JOURNAL OF DANISH ARCHAEOLOGY

VOLUME 10 · 1991
ODENSE UNIVERSITY PRESS

EDITORS

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THIS VOLUME IS PUBLISHED WITH GRANTS FROM

The Danish Research Council for the Humanities
The National Museum
The National Forest and Nature Agency

SUBSCRIPTION

Journal of Danish Archaeology is published in one annual volume. Annual subscription rate: 200 Danish kroner, excl. postage. Subscription orders should be sent to Odense University Press, 55 Campusvej, DK-5230 Odense M, Denmark.

MANUSCRIPTS

Manuscripts for publication in *Journal of Danish Archaeology* should be sent to editors or to any member of the editorial board. Editorial adress: Prinsens Palais, Frederiksholms Kanal 12, DK-1220 Copenhagen K.

BOOKS FOR REVIEW

Books for review in *Journal of Danish Archaeology* should be sent to the editorial adress.

Cover: Uffe Rosenfeldt
Photoset and printed by AiO Print Ltd., Odense, Denmark
ISBN 87 7492 795 7
ISSN 0108-464X

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Settlements of the Hamburgian and Federmesser Cultures at Slotseng, South Jutland

by JØRGEN HOLM

INTRODUCTION AND FIND HISTORY

This article presents the results obtained to date from the archaeological and geological investigations undertaken in the period 1985–91 at Slotseng, South Jutland, in connection with a group of Late Palaeolithic settlements from the Hamburgian and Federmesser cultures. In 1991, sounding in a nearby kettle hole revealed an apparently complete Late Glacial stratigraphy, a flint implement and well-preserved organic material, including reindeer bones with traces of human working. One bone has been dated by accelerated mass spectrometry (AMS) to 12520 ± 190 b.p. C^{14} years, *i.e.* the middle of the Bølling period.

In the investigation in 1981–84 of two settlements, Jels 1 and 2 (Holm & Rieck 1983, 1987, 1992), situated on the Jels lakes, South Jutland (fig. 1), it was ascertained for the first time that it is possible to find settlements older than the Bromme Culture, which has already been subjected to intensive investigation for many years (*e.g.* Mathiassen 1946; Andersen 1973; Madsen 1983; Fischer & Nielsen 1987). The Jels settlements derive from the Hamburgian Culture, which was apparently the first to appear in the North European tundra areas after the last glaciation, more precisely at the beginning of the Bølling Period, c. 13000 b.p. in C^{14} years (Burdukiewicz 1986).

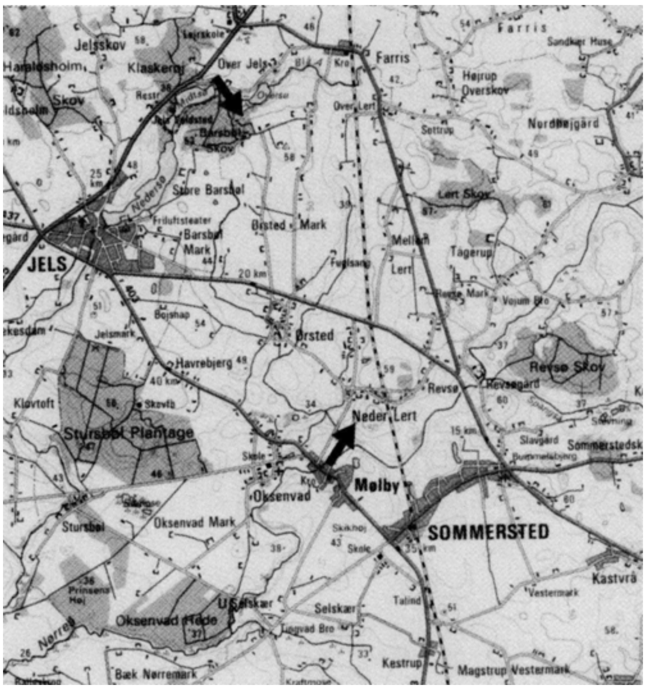

Fig. 1. Section of map sheet 1212 Haderslev (1:100.000). The arrows indicate the settlements of Jels (above) and Slotseng (below). Reproduced by permission of Geodetic Institute (A. 404/85).

The most northerly Hamburgian sites in Germany are found at Ahrenshöft, Kreis Nordfriesland (Hartz 1987), and it was only to be expected that other Hamburgian sites would appear in South Jutland. This quickly proved to be the case, although in an unexpected manner: during a general examination of the Stone Age material in the store rooms of Haderslev Museum during 1985, it was found that a flint assemblage acquired by the museum as early as 1962 is from the Hamburgian Culture. *I.a.* 1 double Zinken, 2 single Zinken and 1 scraper could be distinguished, besides a score of flakes.[1]

TOPOGRAPHY AND GEOLOGY

The find locality is the northern edge of the Nørreå valley between the villages of Mølby and Neder Lert in the western part of an extensive hill formation occupying the angle between Nørreå, which flows from the north-east, and its tributary Ørsted Å, which comes from the north-west (fig. 1). This is the extreme western edge of the East Jutland late moraine landscape, formed during the Weichselian glaciation. The stationary ice line is assumed at its maximum extent to have stood around the modern town of Jels – a mere 5 km or so to the west. Wind- and water-deposited sand and gravel seems to predominate in this area, but there are also considerable tracts with boulder clay, especially in the high hills east of the find-area.

Fig. 2. The Late Palaeolithic settlements lie at the top of the hill – near the tent and the site trailers. At the foot of the hill, sounding is in progress in the kettle hole. In the foreground is a meadow, which in Late Glacial times was presumably a lake. View from the north-west – from the road between Mølby and Neder Lert. Photo: Jørgen Holm.

From the Nørreå valley there is a direct valley connection to the Jels lakes. If the depression through which the stream Barsbøl Bæk flows is followed to the north-west, the Hamburgian sites Jels 1 and 2 are reached, a stretch of about 5 km as the crow flies.

Just where the modern road between Mølby and Neder Lert crosses the river Ørsted Å in the form of a causeway, the brinks of the valleys lie very close together, a natural funnel in Late Glacial times. The actual find locality lies only about 250 m ENE of this spot – on a sandy plateau rising about 10 m above the surrounding wetlands, which fall gradually to the north-west to form a brink where the settlements lie. Below this is a semicircular depression which to the east cuts into a more elevated landscape, the open western part of which is connected with the valley of Ørsted Å. There must have been a lake of considerable extent here in Late Glacial times (fig. 2 and 3).

The geology and stratigraphy in immediate connection with the settlements may be generally characterized in the following way (fig. 4 and 5). 25–30 cm thick ploughed topsoil and immediately under this 10–40 cm featureless, strongly cryo- and bioturbated fine sand, presumably of aeolian origin and stained dark by eluted humic material. Close to the base of the tilth are possibly the remains of a podzol horizon (Allerød?). Under this again are alternating highly irregular sand, gravel and silt layers, which mainly seem to be of fluviatile origin. In a few places, the series reaches right up to the base of the tilth, but layers of aeolian origin seem also to occur – well-sorted sand with only indistinct layering. These layer series are broached – and thus disturbed – by numerous frost cracks, uprooted trees, root holes and animal burrows that can sometimes be followed down to a depth of over 1 m. These disturbances are as a rule sharply defined in relation to the original geological layers and filled with soft, featureless sand. This sand contains – apparently quite at random, but with diminishing frequency from top to bottom – the flint artefacts. The frost phenomena must have primarily arisen in the Late Dryas.

The aeolian and fluviatile layers are judged to be several thousand years older than the settlements and probably derive from the melting of the ice from the main stationary line only a few km to the west near the town of Jels. The stratigraphy greatly resembles that of Jels 1 and 2, and here we have some thermoluminescence datings of aeolian sand of "Older Cover Sand Type" (Kolstrup 1992): 14700 ± 1500 and 14300 ± 1500 B.P. respectively (Huxtable & Mejdahl 1992). It should be borne in mind that TL-datings express calendar or solar years, while the Late Glacial chronology is based on C^{14} years.

RECONNAISSANCE AND SOUNDING

In the period 1985–89 reconnaissance has been carried out every spring and autumn in the Slotseng locality, and a considerable material has been collected from the surface. It was notable that the Late Palaeolithic flint could be found over so large an area as 75 × 75 m – but without clear concentrations. In order to cast light on this circumstance, the National Museum, under the direction of the author, carried out a trial excavation in the autumn of 1989.

The sounding strategy at Slotseng was based on a knowledge of the smallest size of known Hamburgian settlements: c. 5 × 5 m. Pits measuring 50 × 50 cm were dug in the area, which covered more than 5000 sq.m., at 5 m intervals. At a few places, down the slope to the north-west, where settlements could hardly be expected, the interval was set to 10 m, however.

A total of 111 holes were dug. Only a shovel was used, but all soil was sieved. Mesh size was 5 mm, and dry weather throughout the excavation period made it possible to dry-sieve. Finds from the tilth and the underlying sand layers were kept apart. No attempt was made to plot the exact position of the flint in the underlying sand, the most important thing in this phase being to discover whether flint was present under the tilth. We had already learned from the investigation of the Jels settlements that geological processes and bioturbation after settlement have caused a considerable dislocation of the flint, so it would be unproductive to perform a detailed three-dimensional plot.

Taking the number of artefacts from the various probes, a density contour map was produced.[2] Three very distinct find concentrations were observed right out on the brink, marked from east to west *a*, *b*, and *c* (fig. 3). A fourth concentration, designated *d*, some way downslope to the north-west, should, with its 16 flakes found in a single probe, also be considered, but hardly represents a proper settlement. The finds are confined to the tilth layer, and comprise only chips. This is probably washed-out or slipped material – and most probably derives from find concentration *b*.

If the density curves for 5–30 chips per probe are examined, a continuous, c. 60 m long by up to 20 m wide, irregular find zone may be discerned roughly parallel to the edge of the slope. Extensive out-ploughing is doubtless mainly responsible for this picture, but there was probably also sporadic traffic along the edge during the settlement period – behaviour which has resulted in a more scattered occurrence of artefacts between the concentrations.

The curves for 15–30 flakes per probe probably give a more accurate picture of the settlement's original extent.

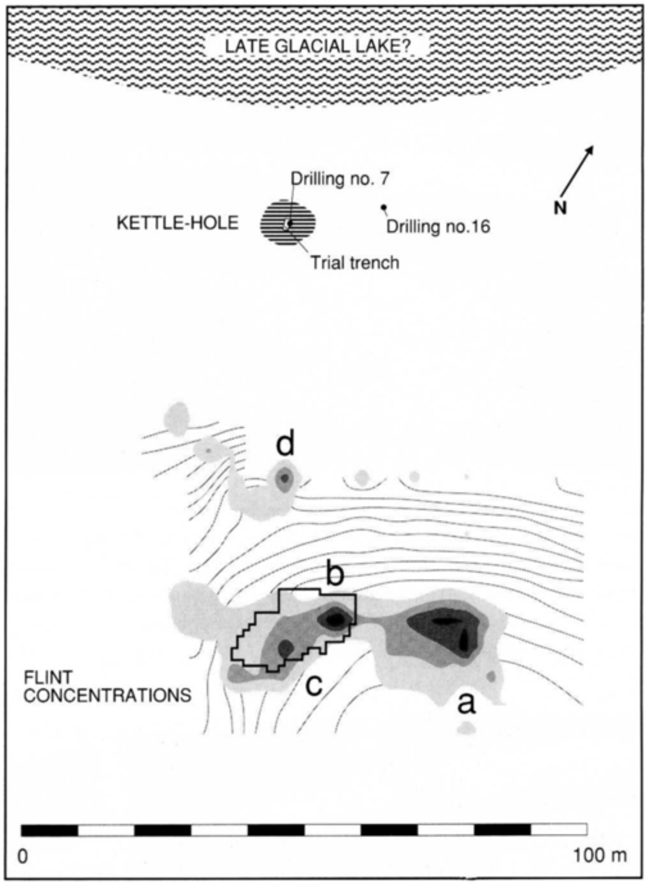

Fig. 3. Flint concentrations *a–d* shown with density curves (rasterized) for flakes and blades at an interval of 5 pieces per ¼ sq.m. *a*: Still uninvestigated, probably from the Hamburgian Culture. *b*: Settlement of the Federmesser Culture. c: Settlement of the Hamburgian Culture's Havelte group. *d*: A few small flakes. Also shown are the excavation area for the 1990–91 investigation and the location of the kettle hole, trial trench and drillings no. 7 and 16. Computer graphics: Jørgen Holm.

The above-described probe method has proved an excellent method of localizing and delimiting flint concentrations. If fig. 3, showing flake spread and frequency expressed in density curves after sounding, is compared with fig. 6, which shows the final density curves for the fully excavated settlements *b* (Federmesser Culture) and *c* (Hamburgian Culture), a convincing congruence will be found, whereas this method is inadequate if it is desired to identify the involved culture. Implements should be precisely plotted in already during the reconnaissance phase and the small probes supplemented with excavation of larger holes, of 1 sq.m., for example, in the centre of the concentrations, in order to obtain sufficiently characteristic material for this purpose.

Fig. 4. Profile section through the Hamburgian settlement *c* seen from the north. In a 0.5 m wide baulk, the featureless, soft, artefact-bearing sand has been removed with a combination of digging and hosing down. Remaining, in highly irregular relief, are the remains of the harder fluviatile layer series, disturbed by frost phenomena and bioturbations. For a more detailed general description, see the main text. Photo: Jørgen Holm.

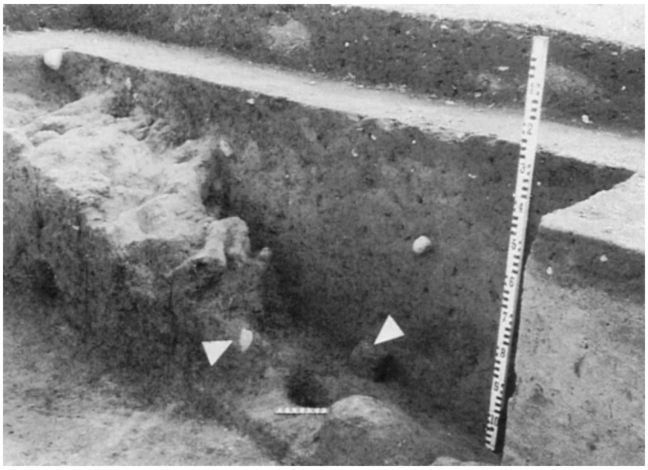

Fig. 5. Part of a profile section through the Hamburgian site (c). The cryo- and bioturbated artefact-bearing sand has been removed to a breadth of 0.5 m. Two flint flakes remain at a depth of about 1 m (shown with white triangles). Viewed from the west. Photo: Jørgen Holm.

