are noted as possible parallels, while both the possibility of a timber structure that was not part of the funeral pyre and the primary cremation layer with severely burnt grave goods also remind me of Grydehøj at Lejre, where impressions of unburnt timber were found on the cremation layer. The calibrated C 14 datings place Grydehøj most probably in the first half of the 7th century (pers. comm. Steen W. Andersen, who is publishing the Lejre graves).

J. D. Richards writes on the use of symbols in connexion with Anglo-Saxon burials. I must confess that I found it difficult to follow him where, for instance, he relates the decoration on cremation urns to the sex, age and status of the deceased. In part, I find it difficult to imagine how so intimate a relationship between people and pottery could have worked in daily life if the urns were taken from the pottery the family owned; it would work better, of course, if the urn were specially made for the funeral. But the whole thesis is further dependent on secure determinations of the sex of the cremated bone, and I would be much more cautious about this than Richards. Comparing frequencies of animal species in graves and settlements also looks decidedly problematic when one considers the random survival of bone on settlements and how difficult it is even to assess the importance of the various species in the diet.

Far more substantial is Heinrich Härke's discussion of weapon burials which also relates much more convincingly to recognizable social circumstances. Weapons occur in 47% of the early Anglo-Saxon men's graves and 9% of juveniles' graves. Weapons, thus, did not signify that the deceased belonged to a special warrior class but were normal grave goods for all relatively well-off Anglo-Saxon males. The men's graves without weapons are on average poorer in other grave goods too, while weapons also appear with males who were too young, too old or disabled to be able to use them. These, however, often had to be content with a spear, the commonest weapon, while rarer types such as swords and battle-axes seem to have been restricted to active warriors.

In the 5th and 6th centuries, the skeletons in weapon graves clearly are of greater average height than those in men's graves without weapons. On the other hand, marks in the tooth enamel show that those men who were buried with weapons suffered the same incidence of hunger and sickness in childhood as the others. This, then, is no social elite with greater control of the food resources, but the greater height may have an ethnic explanation: the average height of the incoming Anglo-Saxons was certainly 4 cm. more than that of the Romano-British population. There is less variation in height in the weapon graves than in those without weapons, and the latter therefore could contain both poorer Anglo-Saxons and descendants of the earlier population who did not use weapons as grave goods. In the 7th and 8th centuries the difference seems to even out (an incipient assimilation of Anglo-Saxons and Britons?) but the material is rather sparse here: weapon graves appear to lose significance as markers of ethnic or social status.

The situation in Francia is considered in several essays. Guy Halsall discusses social development in Austrasia around the year 600. The historical sources indicate that power and influence in the Merovingian realm in the 6th century depended very much on the king, who could both grant and take away privileges. After about 600, however, an upper class was established, with heritable property and positions of power, to some degree at the king's expense. Correspondingly, grave goods in the 6th century are varied, with many different types, while in the 7th century grave furnishing grows stereotyped. In the 6th century there was a need to display the family's status in burials, certainly for a public gathering from several neighbouring communities, while in the 7th century positions were both more established and could be marked in more durable ways, for instance by building churches and being buried in them.

Edward James deals with the burials of the Frankish kings. Strictly speaking we know only one of these for certain, the grave of Childeric in Tournai, while both the Arnegunde grave in St. Denis and the two graves in Cologne Cathedral are not certainly royal. Some royal graves may, however, have been found in the 17th and 18th centuries though nothing is preserved from them. The Merovingian kings were keen to build chapels of rest and often decided where they themselves and their closest relatives would be buried, but this did not lead to the same church being used for a long period. This stands in contrast to, for example, Kent, where the kings were buried in Canterbury for 200 years. One reason may be the abundance of the Merovingian royal family, which for one thing led to many, fluctuating divisions of the Merovingian empire, but which on the other hand for centuries was the undisputed royal clan. In Kent, by contrast, new dynasties were constantly being created, and it may have been important for the "usurpers" to demonstrate their adherence to a royal tradition.

Francia and its royal graves are also considered in Lotte Hedeager's contribution. In connexion with a summary of her model of social development and state-formation processes in Denmark, she uses several maps to compare Scandinavia and Francia as parallel (though possibly opposed) centres of power. In both areas, we see that prestigious artefacts are rare in the central zone – Denmark/Skåne and Central Gaul – but occur in greater numbers in more peripheral areas: Norway, Sweden and western Finland; southern England, Belgium and the Rhineland. This holds for ring-swords, graves with two-edged display swords, Continental finds of brooches of Scandinavian type, and crested helmets in graves. The bracteates are included too, though this map would have been more persuasive if it had only included the examples from graves. The differences are interpreted as those between central areas (Denmark and Francia) in which those with power were well consolidated and more peripheral areas with unstable power relations where it was necessary to mark one's status and allegiance or independence to/from both central and other local potentates.

It is reasonable to believe that state-formation took place earlier in the fertile and closely connected south of Scandinavia than in Norway and Sweden. I would question, however, the warrior ideology that Hedeager identifies as driving force in this process. Or, more accurately, one gets the impression that she does not distinguish between the ideology of the elite and its real world. The ideal of the heroic legends can be pretty well summed up as something like: "The aim of life is a death in battle, so let us go out to fight and loot something prestigious!". But no community can live on these terms. On the contrary, the intensity and range of contacts we find this way and that across Europe required fairly well-regulated conditions. As a comparison, I would suppose that most medieval knights actually died of sickness, despite the martial ideals of chivalrous romance. And in his large corpus of weapon graves, Härke found traces of wounds only on about one in a hundred skeletons.

Despite the importance of plunder and imported prestige goods, I believe that substantial land rights (however in fact they were organized) and a similarly inherited social status were essential prerequisites for any subsequent access to prestigious goods; this is also acknowledged by Hedeager. I also believe that competition for the real central power – the kingship (whatever rights and titles it may have had) – was restricted to a very small circle: in the case of Denmark, perhaps, to a single clan or whatever we ought to term it, pretty well as in the Merovingian realms. It is striking that all Danish kings of the late Viking Period and the Middle Ages apart from Magnus the Good are from one family, which can be said still to be on the throne today. This principle included a considerable flexibility in the recognition of royal bastards and female lines, but there was no member of the *Hvide* family or of any other leading family who even attempted the throne. Similarly when we hear of Danish kings in the period between the 790's and the 860's, it is mostly brothers and cousins who compete for power.

Both Hedeager and other scholars before her appear to take the great barrows at Lejre and Jelling as starting points for new dynasties. But neither the Mervingians nor the medieval Danish kings stuck to established burial-churches for considerable periods: a change of the royal burial-place needs not to indicate a new dynasty. We will of course never in any way be able to assert that Queen Margrethe II is a descendant of Chlochilaich, but without going to extremes I believe we should be amenable to the idea that there has been extensive continuity in social development despite all the fluctuations.

The book contains several further contributions. Bjørn Myhre gives a report on the new excavations at Borre, where there seems to have been pre-Viking activity. Margaret Gelling writes on place-names in Suffolk, though regrettably only at a parish level: I would very much have liked to see a detailed study of the names around Sutton Hoo. There are articles on the situation in the Celtic West and in Scotland, and much besides. This is a useful and interesting work, which provokes both reactions and second thoughts! (*Translated by John Hines)*

Morten Axboe

# Book Chronicle

JØRGEN HOLM & FLEMMING RIECK: *Istidsjægere ved Jelssøerne. Hamburgkulturen i Danmark. With contributions by JOAN HUXTABLE, ELSE KOLSTRUP, BO MADSEN and VAGN MEJDAHL.* Skrifter fra Museumsrådet for Sønderjyllands Amt, 5. Haderslev 1992. 151pp (with English summaries).

The first settlement sites of the Hamburgian Culture excavated in Denmark (see preliminary report in *JDA* vol. 2). This final report on the two sites at Jels includes contributions on flint technology, geology and climate, as well as thermoluminescence dating.

DAVID LIVERSAGE: *Barkær. Long Barrows and Settlements.* Arkæologiske Studier Vol. IX. Akademisk Forlag, København, 1992. 124pp.

The famous long-houses from the Early Neolithic excavated 1931-49 by P.V. Glob at Barkær in Eastern Jutland are reinterpreted as earthen long barrows in this publication which presents a full report on the excavation. It also gives a critical review of the chronology of the Early Neolithic in Denmark.