There is naturally nothing new in digging probes to localize and delimit flint concentrations, but Slotseng has shown that this part of the process may be carried out with relatively few, small holes. The saving in time and money is obvious, and computer-generated graphical presentation is an excellent point of departure for planning subsequent field-work.

The artefact material from both surface collection and probes suggested the presence of settlements exclusively of the Hamburgian Culture. In addition, there were a couple of stray tanged points of Bromme type. A few backed blades did not raise at this stage any suspicion of Federmesser Culture, but were merely perceived as an integrated and not particularly surprising part of the Hamburgian inventory (a few implements of this kind have also been found at the Jels sites and are known in considerable numbers from certain north German sites, *i.a.* Teltwisch 1 (Tromnau 1975)).

Flint concentration *b* seemed especially promising. Not only were there many artefacts under the tilth, but the presence of a couple of rocks under the tilth in one of the probes raised hopes of proper constructions. This settlement was therefore made the primary target of the investigation in the summer of 1990, which also covered the peripheral parts of concentration *c*, however. The latter was excavated in the course of the summer and autumn of 1991. This campaign also comprised geological probes.[3] In connection with these, a kettle hole was found with well-preserved organic material, including reindeer bones and a flint implement about 70 m north-west of the settlement heap (fig. 3 and 10).

As yet uninvestigated is a very large flint concentration, *a*, which probably covers at least two settlements. The finds from the surface collection and probes mostly suggest Hamburgian Culture.

THE EXCAVATION PROPER – METHOD

The topsoil in the two settlements was excavated in squares of 1 sq.m. The soil was sieved, using a 4 mm mesh. Both dry- and wet-sieving were employed, but in the author's experience it is advisable in excavations of this kind always to employ wet-sieving, which is effective in all weathers.

Under the topsoil, which was everywhere 25–30 cm thick, squares of ¼ sq.m. were consistently employed, and all material was wet-sieved. At the Federmesser site, a cross-profile and a surface-oriented excavation method were employed. After the topsoil had been investigated, the underlying sand was scraped clean, and from then on excavated in artificial 10 cm layers – not horizontal, but following the natural slope of the land.

It soon became apparent, however, that the flint had a vertical spread of over 1 m (from the top of the tilth), and it was difficult, not to say impossible, to gain an impres-

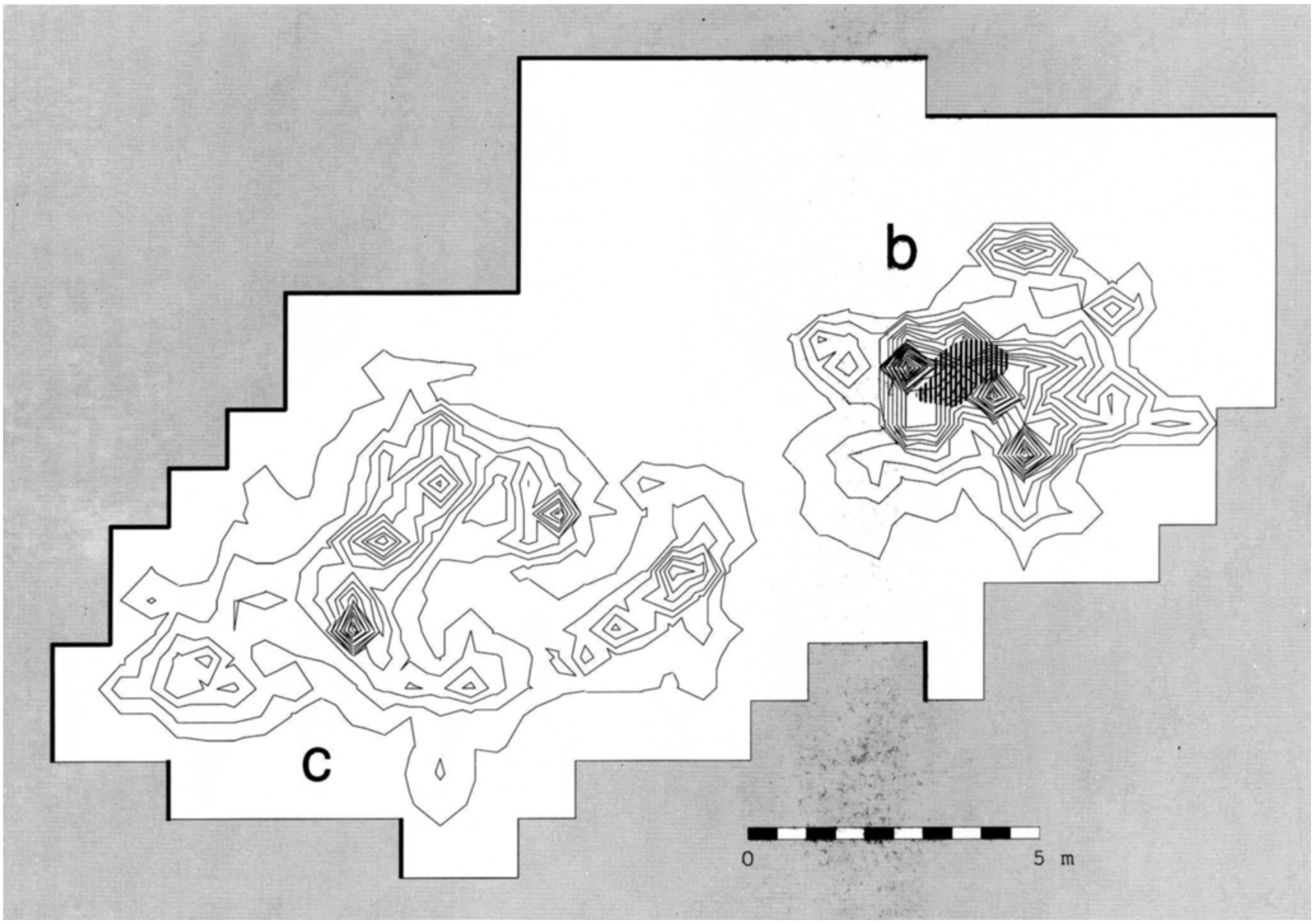

Fig. 6. The Federmesser settlement (*b*) and the Hamburgian settlement (c). The distribution of flint flakes is shown in density curves at an equidistance of 10 pieces per ¼ m. Vertical hatching: The putative fireplace of the Federmesser site. Computer graphics: Jørgen Holm.

sion of the geology and other factors that had caused this pronounced and apparently random spread of artefacts, which undoubtedly occurred *after* settlement (fig. 4 and 5). In order to obtain a better understanding of these conditions, it was therefore decided in 1991 in connection with the investigation of the Hamburgian site only to excavate in a section-oriented manner, so that the excavator always had a c. 1 m high profile ahead, and advanced in a straight line, 0.5 m at a time. This also afforded an opportunity to establish parallel sections at ½ m intervals and thus a much better possibility of making stratigraphic observations. On account of the geological and biological disturbances, it was also now considered pointless to excavate in arbitrary 10 cm thick layers. This altered strategy reflects a realization that we were confronted with anything but an *in situ* situation. To excavate in artificial layers – whether of 10 or 5 cm thickness – was under the circumstances considered to be a waste of time and money. We were now content to excavate and sieve the artefact-bearing sand in one operation and to quickly remove the remains of the intervening mainly fluviatile, completely sterile layer series (fig. 4). We had some success with – experimentally – carrying out the wet-sieving in the excavation itself, *i.e.* with a suitable pressure flushing the soft sand and flint artefacts out of frost cracks, animal burrows, etc., down onto a sieve placed in front of the section.

In connection with the Federmesser settlement, the investigation of the topsoil was started where the soundings had indicated most flint. Excavation was then extended to all sides, until the flint frequency had typically fallen to 20–30 pieces per sq.m. That is to say the topsoil was investigated over a large area, prior to work on the underlying layers.

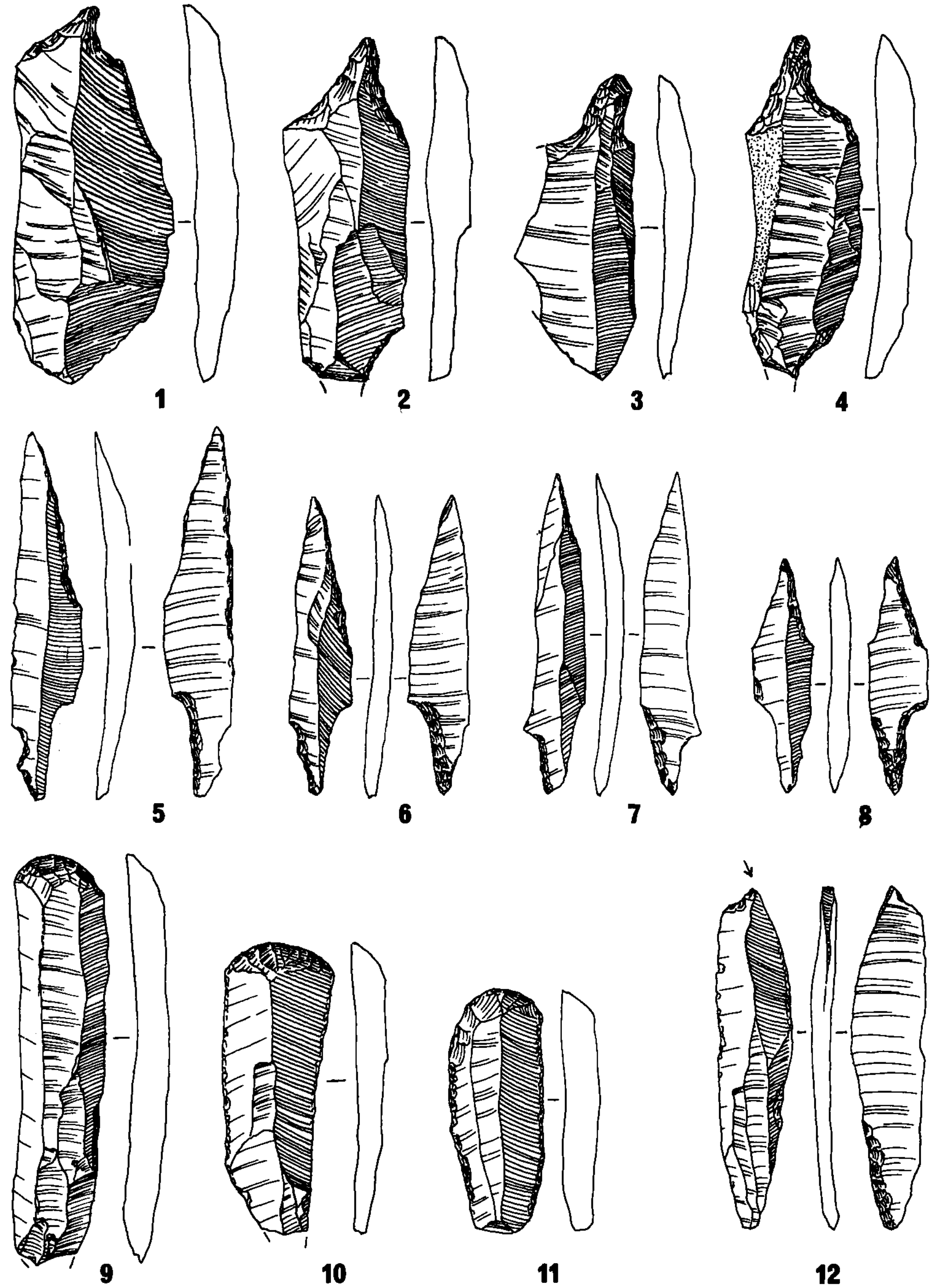

Fig. 7. Flint implements from the Hamburgian site (c). 1–4: Zinken. 5–8: Tanged points (Havelte type). 9–11: Scrapers. 12: Burin. 3:4. Drawing: Jørgen Holm.

A different procedure was followed at the Hamburgian settlement. Here the tilth was investigated with only a single row of 1 m squares, before excavation of the underlying sand was initiated. It was now only the spread and frequency of flint under the tilth that determined in which direction and to what point the excavation should extend. Some concrete and relatively consistent criteria were set: when the frequency per ¼-m square was 10 flakes or less, excavation was stopped. It must be admitted that this is still rather a high frequency, but this delimitation was in accordance with the maximum spread of tools and – not unimportantly – within the time and money framework of the campaign, to which should be added the pessimistic argument that only part of the material could be recovered anyway, due to the marked horizontal spread of the material in the tilth.

THE HAMBURGIAN SITE (c)

The spread of artefacts in the tilth (not illustrated) showed, as expected, a blurred picture. But in the underlying sand (fig. 6), an ellipsoid spread is seen, which to the east runs out in a small tongue. The concentration, which is here delimited by the 10 flakes per ¼ sq.m. contour, measures 11 × 8 m. The vast majority of the flint was found within the main western concentration, however. There is a particularly marked concentration of implements in the most northerly part of this area: 8 implements were found within a single ¼-m square, for instance.

The following find list is based on a preliminary scrutiny of the material (1.8.1992):

Cores	73
Flakes and blades	8305
Zinken	37
Borers	29
Tanged points	35
Scrapers	42
Burins	22
Combination tools	7
Backed flakes and blades	9
Flakes and blades with terminal retouch	21
Backed points (= Federmesser)	4
Total typed implements	206

In addition there are numerous retouched and notched flakes and blades, truncated Zinken and borer tips, broken-off working edges (including scraper edges), burin spalls, microburins and shouldered fragments. In the border area between concentrations *b* and *c*, a single large hammer-stone of quartzite was found.

About 35% of the material was found in the tilth, the remainder in the underlying sand.

Only about 135 pieces of flint show fire-marks, and they were also so scattered that it is not possible to indicate a fireplace.

The large numbers of Zinken (fig. 7.1–4), including double Zinken, assign the material unambiguously to the Hamburgian Culture, and the many tanged, not shouldered, points (fig. 7.5–8) allow the identification to be further refined to this culture's hitherto mainly western Havelte group, which is traditionally, but not necessarily correctly, perceived as a late phase. The scrapers (fig. 7.9–11) are as a rule produced from regular blades with parallel edges, which are sometimes retouched. Among the burins (fig. 7.12), dihedral burins predominate.

THE FEDERMESSER SITE (b)

The preceding surface collection and probes indicated, as already mentioned, only the presence of settlements of the Hamburgian Culture. It was therefore a total surprise to the excavators that during the proper excavation of flint concentration *b* increasing quantities of small blades with one long edge retouched appeared: Federmesser (fig. 9.1–5) or "backed" points, which now seems to be

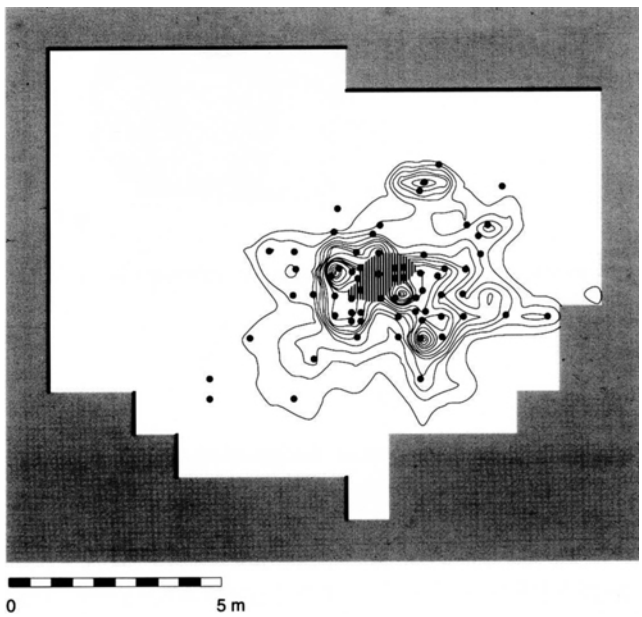

Fig. 8. The Federmesser settlement (*b*). The spread of Federmesser points is shown with filled circles. In addition, density curves for flakes and the putative firepace (vertical hatching) are shown. Computer graphics: Jørgen Holm.

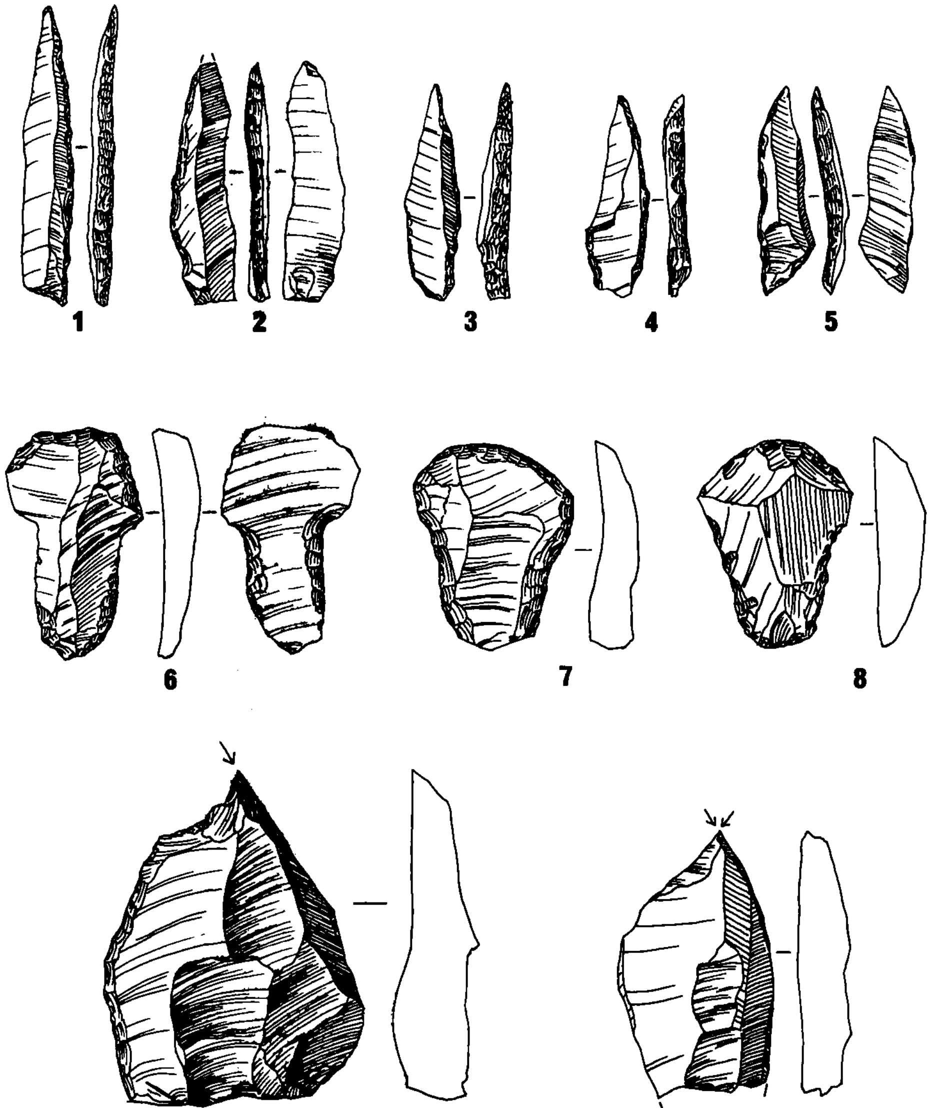

Fig. 9. Flint implements from the Federmesser settlement (*b*). 1–5: Federmesser points. 6–8: Scrapers (Wehlen type). 9–10: Burins. 3:4. Drawing: Jørgen Holm.

the preferred, more neutral designation of German archaeologists (*Rückenspitze*). It gradually became apparent that we were dealing with a settlement of the Federmesser Culture, especially as none of the Hamburgian Culture's typical implement forms occurred under the topsoil. Also the predominant scraper type – small, sturdy pieces with edge retouch and almost tang-shaped base, the Wehlen type (fig. 9.6–8) (Schwabedissen 1954) – which is known in particular from the older phase of the Federmesser Culture, and a general superficial evaluation of the basic flint technology, supported and straightened an assignment to the Federmesser Culture. This was the first time a settlement from this culture had been excavated in Denmark.

Under the tilth, the flint swarf was mainly found within an area measuring c. 8 × 6 m, forming an almost stellate concentration with rounded points (fig. 6). In the centre of this figure, a marked concentration of burnt flint was found, suggesting the presence of a fireplace. Most of the implements were concentrated around this spot, suggesting once again that the fireplace was the centre about which settlement activities occurred. The Federmesser points (fig. 8), in particular, were found around and in the fireplace. A few were located more peripherally in the concentration, and a couple of pieces to the south, in the border area between this and the Hamburgian site. Almost all the scrapers lay inside the 10 flakes per ¼ sq.m. contour, mainly west and east of the fireplace. The occasional burins (fig. 9.9–10) all lay within the 10-flake per ¼-sq.m. curve in the northern part of the settlement. Under the topsoil, about fifty stones larger than 5 cm were found. They mainly occupied a more peripheral position in the concentration, but so scattered and irregularly that it is impossible to say whether they were part of a structure.

The following list of finds is based on a preliminary examination of the material (1.8.1992).

Cores	110
Flakes and blades	10368
Federmesser	128
Scrapers	112
Burins	22
Borers	4
Flakes and blades with oblique end retouch	19
Flakes and blades with transverse retouch	2
Notched flakes	4
Combination tools	3
Zinken	6 (all from the tilth)
Tanged points (Havelte type)	2 (both from the tilth)
Total typed implements	302

In addition, there were about 250 flakes and blades with various retouching and a considerable quantity of more or less certain burin spalls.

About 50% of the material derives from the topsoil, the remainder from the underlying sand.

THE KETTLE HOLE

Drilling (no. 7 – fig. 3) at the foot of the hill, c. 70 m north-west of the settlement cluster, produced in August 1991 three bone or antler pieces deriving from an olive-green clay gyttja layer at a depth of c. 4.40 m. Further drilling suggested the presence of a small kettle hole, measuring little more than c. 10 × 10 m. A trial trench measuring 2 sq.m. was dug around the bore-hole, and produced a reindeer antler[4] and a few bones (fig. 10). Clearing of the trench floor produced a Zinken-like implement near the bones and at about the same level (fig. 11).[5] Intrusive groundwater made further excavation impossible, and we had to resort to breaking off that piece of the antler which stuck out of the trench wall. The rest of the bones were abandoned, to await a future investigation.

A preliminary report by Charlie Christensen, of the Environmental Department of the National Museum (Christensen 1991), states that the kettle hole appears to contain a complete Late Glacial and part of a Post-glacial (Holocene) layer series. Bones and flint lay at the top of a c. 60 cm thick layer of clay gyttja. The first evaluation already favoured a dating to the Bølling Period. This has now been fully confirmed by an AMS-dating of the bone/antler pieces obtained from drilling no. 7. The dating has been carried out by the AMS Laboratory, Institute of Physics and Astronomy, University of Aarhus:

AAR #	^{14}C age (bp)	$\delta^{13}C$ (0/00) PDB
AAR-906	12,500±190	−17.98

I.e. the dating falls in the middle of the Bølling Period (13000–12000 bp in C^{14} years).

DISCUSSION

The last decade has seen a marked increase in research into the Late Palaeolithic of Denmark. We can now state that practically all the cultures/industries associated with the final phases of the Weichselian glaciation and known from the North European lowlands are also represented in Denmark: the Hamburgian, Federmesser, and Ahrensburgian cultures. In addition we have the Bromme Culture, which seems mainly to be a South Scandinavian phenomenon.

The Hamburgian Culture is represented by a stray find, the shouldered point ("Kerbspitze") from Bjerlev Hede between Vejle and Horsens (Becker 1970), the Jels settlements (Holm & Rieck 1992) and Slotseng, and a relatively newly found cluster of settlements at Sølbjerg, south Lolland (Vang Petersen & Johansen 1993, this volume). Jels 2 is with respect both to settlement area (c. 11 × 8 m) and number of implements (c. 700), one of the largest and richest Hamburgian settlements found. Jels 1 and Slotseng *c* occupy equally large areas, but are far poorer in implements: c. 125 and 200, respectively (for a comparison with German and South Scandinavian Hamburgian, Federmesser, Bromme and Ahrensburgian sites, see Bokelmann 1978).

The Federmesser Culture was until 1990 known only from a series of surface finds, stray Federmesser (Andersen 1977; Madsen 1982; Fischer 1990), and scrapers of Wehlen type and a single, secure settlement on Rundebakke, Knudshoved Odde, South Zealand (Petersen 1974). In addition there is a flint workshop, consisting exclusively of cores, blades, and flakes at Egtved, South Jutland. This is assigned on its basic flint technology to the Federmesser Culture (Fischer 1990). But the presence of this culture in Denmark has now been established by excavation at Slotseng *b*, which – in comparison with foreign finds (Bokelmann 1978) – appears atypically large and rich.

The Ahrensburgian Culture, which has hitherto only been glimpsed in more or less uncertain single finds – tanged points, antler striking-weapons, and large-barbed harpoons with spatulate base (Becker 1971; Skaarup 1974; Taute 1968; Andersen 1974) – is now represented by a securely attributed excavated settlement at Sølbjerg, where, as mentioned above, settlements of the Hamburgian Culture have also been attested (Vang Petersen & Johansen 1993, this volume).

This significant increase in the Danish Late Palaeolithic material has, as we have often seen before, its background in a combination of determined search and good fortune. Not least amateur archaeologists have made an enthusiastic contribution. In addition, when one Late Palaeolithic settlement has been found, closer scrutiny will often reveal more in the immediate vicinity. Jels, Slotseng, and – in particular – Sølbjerg are good examples. It is also interesting to see that several cultures from more or less different periods are sometimes represented at the same locality: at Slotseng Hamburgian, Federmesser, and Bromme cultures and at Sølbjerg an even longer sequence from the Hamburgian to the Ahrensburgian. This is hardly a coincidence. The reason should probably be sought in a roughly similar way of life, hunting strategy and demands on raw material resources. A particularly noticeable common feature is a penchant for placing the sites at topographical funnels, *e.g.* valley constrictions where the reindeer could easily pass on their seasonal migrations along fixed routes.

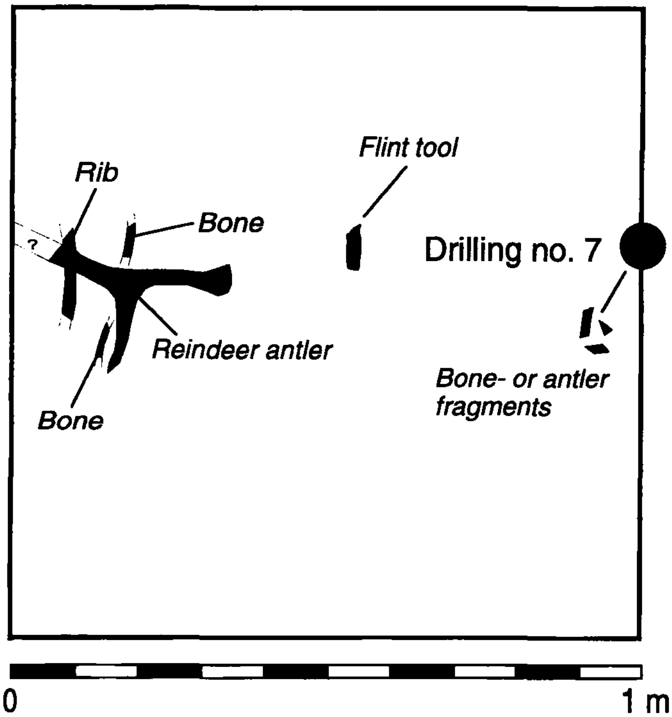

Fig. 10. The trial trench in the kettle hole with finds of reindeer bones and flint implement (it is possible to give only the approximate position of the latter). The artefacts were found 4.20–4.40 m below the surface. The eastern profile cuts drilling no. 7, which yielded the first bone/antler pieces. Computer graphics: Jørgen Holm.

In Denmark, we often see that the sites occupy an elevated position in the landscape with an extensive view to all sides. One interpretation is obvious: observation posts (an extreme North German pendant is Schalkholz, where settlements from both the Hamburgian and Federmesser cultures have been made at the top of a 40 m high hill (Tromnau 1974; Bokelmann 1978)). It would, however, be hasty to draw the conclusion that the Late Palaeolithic sites necessarily occupy elevated positions in the landscape. An obvious source of error should be pointed out here: low-lying sites are far more likely to have been covered with metre-thick soil deposits. Such sites will naturally not reveal themselves on the surface, even less with normal trial excavation.

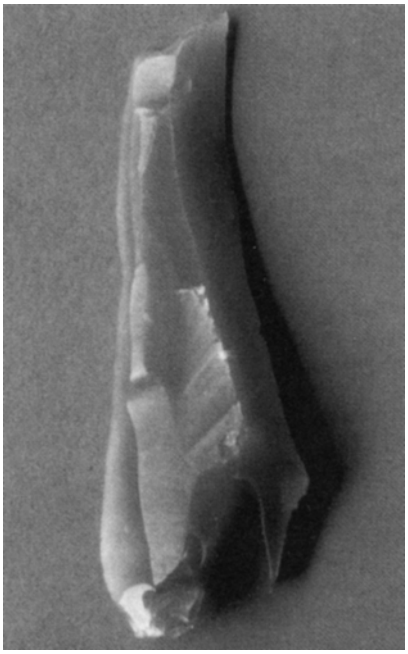

Fig. 11. The completely fresh, Zinken-like implement from the kettle hole. The piece shows wear-marks after work with bone or antler. 1:1. Photo: Jørgen Holm.