J.A. BAKKER: *The Dutch Hunebedden. Megalithic Tombs of the Funnel Beaker Culture.* International Monographs in Prehistory, Archaeological Series 2. Ann Arbor, Michigan, 1992. 214pp.

The 53 Dutch *Hunebedden* (passage graves) are under survey in this well-structured handbook containing a wealth of details and references (21pp of bibliography).

SVEND HANSEN: *Jættestuer i Danmark. Konstruktion og restaurering.* Miljøministeriet, Skov- og Naturstyrelsen, København 1993. 151pp (with an English summary supplied separately on request by the publishers).

The Danish passage graves are here described by the restaurator, focusing on architectural aspects. The book contains a summary of our present knowledge about the construction of the tombs and their mounds. Ground plans of 205 passage graves – about half the number of surviving monuments – are given in the same scale.

NILS BJÖRHEM & ULF SÄFVESTAD: *Fosie IV. Bebyggelsen under brons- och järnålder.* Malmöfynd 6. Malmö Museer 1993. 408pp (with an English summary).

One of the largest settlement excavations in Sweden took place 1979-83 near Malmö in SW Scania. A settlement with Late Neolithic long-houses was already published 1989 (in Malmöfynd 5). The book offers a detailed documentation of the remains of settlement from the Bronze and Iron Ages.

KARL-HEINZ WILLROTH: *Untersuchungen zur Besiedlungsgeschichte der Landschaften Angeln und Schwansen von der älteren Bronzezeit bis zum frühen Mittelalter. Eine Studie zur Chronologie, Chorologie und Siedlungskunde.* Offa-Bücher Band 72, Neumünster 1992. 679 pp.

This voluminous dissertation is based on the records of the *Landesaufname* and summarises the archaeological source material from the eastern part of Southern Schleswig. It is volume one of a series of publications planned in order to present the results of recent investigation in the Kosel area, Kreis Rendsburg-Eckernförde (volume two is the survey of historical sources by H. Unverhau, see Offa-Bücher Band 69).

KENT ANDERSSON: *Romartida Guldsmide i Norden I,* Katalog. Aun 17, Uppsala 1993. 292pp and 67 distribution maps.

A catalogue of Roman period gold jewellery in the Nordic Contries with all relevant references, written in Swedish but with an English glossary.

W. HAIO ZIMMERMANN: *Die Siedlungen des 1. bis 6. Jahrhunderts nach Christus von Flögeln-Eekhöltjen, Niedersachsen: Die Bauformen und ihre Funktionen.* Probleme der Küstenforschung im südlichen Nordseegebiet, Band 19. Hildesheim 1992. 360pp.

Large-scale excavations of the naturally bounded settlement area at Flögeln took place 1971-1986, admired by Scandinavian archaeologists because of its organization and interdisciplinary approach. This volume of *Probleme der Küstenforschung* is a monograph, which offers a presentation and discussion of the buildings of the Roman Iron Age and Migration Period.

PER H. RAMQVIST: *Högom. The excavations 1949-1984. Högom Part 1.* Archaeology and Environment 13. Neumünster 1992. 236pp and 154 plates.

Following the publication by Margareta Nockert, *The Högom find and other Migration Period textiles and costumes in Scandinavia* (1991), the present volume reports in detail on the magnificent finds from the princely burials from the Migration Period at Högum in Central Norrland, Sweden.

JOHN HINES: *Clasps, Hektespenner, Agraffen. Anglo-Scandinavian Clasps of Classes A-C of the 3rd to 6th centuries A.D. Typology, Diffusion and Function.* Kungl. Vitterhets Historie och Antikvitets Akademien. Stockholm 1993. 126pp and 5 plates.

The way people button their clothes may be indicative of social status and group identity – in the present as in the past. The author has produced a 'history of the button' which also supplements the history of decorative arts in the Migration Period.

WIETSKE PRUMMEL: *Starigard/Oldenburg. Hauptburg der Slawen in Wagrien. IV, Die Tierknochenfunde unter besondere Berücksichtigung der Beizjagd.* Offa-Bücher Band 74. Neumünster 1993. 154pp and 16 tables.