Also the location of the Jels sites in immediate association with springs is a striking example of a settlement-locating factor. And these sites are situated not merely in the vicinity of an obvious funnel, the valley constriction between Jels Oversø and Midtsø, but both west and east of them are deep, V-shaped erosion gullies that may very well have been used in connection with battue. Such erosion gullies were also ideal places for collecting raw flint.

If we look at southern and South Jutland, a striking tendency is seen for Late Palaeolithic finds to collect around the Jutland ridge, the watershed – or put differently: the host road (*hærvej*) stretch. This applies to a large number of single finds and to, for example, the settlements in Hjarup Mose (from Federmesser, Bromme and Ahrensburgian cultures – Andersen 1977) and at Jels and Slotseng. This is interpreted to mean that there was here a favoured N–S oriented migration route, where animals and men had to cross only a minimum of rivers and swamps (for a further discussion of the migration route problem, see Vang Petersen & Johansen 1993, this volume).

It is likely that the Slotseng sites should be perceived as a part of the hunting technique that has facetiously been called the "head-'em-off-at-the-pass" strategy (Bokelmann 1979), mass slaughter of reindeer at certain times of the year – like the model Klaus Bokelmann has presented in a revaluation of Alfred Rust's finds from the Ahrensburg valley, *i.a.* Meiendorf and Stellmoor (Bokelmann 1991). The settlements at Slotseng are close to a funnel, they are high up with a view for miles around, and below them is a kettle hole with reindeer bones. And just north of this, everything seems to show that there was a lake into which the hunters can have driven the reindeer. Moreover, numerous projectiles (tanged points and Federmesser) have been found at both the Hamburgian site (*c*) and the Federmesser site (*b*), including some with use-damage.

There is nevertheless reason to warn against drawing too hasty conclusions. It is tempting to perceive the reindeer bones and the flint implement found in the kettle hole in relation to the settlements above it, but the distance is, as already mentioned, no less than c. 70 m, and there is no certainty that there was chronological and cultural contact. The flint implement most closely resembles a Zinken, but is insufficiently characteristic to be placed in the Hamburgian Culture. If we look at the C^{14} date, 12520 ± 190 b.p. *i.e.* the middle of the Bølling Period, we can confidently rule out the Federmesser Culture, which does not appear before the Bølling-Older Dryas transition (Bokelmann *et al.* 1983; Houtsma *et al.* 1984). The dating does, however, fit a relatively early phase of the Hamburgian Culture and is close to those of Poggenwisch (the Polish site Olbrachcice 8 is slightly older (Burdukiewicz 1986) and Meiendorf slightly younger (Fischer & Tauber 1986)). But here we run into the next problem: we assign Slotseng *c* – especially on the basis of the projectiles' special shape (tanged rather than shouldered points) – to the Havelte group, which is traditionally perceived as a late phase within the Hamburgian Culture (Bohmers 1947; Tromnau 1975, 1981; Stapert 1984, 1985), an evaluation which seems to find support in the thermoluminescence dating, 12400 ± 1600 b.p. that has been obtained on the basis of burnt flint from Jels 1 (Huxtable & Mejdahl 1992), which is also assigned to the Havelte group. Once more it is necessary to point out that thermoluminescence datings (calendar years) and uncalibrated C^{14} dates are not immediately comparable: ice core datings from Greenland (Hammer *et al.* 1986), more recent varve chronology from Sweden (Strömberg 1985) and U/Th dating of Barbados corals (Bard *et al.* 1990) indicate fairly consistently that about 1000 years should be added to C^{14} dates in the Late Glacial period to obtain calendar or "solar years". If we as a working hypothesis accept this conversion factor, 1000 years then has to be subtracted from the Jels 1 dating to fit the Late Glacial zone division based on conventional C^{14} dates. *I.e.* Jels 1 should fall at about the middle of the Allerød Period (c. 11400 b.p. in C^{14} years). This dating appears to be too late – and it raises numerous problems, for if we accept it we have to accept at the same time that the latest phase of the Hamburgian Culture is coeval with the Federmesser Culture and even approaches the datings we have for the Bromme Culture (Trollesgave c. 11100 b.p. in C^{14} years – (Fischer & Tauber 1986)).

If it should prove that with the dating of the organic material in the Slotseng kettle hole we have simultaneously obtained a dating of the Hamburgian *c* site on the slope above it, this would naturally have drastic consequences for the perception of the Havelte group as a late phase within the Hamburgian Culture. It is more likely at the early end of the culture, and we must look for another explanation of the typological differences in the implements in relation to the Poggenwisch-Meiendorf groups. Are the differences for example regionally, ethnically or functionally determined? We should furthermore also ask ourselves whether these differences are also so large as to warrant the maintenance of this group division.

Perhaps the answer lies in the still uninvestigated flint concentration *a*, which will perhaps prove to belong to a different aspect of the Hamburgian Culture. Finally, there is the possibility, which can certainly not be ruled out, that in the immediate vicinity of the kettle hole – deeply buried – there is a site in its own right, a settlement or special site (kill site or butchery site). A slender indication is perhaps the flint chip which appeared in connection with drilling no. 16 (fig. 3) about 15 m north-east of the kettle hole – from a depth of c. 2.70 m.

Some of these questions will hopefully be answered in connection with future excavations that will comprise excavation of concentration *a*, the kettle hole and probes in the lacustrine deposits to the north.[6]

Translated by Peter Crabb

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NOTES

1. It is apparent from Haderslev Museum's records that the finds were registered 1.10.1962, and that one of the museum's former staff members, the late Peter Lepik, collected the material in the spring of 1962 in connection with probes at the rampart site Slotsbjerg, a few km south-east of Jels. The finding-place was marked on the map, but despite intensive reconnaissance, carried out on the site by the author from the spring of 1985 on, it has not been possible to trace any settlement, only to ascertain that within a fairly large area there are flint artefacts with mainly a Late Palaeolithic appearance, but which are not so typologically distinct as to enable definitive attribution to the Hamburgian Culture. On the other hand, the author and a local amateur archaeologist, farmer H. C. Petersen, Neder Lert, succeeded in finding, about 125 m north of the place Lepik had marked, typical objects of the Hamburgian Culture. This situation naturally raises a serious problem, but there can hardly be any doubt that the original map reference is incorrect. It seems likely that Lepik did not mark the finding-place until about six months after reconnaissance, and from memory, at the point when the flint material was registered for the first time.
2. The tedious work of interpolation was carried out on an Apple Macintosh computer using the spreadsheet programme "Claris Resolve", which performed the necessary computation in a matter of seconds. The density curves for flakes (including blades) were drawn using the same programme's "Contours" module.
3. Jette Lorentzen, Geological Institute, Aarhus University, participated for two months of the 1991 campaign. As part of an assignment – and as support for the archaeological work – it was her job to record and analyse the soil sections of the Hamburgian site and to carry out more general studies of the local and regional geology with a view to landscape reconstruction. The latter aspect was *i.a.* elucidated with drillings in the surrounding wetlands. This was done with a simple manually driven auger with a diameter of 7 cm.
4. A preliminary investigation of the large piece of reindeer antler recovered from the trial trench has been carried out by Kim Aaris-Sørensen, the Zoological Museum, University of Copenhagen. Cut-marks near the burr show with all clearness that it has been in human hands, and preserved remains of the skull rule out that this is a naturally shed antler.
5. The quite fresh, c. 7 cm long Zinken-like implement found in the area between the reindeer antler and drilling no. 7 (the exact position could not be determined) has been examined for wear-marks by Helle Juel Jensen, Institute of Prehistoric Archaeology, University of Aarhus. It appears that the implement has been used to work bone *or* antler. The wear-marks, which are relatively weak, are mainly concentrated right out at the tip. Some transverse striations near the base of the implement are interpreted at present as hafting-marks.
6. The investigations hitherto have been supported by Dronning Margrethe II's Arkæologiske Fond, Brødrene Hartmanns Fond, Lodbergs Legat, Sydbank, Carlsen-Langes Legatstiftelse, and the Danish Research Council for the Humanities.

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Sølbjerg I – An Ahrensburgian Site on a Reindeer Migration Route through Eastern Denmark

by PETER VANG PETERSEN and LYKKE JOHANSEN

INTRODUCTION

For decades our knowledge of the movements of Late Glacial hunter groups in eastern Denmark and Scania has relied mainly on the rich material from the Brommian Culture, consisting of both stray finds and artefacts from excavated settlements.

The Federmesser and Ahrensburgian Cultures have only been represented by a few insignificant settlement sites and occasional stray finds of flint and bone artefacts (Fischer 1991; Larsson 1991); evidence of the Hamburgian Culture has been particularly lacking.[1]

In 1989 this situation changed radically with the location of rich Hamburgian and Ahrensburgian settlements at Sølbjerg in western Lolland. Together with previously overlooked Ahrensburgian finds from Knudshoved Odde and marrow-fractured bones and worked reindeer antler from submarine sites in Køge Bugt, these finds now make it possible to recognize a Late Glacial settlement pattern specifically linked to the treeless periods preceding and succeeding the Allerød Period. In these periods the settlements were, in contrast to those of the Brommian Culture, more closely associated with reindeer migration routes.

In this article we propose the existence of just such a route running southwest to northeast, from the northwest European lowlands, through eastern Denmark, to the

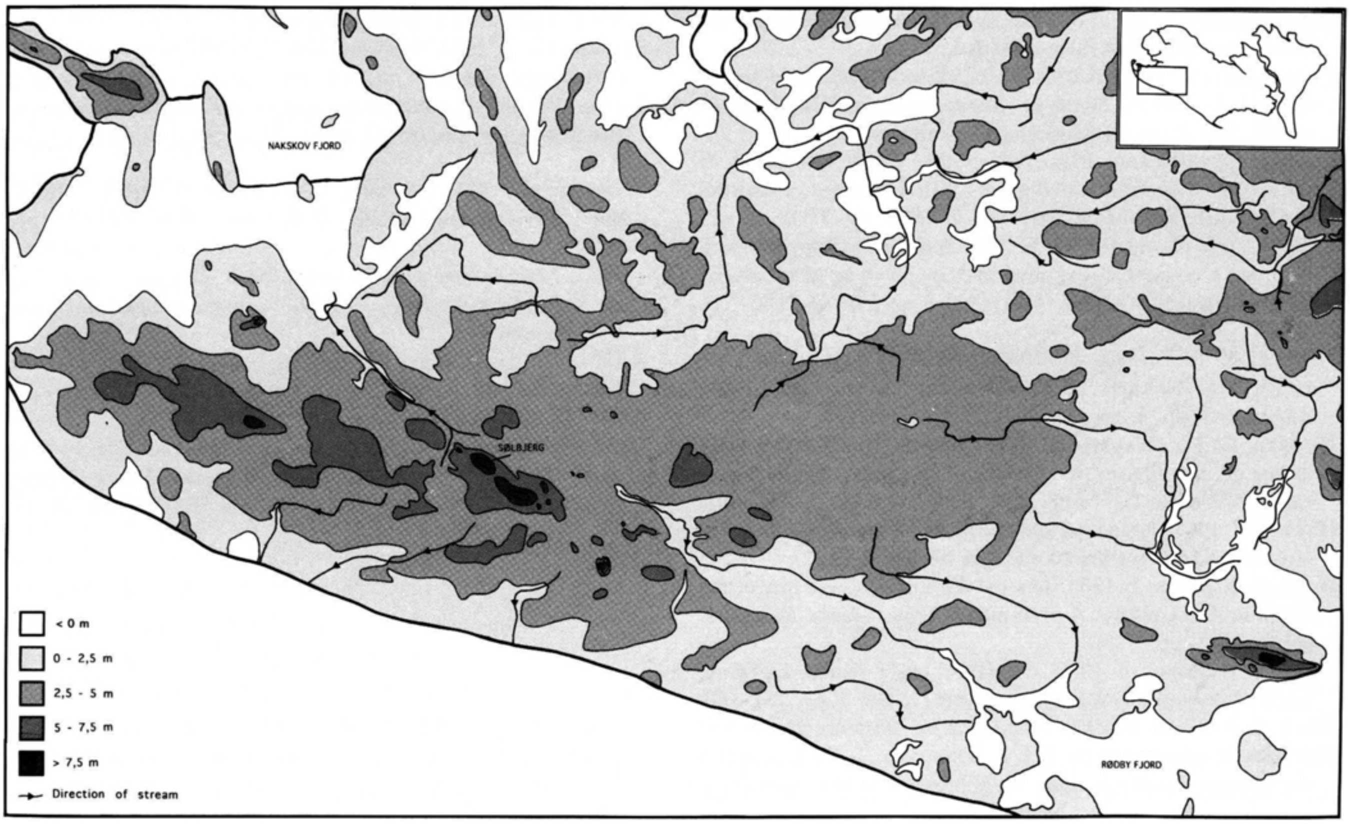


Fig. 1. Relief map of southwestern Lolland showing the location of Sølbjerg. Lykke Johansen *del.*

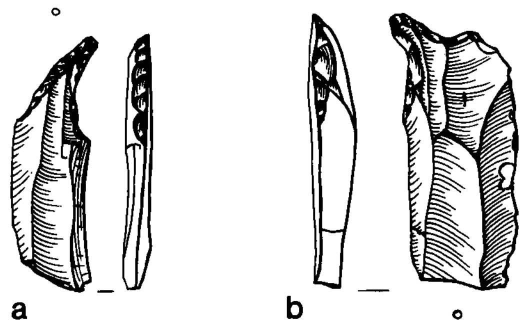


Fig. 2. The first two *Zinken* from Sølbjerg found by amateur archaeologist Hans Chr. Heickendorf. Lykke Johansen *del.* 3:4.

ice-free areas of Sweden west and north of the Baltic Ice Lake (fig. 8).

There must have been considerable migration of reindeer along this route and the traces of Late Glacial hunters which have already come to light in the area suggest that further searches for hunting stations and settlement sites would prove fruitful.

SØLBJERG

Whilst collecting Neolithic flint in 1989 at Sølbjerg, a small sandy hill in southwestern Lolland, amateur archaeologist Hans Christian Heickendorf found two typical *Zinken* (fig. 2). These first traces of the Hamburgian Culture in eastern Denmark led the authors to carry out reconnaissance in the area. Our very first visit to the site resulted in finds including a *Zinken* and some blade end-scrapers, all of which had the bleached white or bluish surface which is often seen on Late Glacial flint in Denmark.[2] Relative to the abundant unpatinated Neolithic flint debitage, the Late Palaeolithic flint finds were sparse. Even so the finds seemed promising enough to prompt an excavation. The bleached flint was clearly concentrated around the summit of Sølbjerg[3] where we started the investigations by excavating 51 trial pits.[4] Our expectation of finding remains from the Hamburgian Culture were however disappointed. Although the majority of trial pits yielded bleached flint, we found neither *Zinken* nor shouldered points on the hill. Instead the pits produced small tanged points of Ahrensburgian type. The discovery of an Ahrensburgian settlement was however just as interesting. Apart from a number of stray finds, small tanged points, biserial barbed harpoons and clubs made of reindeer antler (Bokelmann 1988, fig. 2–3; Fischer 1991, fig. 9), evidence for Ahrensburgian settlement has previously largely been lacking in Denmark.[5]

The Ahrensburgian site – Sølbjerg I

The trial pits revealed a concentration of Ahrensburgian flint on the south side of the hilltop and in 1990–91 an area of 66 m^2 was excavated here. Both the Palaeolithic and Neolithic flints lay at the base of the plough soil and in the top of the underlying layer of humus-rich sand.[6] There were no traces of hearths or other features, which could be linked to the Late Glacial Period. A large pit from the Middle Neolithic, some postholes from the Early Roman Iron Age, and two recent disturbances were however located.

The Palaeolithic flint on Sølbjerg I is all bleached to some extent and it is normally easy to tell it apart from the unbleached Neolithic flint. Despite the disturbances from later pits and postholes mentioned above, the distribution of bleached flint gives a clear picture of an approximately 3 m by 4 m flint scatter of typical Late Glacial character (fig. 3) (*cf.* Taute 1968:254; Fischer 1991:116).

The most abundant finds are small waste flakes and thin blades probably produced by a direct blow with a "soft" hammer-stone (Madsen 1986). Only four unipolar (conical single platform) blade cores were recovered, all of them heavily used. The majority of the blades were struck from unipolar blade cores, but on 8% of the preserved distal ends it is clear that bipolar blade cores were also used. A large blade, a *Riesenklinge* (Taute 1968:16) 13.1 cm in length, was apparently brought to the site from elsewhere.

Including fragments, 18 examples of tanged points were recovered (fig. 4a–p). The length of the points varies from 2,4 – 4,6 cm, and two of them (11%) have the tip located at the proximal end of the blade (fig. 4m–n).[7] Twelve of the points have the tang worked from the ventral side, one is propel retouched on the tang (fig. 4e), and four are of the Hintersee type (Taute 1968:5) with the tangs formed by "reverse" retouche (fig. 4d, h, l and p). The percussion bulb on all the points has either been removed by retouche or has been broken off, and the majority of the points have oblique retouche at the tip. Several of the points are fragmented and small chips, probably damage from use, can be seen on some of them. Four obliquely-retouched blade fragments (fig. 4q–r) are

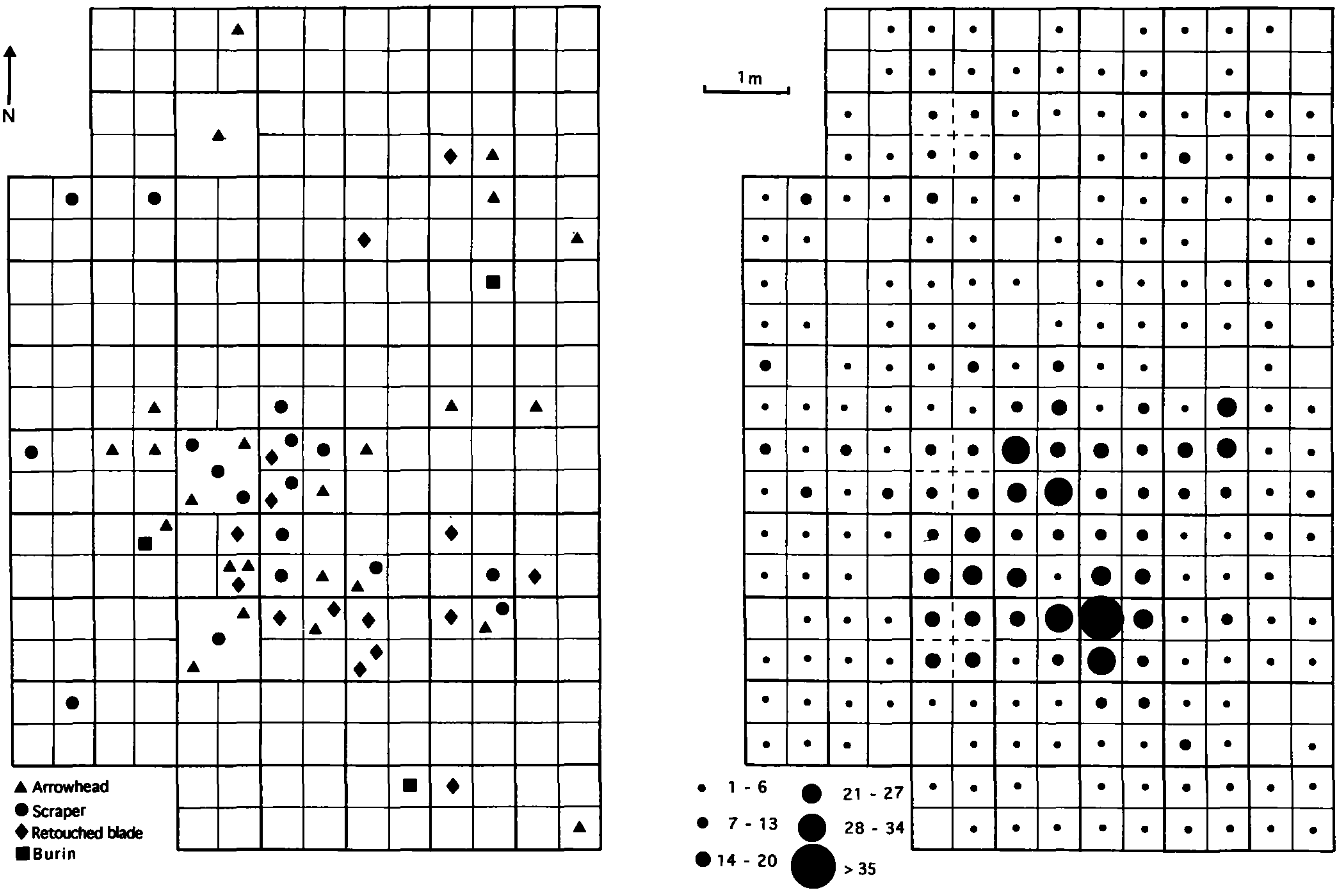


Fig. 3. Sølbjerg I – distribution of flint tools and fragments. Lykke Johansen *del.*

interpreted as being broken points. Three Zonhoven points (Taute 1968:182–183) both with and without basal retouche are present (fig. 4s–t).

The 16 scrapers (fig. 5) are mostly made from blades. Many of them are broken and several show a short light edge retouche at the proximal end. There are only three burins, a dihedral burin and two transverse burins one of which has been struck on edge retouche (fig. 6f). One blade is heavily chipped along the edges (fig. 6a). This must have been the result of heavy chopping or cutting of hard material such as bone or antler. Finally there are 15 retouched blades (knives) with light edge retouche at the proximal end, at the tip, or along the back (fig. 6b–c).

Within the excavated area, the points, like the scrapers, knives, and burins, are concentrated in the flint scatter itself. It has not been possible to prove the existence of a hearth linked to the scatter, as Palaeolithic burnt flint can not be separated from Neolithic burnt flint.

Other Late Glacial occupation at Sølbjerg

The trial pits show that thin blades, scrapers and points of Ahrensburgian type are to be found spread over the whole of the hill. Small tanged points were collected at the foot of the hill both to the south and to the north, so it is clear that there are several flint concentrations of Ahrensburgian character yet to be located on Sølbjerg.

Our survey in the area below the hill has revealed flint scatters with *Zinken*, burins, edge-retouched blade scrapers, shouldered points, and Havelte type points (fig. 7), which must represent repeated occupation during the Hamburgian phase.[8]

Apart from the abundant finds of Hamburgian type, there are four Federmesser points (fig. 7) and a robust tanged point – the only trace of the Brommian Culture at the site to date. An isosceles triangular microlith is the only trace of Mesolithic activity in the area.

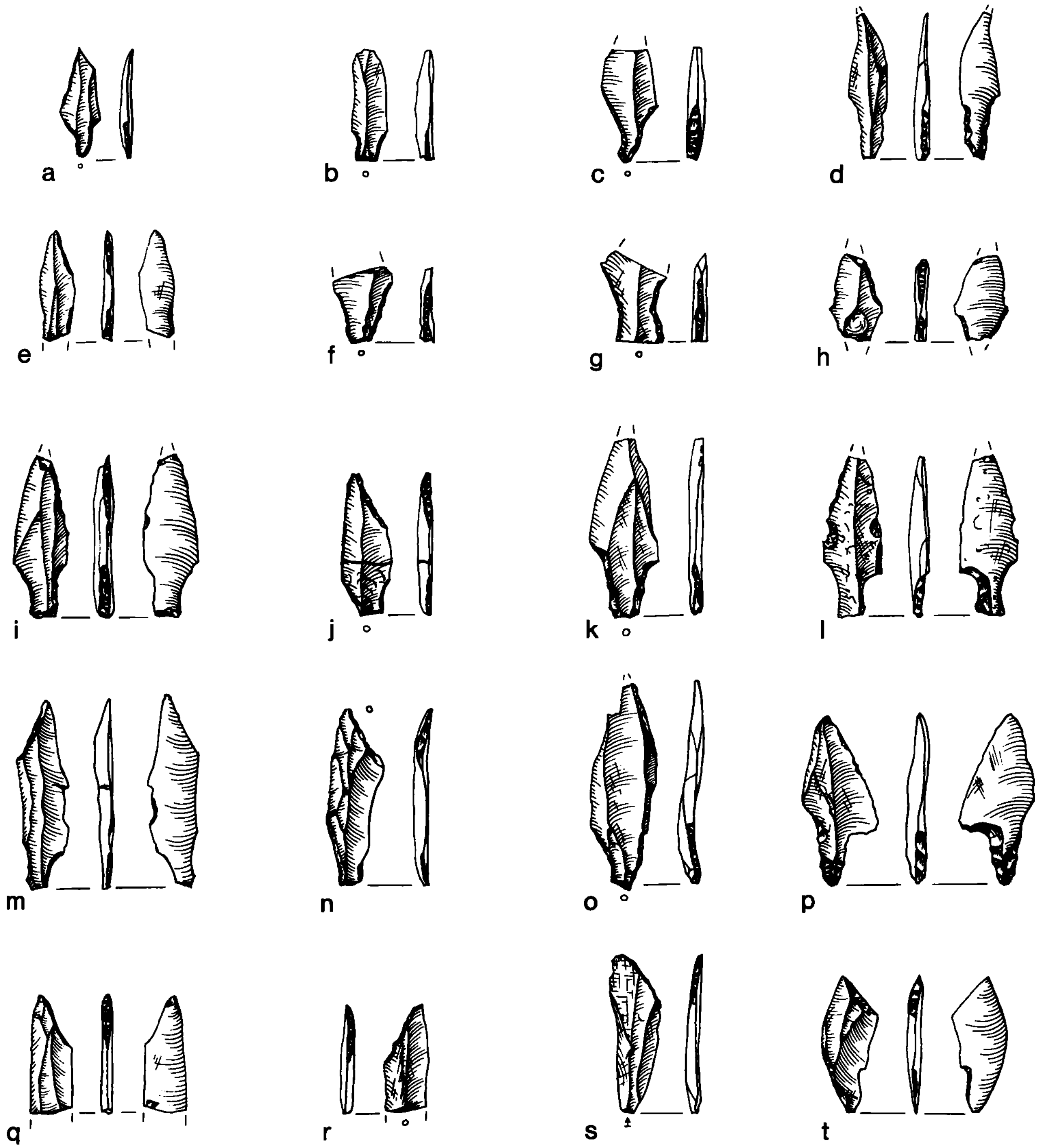


Fig. 4. Sølbjerg I – Ahrensburgian points (a–p), blade fragments with oblique retouche (q, r) and Zonhoven points (s, t). Lykke Johansen *del.* 3:4.

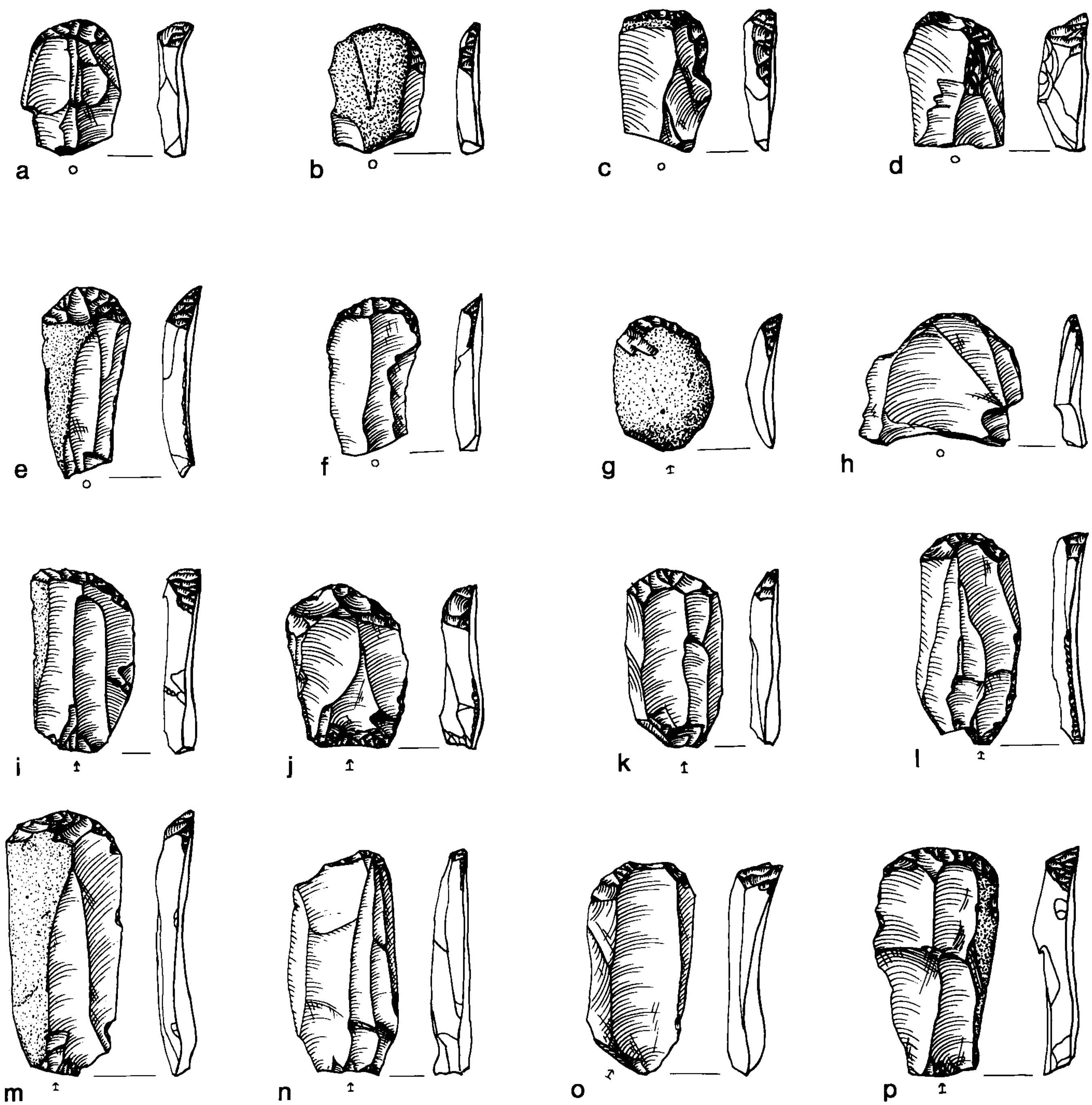


Fig. 5. Sølbjerg I – scrapers. Lykke Johansen *del.* 3:4.