The Slavonic and early German castle at Starigard/Oldenburg was excavated 1953-86 under the direction of K.W. Struve. Being one in a series of reports on the find material, this volume presents the faunal remains from the Medieval layers. It includes an interesting contribution to the history of falconry.

JØRGEN JENSEN: *Thomsens Museum. Historien om Nationalmuseet* Gyldendal, København 1992. 432pp.

Some books deserve mention in spite of being entirely in Danish. J. Jensen's biographic book on C.J. Thomsen is one of them. It is an account of how archaeology in Denmark grew to become a research discipline and how museum collections were organized and presented to the public during the first half of the 19th century – seen on the background of the cultural, political and intellectual history of the time.

L. LARSSON, J. CALLMER & B. STJERNQUIST (eds.): *The Archaeology of the Cultural Landscape. Field work and research in a south Swedish rural region.* Acta Archaeologica Lundensia. Ser. in 4°, N° 19. Lund 1992. 498pp and 15 colour plates.

The Ystad Project in southern Sweden was carried out 1982-1990 by the University of Lund as an interdisciplinary study of settlement and environment from the Mesolithic until the present – see rewiev of the project report, *The Cultural Landscape during 6000 Years in Southern Sweden,* in this volume. This book contains the results of the archaeological investigations of the project and deals with the time from the beginning of agriculture until the Early Medieval.

*The Study of Medieval Archaeology. European Symposium for Teachers of Medieval Archaeology, Lund* 11-15 June 1990. Edited by HANS ANDERSSON and JES WIENBERG. Lund Studies in Medieval Archaeology 13. Stockholm 1993. 387pp.

Twenty-five papers in German and English describe various aspects of medieval archaeology in Europe, together forming a profile of the research discipline. One section contains short descriptions of 22 university institutes teaching medieval archaeology in 14 countries.

GUDRUN SVEINBJARNADOTTIR: *Farm Abandonment in Medieval and Post-Medieval Iceland: an Interdisciplinary Study.* Oxbow Monographs 17. Exeter 1992. 192pp.

The book deals with the nature and distribution of habitation in Iceland since its earliest settlement in the 9th century, and the extent and causes of early farm abandonment.

S. HVASS & B. STORGAARD (eds.): *Digging into the Past. 25 Years of Archaeology in Denmark.*

76 scholars present an up-to-date survey of archaeological work in Denmark during a quarter of a century. A most informative book on various aspects of contemporary archaeology also including sections on legislation and institutions (with 25pp of references). Danish version available.

# Instructions to Authors

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Radiocarbon dates: It must be clearly indicated, whether radiocarbon dates are given in conventional C-14 years or as calibrated dates. For uncalibrated dates use bp (before present) and bc/ad (before Christ/after Christ). For calibrated dates please use BC and AD. When quoting individual dates, a reference must be given to the laboratory and and sample no., e.g. (K-5030). For calibrated dates, please refer to the calibration curve in question.

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Do not use *et al.*, but list all contributors. Give full periodical data and do not use abbreviations.

Note the following reference styles for journal articles (1); articles in compendia (2); or in serials (3); monographs in serials (4); and books (5):

1 Bennike, Pia 1990: Human Remains from the Grøfte Dolmen. *Journal of Danish Archaeology* 7, 1988 (1990), pp. 70-76.

2 Roesdahl, Else 1988: Vikingetidens befæstninger i Danmark – og hvad siden skete. In T. Madsen (ed.): *Bag Moesgårds maske,* pp. 203-216. Århus: Aarhus Universitetsforlag.

3 Hvass, Steen 1988: Jernalderens bebyggelse. In P. Mortensen & B. M. Rasmussen (eds.): *Jernalderens stammesamfund. Fra Stamme til Stat i Danmark 1.* Jysk Arkæologisk Selskabs Skrifter 22, pp. 53-92.

4 Ørsnes, Mogens 1988: *Ejsbøl I. Waffenopferfunde des 4.-5. Jarh. nach Chr.* Nordiske Fortidsminder, Serie B 11.

5 Aaris-Sørensen, Kim 1988: *Danmarks forhistoriske dyreverden. Fra istid til vikingetid.* København.