The Late Glacial finds from Sølbjerg are dominated by Hamburgian and Ahrensburgian types. The Hamburgian Culture appears on present evidence to date to the relatively mild Bølling Period (Usinger 1975), before the forest became established in southern Scandinavia. The Ahrensburgian Culture belongs primarily to the substantially colder Younger Dryas, when most of the forest which developed during the Allerød Period disappeared again.

The Late Glacial occupation of Sølbjerg therefore seems to be linked to tree-less phases, when reindeer were the overwhelmingly dominant game animal. Sølbjerg lies in very flat terrain,[9] and a position on the hilltop gave the reindeer hunters the best possible view of the animals' movements over Lolland's flat glacial plain.

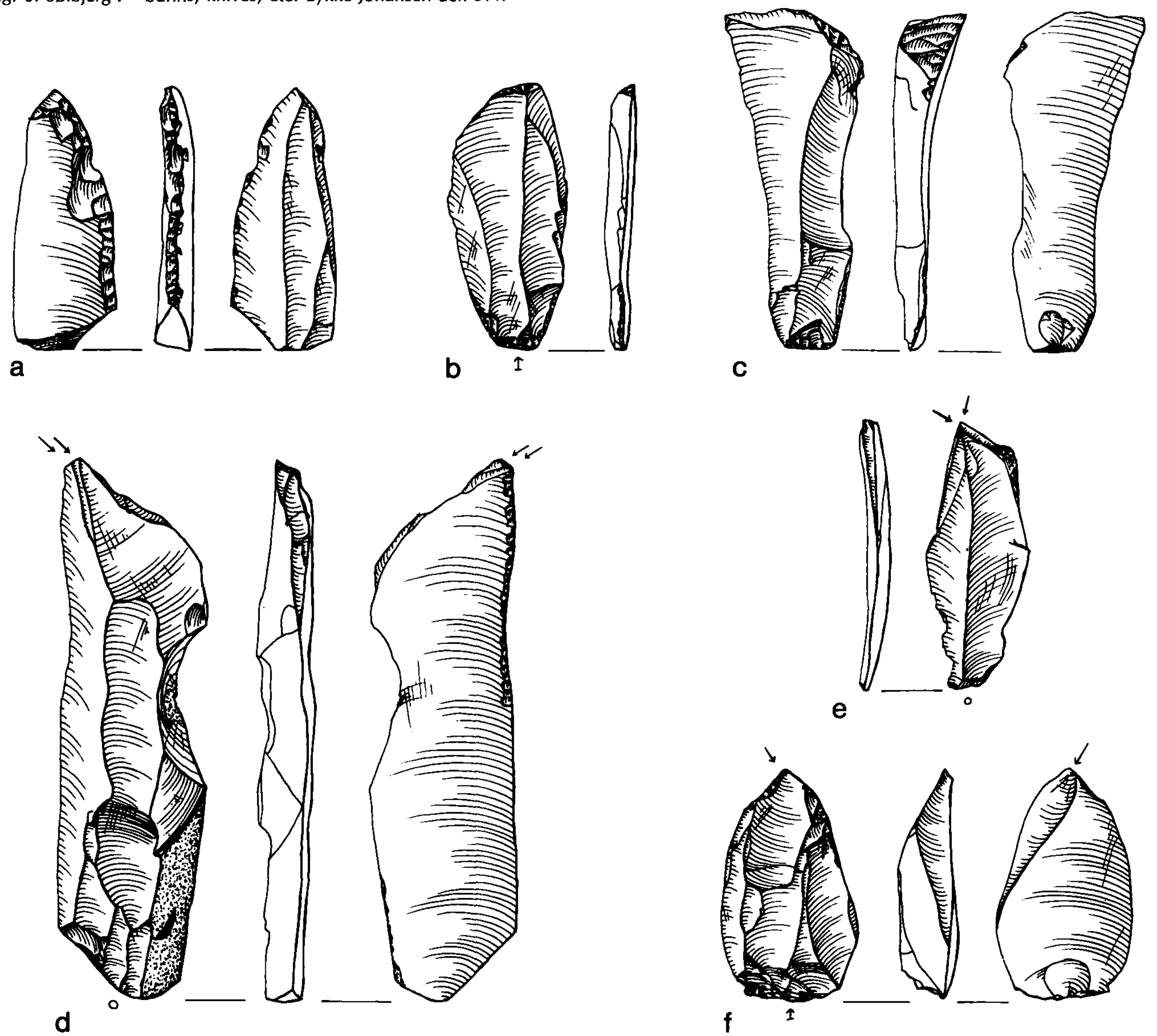
The sparse finds from the Allerød Period and the Mesolithic suggest that the site's suitability for hunting was poor when the view was obscured by woodland.

The preliminary investigations at Sølbjerg show that the site was subject to repeated occupation during the Hamburgian and Ahrensburgian phases. Finds from the two cultures lie at different levels on the hill, with the Ahrensburgian sites lying highest.

At Deimern (Taute 1968, fig. 4) and Ahrensburg (Bokelmann 1991, fig. 9.5), where Ahrensburgian and Hamburgian sites are found together, the tendency is also for the later sites to lie highest. Ahrensburgian sites such as Steinbeck and Westerhausen (Taute 1968, No. 8a and 57) are similarly located on high ground with a good view.

In eastern Denmark surveying on suitable areas of higher ground has been limited, and here lies a possible explanation for the previous lack of Ahrensburgian sites in southern Scandinavia. Amateur archaeologists, who have been responsible for most of the survey work, have concentrated their efforts along lakes and streams where Mesolithic and Neolithic finds are abundant, but where

Fig. 6. Sølbjerg I – burins, knives, etc. Lykke Johansen *del.* 3:4.



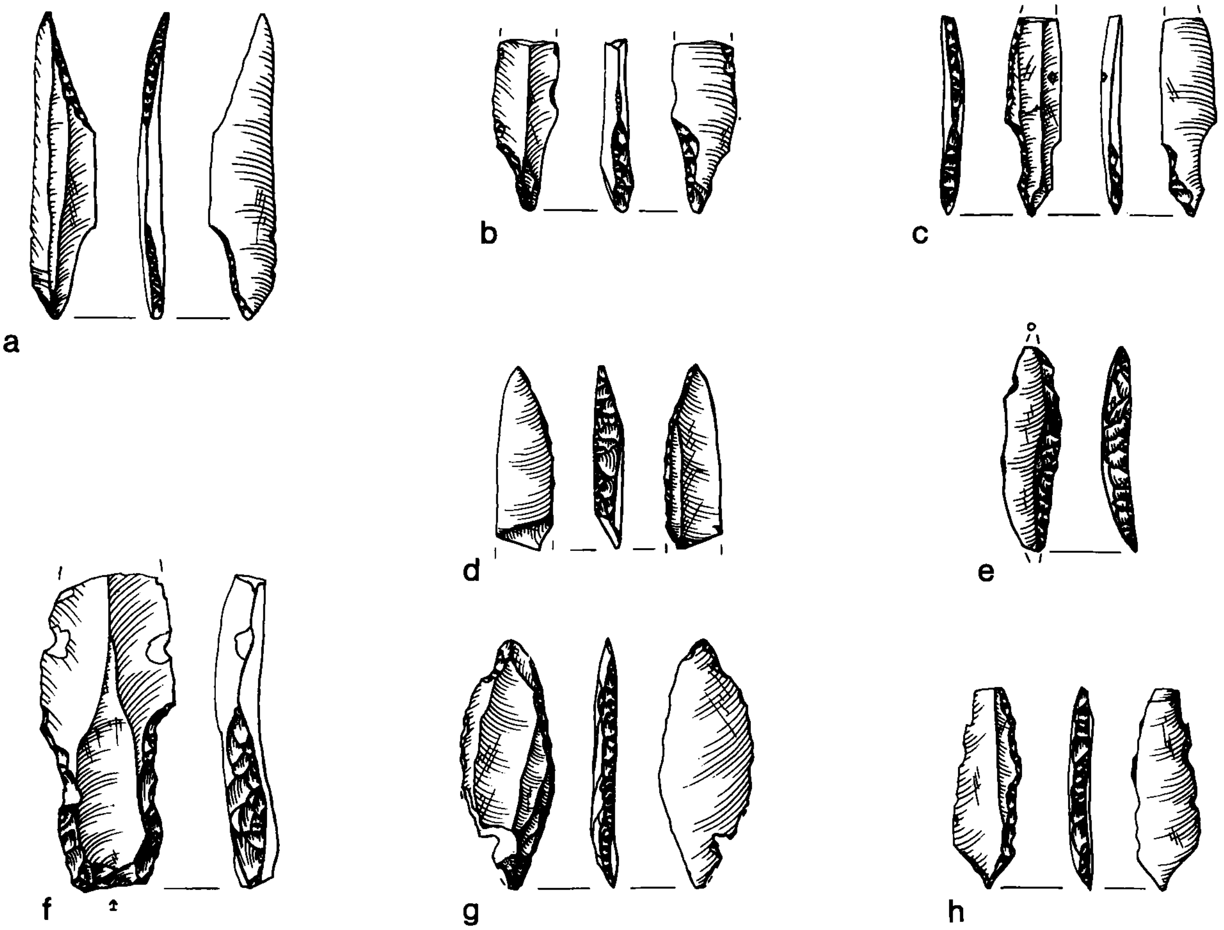


Fig. 7. Finds from survey on Sølbjerg – shouldered point (a), Havelte points (b–c), Federmesser (d–e, g–h) and Brommian point (f). Lykke Johansen *del.* 3:4.

traces of the Ahrensburgian Culture are sparse. One result of this survey strategy has been the location of many Brommian sites at former lakes, in particular around inlet and outlet streams (Fischer 1985:85). This link with the drainage system, which the Brommian Culture shares with Mesolithic inland sites, is in turn presumably linked with the "Mesolithic" economy which prevailed in the later part of the Allerød Period. Pike fishing is thought to have played an important role and relatively non-migratory deer such as elk and red deer overtook the reindeer's role as the hunters' most important prey. Hunters in the Allerød Period did however still hunt reindeer; the faunal material from Bromme contains pieces of reindeer antler and stray finds of reindeer antler from Denmark dated to the Allerød Period include some which show signs of having been worked.[10]

REINDEER MIGRATION TOWARDS SØLBJERG (FIG. 8)

There are several somewhat contradictory theories regarding the migratory behaviour of reindeer in the Late Glacial. Finds of bones and antlers from bogs show that reindeer were present in southern Scandinavia during the winter (Degerbøl & Krogh 1959:97). On the basis of this the theory was proposed that reindeer, or at least some of those which spent the summer on the northwest European plains southwest of the Elbe, had their winter territory in northeastern areas, i.e. in Schleswig-Holştein, Denmark, and southern Sweden (Sturdy 1975:70; Bokelmann 1979).

Extreme low temperatures present no problem for the tundra reindeer, whereas the level of precipitation is crucial. Heavy snow cover prevents the animals from scraping down to lichen and other tundra vegetation which

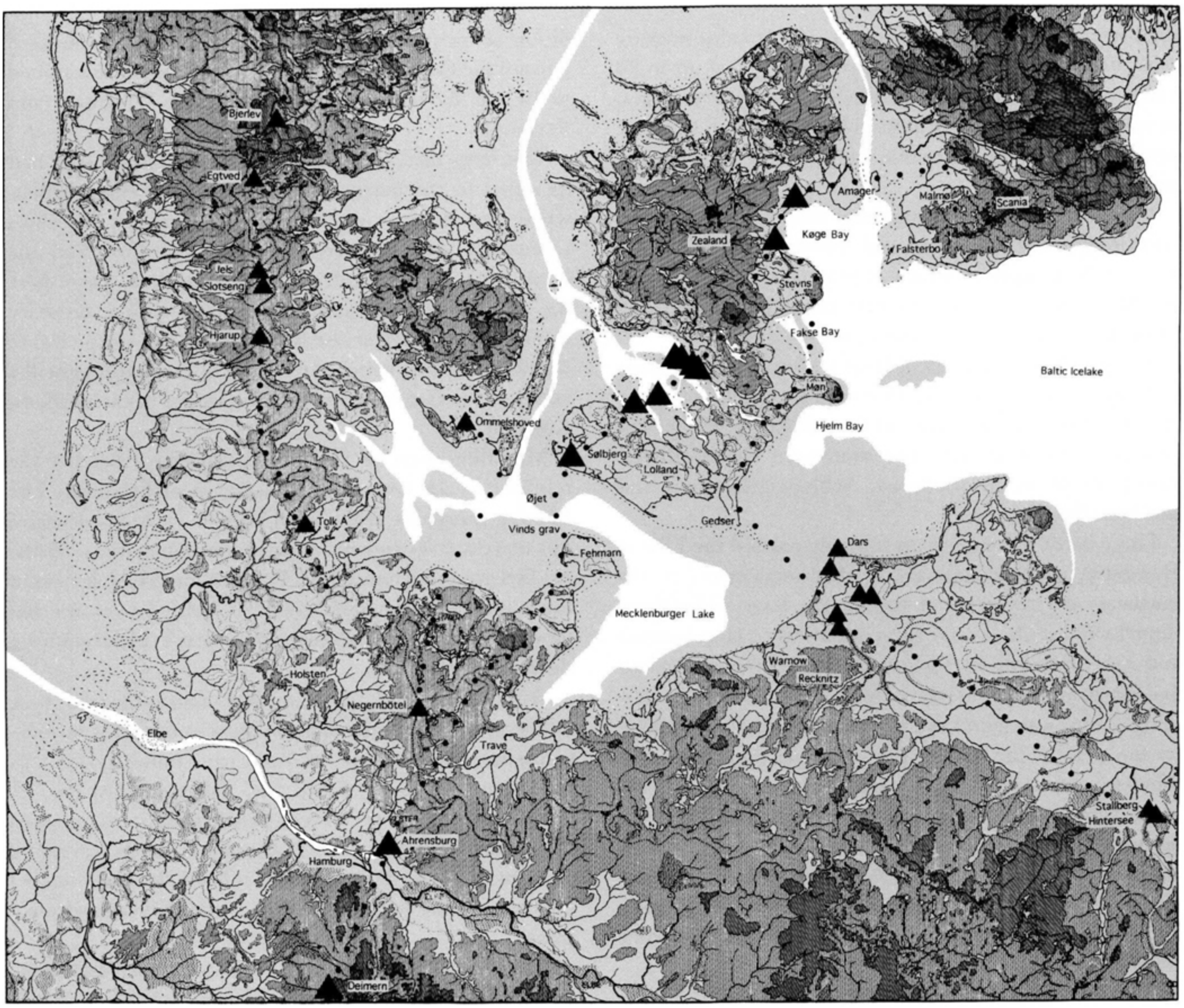


Fig. 8. Northern Germany and southern Scandinavia in Late Glacial times. Important settlement concentrations and suggested migration routes for reindeer.

makes up their winter food supply. We know that the snowfall was moderate in southern Scandinavia from the presence in the Late Glacial flora of species which can not tolerate extended snow cover (Iversen 1954:103).

In support of the theory that part of the European reindeer population spent the winter in southern Scandiavia is the fact that the animals, in this way, avoided swarms of irritating insects. In summer these would have had optimal growth conditions in the innumerable small pools and lakes in the moraine landscape. In winter the reindeer could forage on the extensive frozen wetlands; exposed freeze-dried bog vegetation such as Bogbean (*Menyanthes trifoliata*) and Mare's Tail (*Hippuris vulgaris*) could have provided an important supplement to the reindeers' winter fodder.

In the early autumn, before the rut, reindeer are in prime condition and during the migration to their winter territory the animals were particularly exposed to attacks from hunters. In the autumn the males and females migrate together and the migration is more concentrated than in the spring when the males and females migrate separately. The animals can run at a speed of up to 70 km/h, and in open terrain hunting is best between lakes, in valleys, and near other natural barriers which force the herd into narrow passages thus reducing the opportunites for escape.

In northwestern Europe the large settlement concentrations from the Hamburgian and Ahrensburgian Cultures are found at localities which appear to have lain strategically in relation to the reindeer migration routes. The same is the case for the Sølbjerg sites (fig. 8).

The first in a long series of large settlement site concentrations is to be found at Deimern on the Lüneburger Heath. These sites are thought to be linked to the migration route running from the southwest, the northwest European plain, to northeast, Schleswig-Holstein and southern Scandinavia.

Large herds of reindeer presumably crossed the Elbe at Hamburg, and the animals' further movements to the northeast led them along the 12 km long Ahrensburg tunnel valley. There were large numbers of Hamburgian and Ahrensburgian sites where lakes filled the valley floor and narrowed the passage. The largest known Ahrensburgian site was found on Stellmoorhügel, a small ridge on the edge of the valley. The bones of more than 600 reindeer, excavated from the lake sediments below Stellmoor, show that the animals had mostly been killed in the autumn (Sturdy 1975). More than 1000 fragments of arrow shafts, which Alfred Rust recorded in the find layers, are interpreted as evidence for extensive shooting of reindeer which tried to swim over the lake at this point (Bokelmann 1991; Bratlund 1991).

Where the reindeer went after they passed the Ahrensburg lakes we can only guess, but for animals whose destination was the northern reaches of southern Scandinavia, and in particular the areas closer to the ice margin in southern Sweden, the route must have followed the end morains through eastern Holstein and up over Fehmarn (fig. 8).

In the Late Glacial a very large lake lay in the bays off Lübeck and Mecklenburg, the 60 km long shore of which stretched from Travemünde to the western end of the Fehmarn Belt.

Meltwater clay, gyttja and peat layers on the sea bed show that the water level in the Mecklenburger Lake lay 19–23 m under present sea level (Kolp 1965, figs. 18–19). In the first stages of deglaciation the basin was filled up with meltwater which deposited varved clay. Further addition of meltwater stopped when the icefront retreated beyond the Gedser-Dars moraines, but the lake continued to be fed by small rivers – the Trave, Warnow, and Recknitz.

This large lake, with a surface area of c. 15000 km^2, had its outlet in the northwestern end of the Fehmarn Belt, where the channel Vinds Grav cuts through the short submarine ridge between Markelsdorfer Huk and the bank, Øjet, to the south of western Lolland. From here the water flowed to the northwest and with a tributary coming from the present-day Bay of Kiel, it was a river of considerable size which flowed northwards throught the valley of the Great Belt to the Yoldia Sea in the northern Kattegat.

Migration west of the Mecklenburger Lake led the reindeer to the river outlet northwest of Fehmarn. The hunting prospects in this area must have been excellent, but there are no known traces of hunting stations on the sea bed around Vinds Grav. Those animals which crossed the outlet at Øjet could soon be spotted over the flat moraine plain from Sølbjerg – the next critical point on their migration route.

With its summit lying 12 m over present-day sea level, Sølbjerg is one of the highest in a series of low hills, consisting of sand deposits from ice-dammed lakes, situated between Rødby Fjord and Nakskov Fjord (fig. 1). The watershed between these two drainage systems runs to the east of Sølbjerg, and for animal herds traversing western Lolland, this watershed offered the best chances for crossing the flat, and almost certainly very wet, clay plain.[11]

The series of sandhills crosses the watershed and forms a barrier across the migration route. In Greenland similar ridges are equipped with cairns and other scaring devices which lead the nervous animals in the right direction (Grønnow *et al.* 1983, fig. 45). Cairns and similar devices on the neighbouring hills could similarly have led the animals towards Sølbjerg and the waiting hunters.

A POSSIBLE MIGRATION ROUTE FURTHER TOWARDS THE NORTH-EAST (FIG. 9)

In western Lolland the route presumably went along the prominent Halsted tunnel valley to the hills at Birket in the northwest. From here the migration continued over the low-lying area which is now covered by the Smålands Sea. From our knowledge of the relief of the present-day

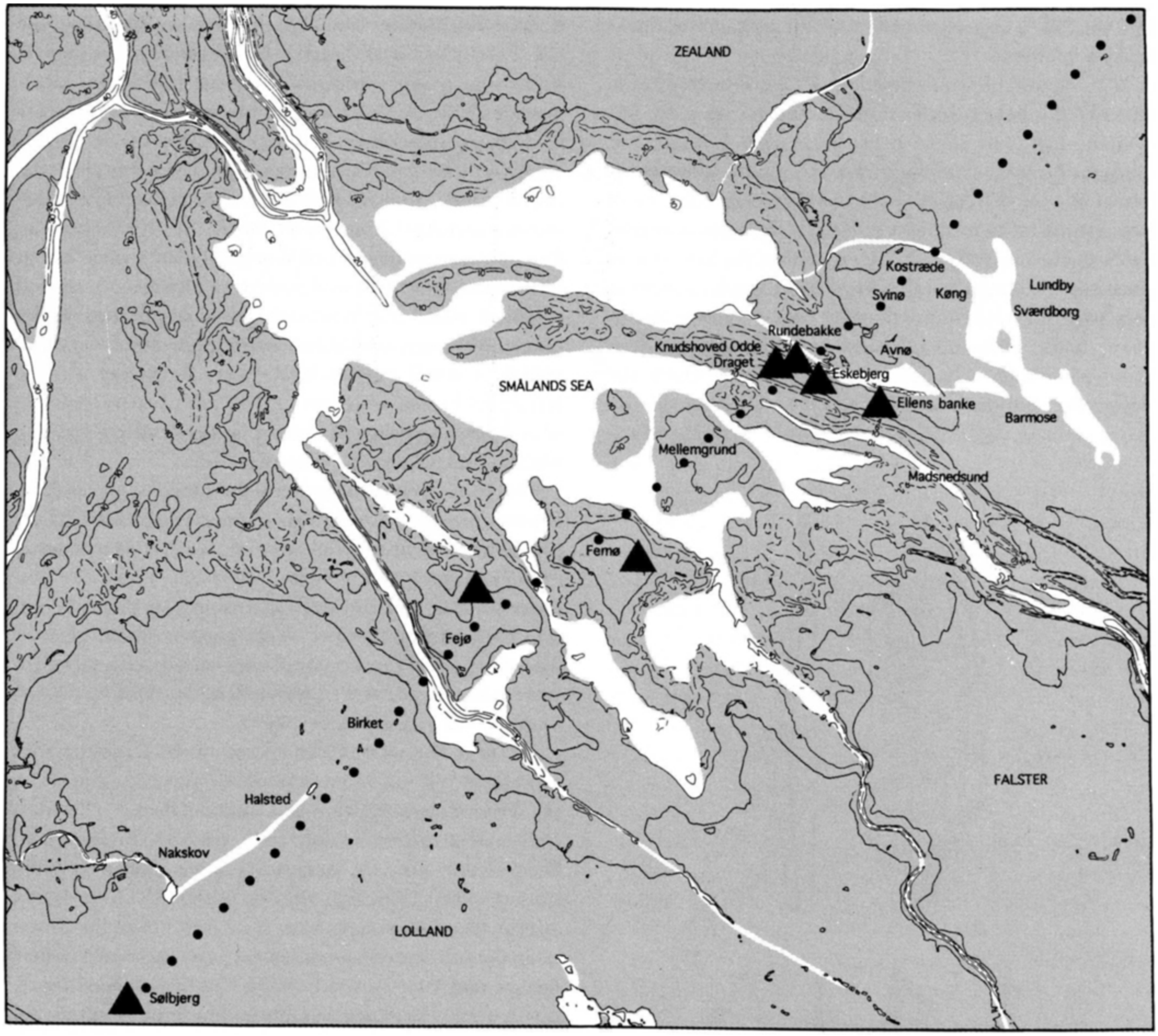


Fig. 9. Model for the Late Glacial landscape in the present day Smålands Sea with prehistoric finds and the suggested migration route for reindeer.

sea floor, supplemented by information about Late Glacial and Post-Glacial deposits from sea bed surveys,[12] we can reconstruct a landscape (fig. 9). This was penetrated by SE-NW oriented valleys and streams which flowed to the northwest, past Fejø and Femø and the submarine bank Mellemgrund, which were the highest points in the landscape. To the southwest of the islands there are several large submarine basins containing peat and clay sediments. In the Late Glacial Period these basins could have contained lakes or bogs. Drainage of these wet areas was by way of streams which flowed to the northwest. The streams' narrow passages between the present-day islands and Mellemgrund offered obvious crossing-places for game, and the numerous stray finds of Brommian points from Femø and Fejø show that the hunters followed the movements of the animals from vantage points on higher ground. The finds[13] have mostly been collected by local inhabitants. It is possible that new systematic survey will bring the more insignificant Ahrensburgian and Hamburgian points into view. A stray find of a *Zinken* from

Fejø (fig. 10)[14], suggests in any case the presence of Hamburgian hunters.

This remarkable concentration of Late Glacial sites is undoubtedly linked to the migration of the animal herds over the low-lying areas between western Lolland and southern Zealand. The clay-rich end-moraine hills, which form the core of Knudshoved Odde, blocked the route from southwest to northeast in exactly the same way that the Sølbjerg sandhills did. We know that the area was of great importance for hunting from, for example, a series of sites with finds of robust tanged points.[15] These Brommian finds undoubtedly represent hunting stations (Fischer 1991:6). The settlement sites from which the Brommian hunters came apparently did not lie on Knudshoved Odde. The highest point on the Odde, the hill Eskebjerg, has though, in addition to numerous Brommian points, produced domestic refuse flint (Rasmussen 1972). A closer look at this material reveals that in addition to scrapers and burins there are retouched blades and five small tanged points of Ahrensburgian type (fig. 11c,f–i). A small trial excavation which John Rasmussen and Axel Johansson carried out on Eskebjerg in 1970, gave no further Brommian points, but instead a flint concentration was located under the plough soil, the full extent of which was not established. In addition to debitage, the concentration contained fragments of very thin blades, a small bipolar blade core, fragments of edge retouched blades, a scraper, a flake with scalene retouch, plus three fragments of small points, of which one is a certain Ahrensburgian point (fig. 11c).

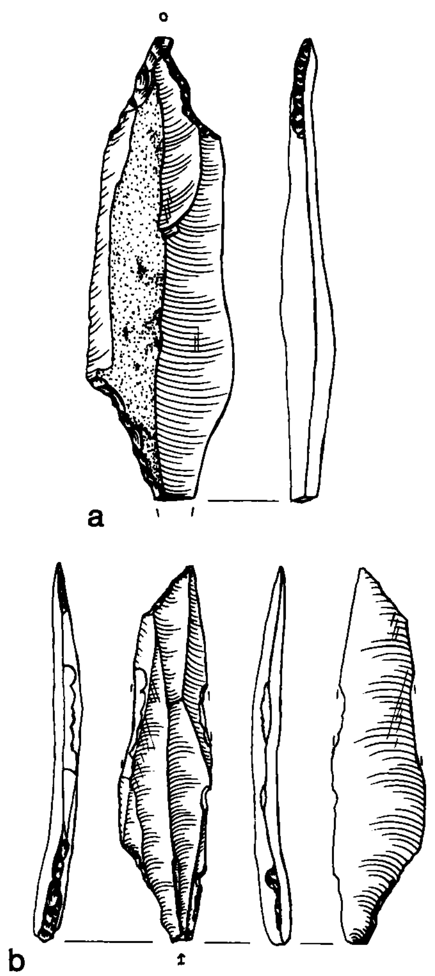


Fig. 10. Isolated finds of Hamburgian character from eastern Denmark – *Zinken* from Femø (a) and point from Holmegårds Mose (b). Lykke Johansen *del.* 3:4.

The flint concentration and the many stray finds of Brommian points are not thought to be connected. There is however a clear parallel in the Ahrensburgian material from Sølbjerg I. An obvious conclusion is that the flint concentration and the five Ahrensburgian points represent the settlement proper on the highest hill in the area. Two more small tanged points (fig. 11a–b), together with two small flint scatters of Ahrensburgian type, have been found in the vicinity of Eskebjerg.[16]

400 m to the west of Eskebjerg, on the top of another prominent hill – Rundebakke, domestic refuse flint from the Federmesser Culture has been collected (Petersen 1974 and in press; Fischer 1990, fig. 14). In Denmark, Federmesser sites are taken to be older than Brommian sites (Fischer 1991, fig. 10). Knudshoved Odde would appear therefore to have hunting stations from the Brommian Culture as well as settlement from the earlier Federmesser and later Ahrensburgian Cultures. There are no traces of the Hamburgian Culture but if the Hamburgian sites lie lower in the terrain, as is the case at Sølbjerg, then they can be hidden under the sea.

There are indications of the existence of a large lake basin to the south of Knudshoved. On the sea bed approximately 800 m south of the promontory, geological investigations have revealed gyttja, peat and clay layers which presumably extend back to the Allerød Period.[17] There are lake sediments on the bottom of an elongated depression in the sea bed, possibly a tunnel valley, which runs parallel with the Odde and continues south past Knudshoved Rev to Masnedsund. The layers are found at a depth of between 15 and 19 m which corresponds to a lake surface at 14 to 17 m below present sea level. The

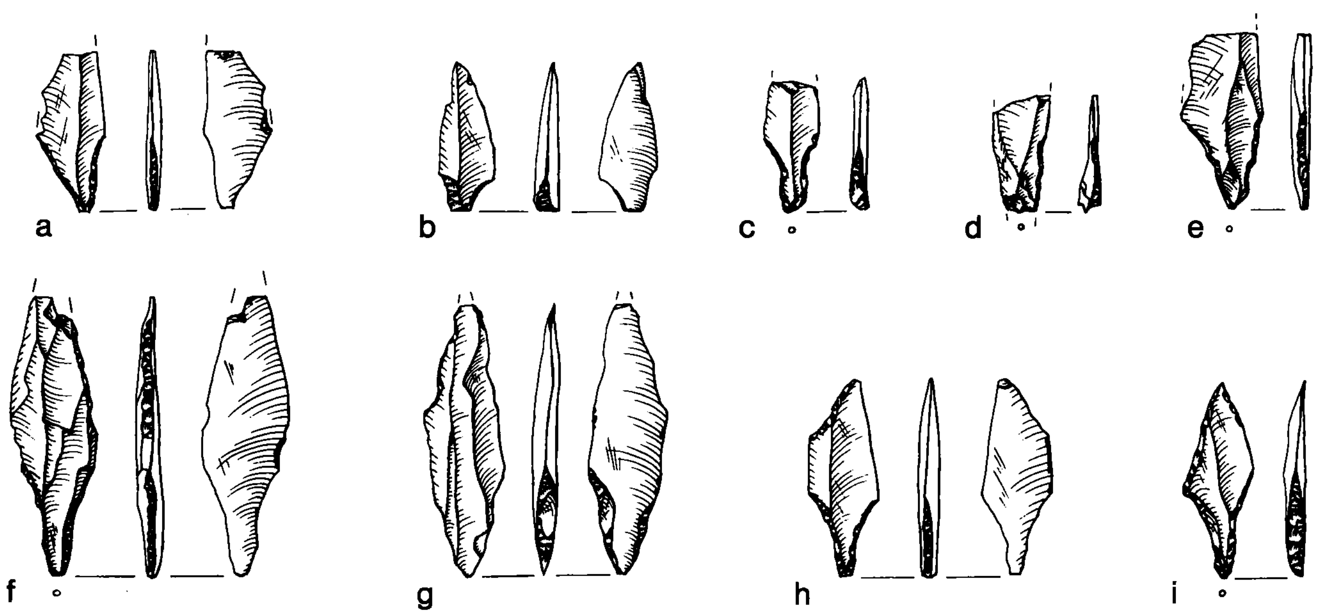


Fig. 11. Knudshoved Odde, southern Zealand – Ahrensburgian points from the site Draget (a, e), Paradiset (b) and Eskebjerg (c–d, f–i). Lykke Johansen *del.* 3:4.

missing Hamburgian sites may be found on the shore of this lake.

The Late Glacial sites on Knudshoved Odde are concentrated in an area stretching from Ellen's Bank in the east, to Draget 5 km to the west. The concentration of sites in this area could be connected with the migration of reindeer across the ridge and past the highest points Eskebjerg and Rundebakke, which acted as landmarks for the animals migrating through the lower-lying landscape now forming the sea floor of the Smålands Sea. From Femø the migration route presumably continued over Mellemgrund and Knudsskov Rev, over Knudsskov and then on towards Avnø and Svinø. The route went to the west of the bogs at Barmose, Sværdborg, Lundby and Køng, which formed a continuous Late Glacial lake 14 km in length (Marcussen 1967). Similarily, Avnø Fjord, to the northwest of Knudshoved, can have housed a large Late Glacial lake basin. The outlet from this ran along the valley which now lies on the sea floor to the north of Knudshoved Odde. The valley was narrowwest, and therefore most easily crossed by the animals, in the area between Knudsskov and Avnø.

REINDEER AND HUNTERS ON THE BALTIC ICE LAKE

The reindeer migration from Knudshoved over southern Zealand presumably went over Svinø, past Kostræde Banke and further along the watershed of the end moraine hills between Hammer Bakker and Køge. The route went to the east of the large lake basins at Holmegårds Mose, where there are numerous Brommian sites and stray finds of points of Ahrensburgian and Hamburgian type (fig. 10).[18]

In eastern Zealand the herds' numbers were surely swelled by animals which had migrated along the eastern route, which ran via Dars and Gedser along the western shore of the Baltic Ice Lake.

Recent geological investigation in Fakse Bugt and the waters around Møn (Jensen in prep.) confirm that the Baltic Ice Lake extended into Hjelm Bugt and Fakse Bugt when the sea level in the Younger Dryas lay 13.5 m below that of the present (fig. 12). The bank, Gyldenløves Flak, was an island which gradually became linked to the mainland by successive beach ridge formation. Behind the beach ridges, an extended lagoon was formed in the inner part of Fakse Bugt which the animals had to make a detour around, at least in ice-free periods.

A reindeer antler with a piece of skull attached, dredged from Fælleskov Rev south of Rødvig on Stevns (Degerbøl & Krogh 1959, pl. 1.) is the only evidence for reindeer movement along the Baltic Ice Lake's now-submerged coast in Fakse Bugt. Further to the north however, in Køge Bugt, sand pumping has produced a remarkable number of Late Glacial finds of animal bones, in particular reindeer but also giant deer, elk and horse. The bones were pumped up from sand and gravel deposits at the edge of submarine bogs lying at a depth of 6–10 m.[19]

Detailed geological studies, such as those from Fakse Bugt, have not been carried out in Køge Bugt, but surveys of the sea bed[20] show that the geology is remarkably similar to that of the former. The bone-bearing sand and gravel in Køge Bugt probably represents the corresponding Late Glacial beach ridges which sealed off lagoons in the submarine end of the tunnel valleys which cut through eastern Zealand at Køge, Karlslunde and Vallensbæk.

The level from which the gravel has been pumped up (a depth of 6–10 m) corresponds to the level of the hard chalk deposits between Amager and Malmø, over which the Baltic Ice Lake had its outlet. The apparent difference in level of 3–5 m between the Ice Lake's coastline in Køge and Fakse Bugt is presumably due to isostatic changes at the end of the Late Glacial. At this time the land rose considerably in the northern part of the Ice Lake's area, whereas the southern part is thought to have sunk. Surveys of the sea floor in the area east of the Gedser-Dars threshold, which the Ice Lake never transgressed (Kolp 1965, fig. 19), suggest that the maximum height of the Baltic Ice Lake in this region lay as much as 19 m below present sea level.

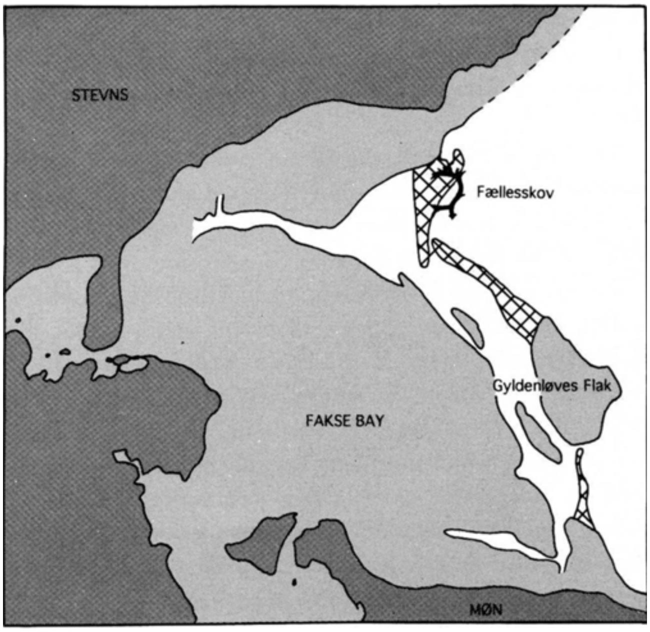


Fig. 12. Model for the Late Glacial landscape in the present day Fakse Bugt with find of reindeer antler, islands, lagoons and beach ridges (after Jørgen Bo Jensen 1992).

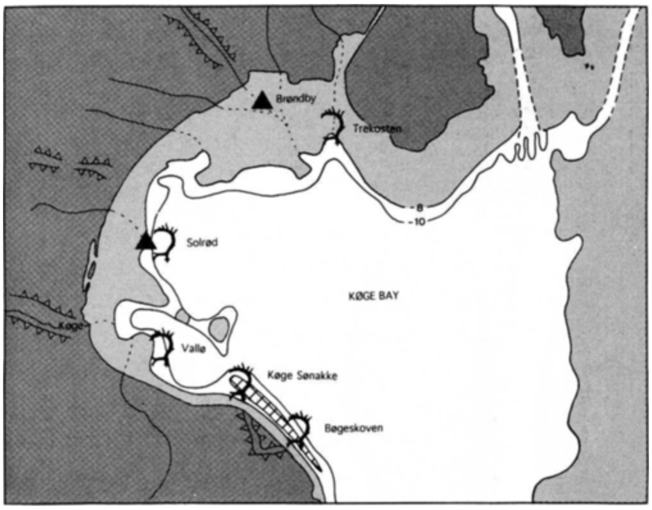


Fig. 13. Model for the Late Glacial landscape in the present-day Køge Bugt with finds of reindeer bones and flint from settlements. The most probable coastline for the Baltic Ice Lake lies at a depth of 8–10 m.

Late Glacial animal bones from six submarine sites in Køge Bugt[21] are kept at the Zoological Museum in Copenhagen. Reindeer bones are the most abundant and are present at five of the six sites. The richest finds appeared in the period from 1935–1961 at a site just over 3 km "off Solrød Strand" (fig. 13). In gravel pumped up from the edge of a large submarine bog there were, in addition to numerous reindeer bones, many bones of horse, aurochs, elk, roe-deer, wild-boar, red deer, domestic ox and sheep. The bones clearly represent widely differing periods, but radiocarbon dating makes it possible to date the bones of the individual species.[22]

Two dates of 11290 ± 160 b.p. (K-4321) and 10380 ± 140 b.p. (K-4322), show the presence of reindeer in the Allerød Period and the end of the Younger Dryas respectively. From the middle of the Younger Dryas there is a metatarsal from an elk, which has been split lengthwise, probably the work of humans. The bone has been radiocarbon-dated to 10740 ± 145 b.p. (K-4320). One further date from a presumed wild horse bone gave a result of 2490 ± 70 b.p. (K4319), which illustrates the difficulties in separating wild horse from Iron Age domesticated horse anatomically. This date does not however exclude the possibility that there are bones of Late Glacial wild horse among the remaining horse bones.

The majority of the bones from the gravel are almost certainly from beached cadavres which the rivers had carried out into the lake. The reindeer may also have died on the breaking ice as the animals are not afraid to migrate over frozen expanses of water. In periods of ice-cover reindeer herds could have crossed over between Stevns and Falsterbo. In this way they avoided the large river mouths between Amager and Malmø, where other dangers such as reindeer hunters surely awaited them.

The fact that reindeer hunters operated along the coast of the Baltic Ice Lake in Køge Bugt is shown by the small collections of marrow-fractured bones and the basal fragment of a reindeer antler with traces of the "groove and splinter" technique (fig. 14), which was pumped up from the site "off Solrød Strand" in 1947. Captain G. Olafsson from the sand pumper Kronborg, who in addition to the bones, also collected a number of flint artefacts, sent the finds in to the National Museum, from where the animal remains were sent to the Zoological Museum.

Fig. 14. Marrow-fractured reindeer bones and reindeer antler with "groove and splinter" technique from the locality "off Solrød Strand". The antler has been dated to 12140±110 b.p. (Late Bølling).[28] Photo: Gerd Brovad.

Quaternary zoologist Magnus Degerbøl recognised immediately that the bones came from a settlement and he expounded the find's importance both on the radio and in the press.[23] At the National Museum however there was, with good reason, doubt about the Late Glacial date for the flint artefacts. In addition to the flint from "off Solrød Strand" Olafsson had also submitted flint from another submarine locality at a depth of 3 m "off Brøndby Strand" (fig. 15). Both finds contained a predominance of flint types from the "Coastal Culture" of the Atlantic Period. The material from "off Brøndby Strand" consisted mostly of well formed blades of Kongemose character and the flint from "off Solrød Strand" comprised a fragment of a heavy core axe or pick. Accordingly the finds as a whole were dated to the Ertebølle Period.[24]

Despite the fact that this find of marrow-fractured reindeer bones[25] and an antler fragment worked in the "groove and splinter" technique characteristic of the Hamburgian Culture,[26] was unique in Denmark, the remains from Køge Bugt were forgotten and the material was never published.[27]

A further examination of the flint which was pumped up[29] shows the presence of a few types which do not really fit into the flint inventory from the Atlantic Period (fig. 15).

From the site "off Solrød Strand" there is a water-rolled piece with retouche, which with some reservation can be classified as an atypical Brommian point (fig. 15d). From the site "off Brøndby Strand" there is a small one-sided blade core (fig. 15e) with alternating platforms of a typical Late Glacial type (Taute 1968: 172; Fischer 1982, fig. 8). A few heavy blades and core waste show the careful preparation of the flaking edge and the hard, direct knapping technique which is particularly characteristic of the Brommian Culture. Amongst the few tools from the site "off Brøndby Strand" there are three scrapers of Late Glacial type made from irregular blades (fig. 15a–c).

The majority of the flint pieces which have been pumped up are slightly water-rolled, bleached and often badly damaged as a result of their passage through the pumping machinery. Due to the state of the flint and the lack of diagnostic types, it is impossible to separate Late Glacial worked flint from Mesolithic flint. However, with regard to the question of presence of reindeer hunters, the dating of the flint is not crucial, as the traces of working on antler and bones alone tell their own clear story.

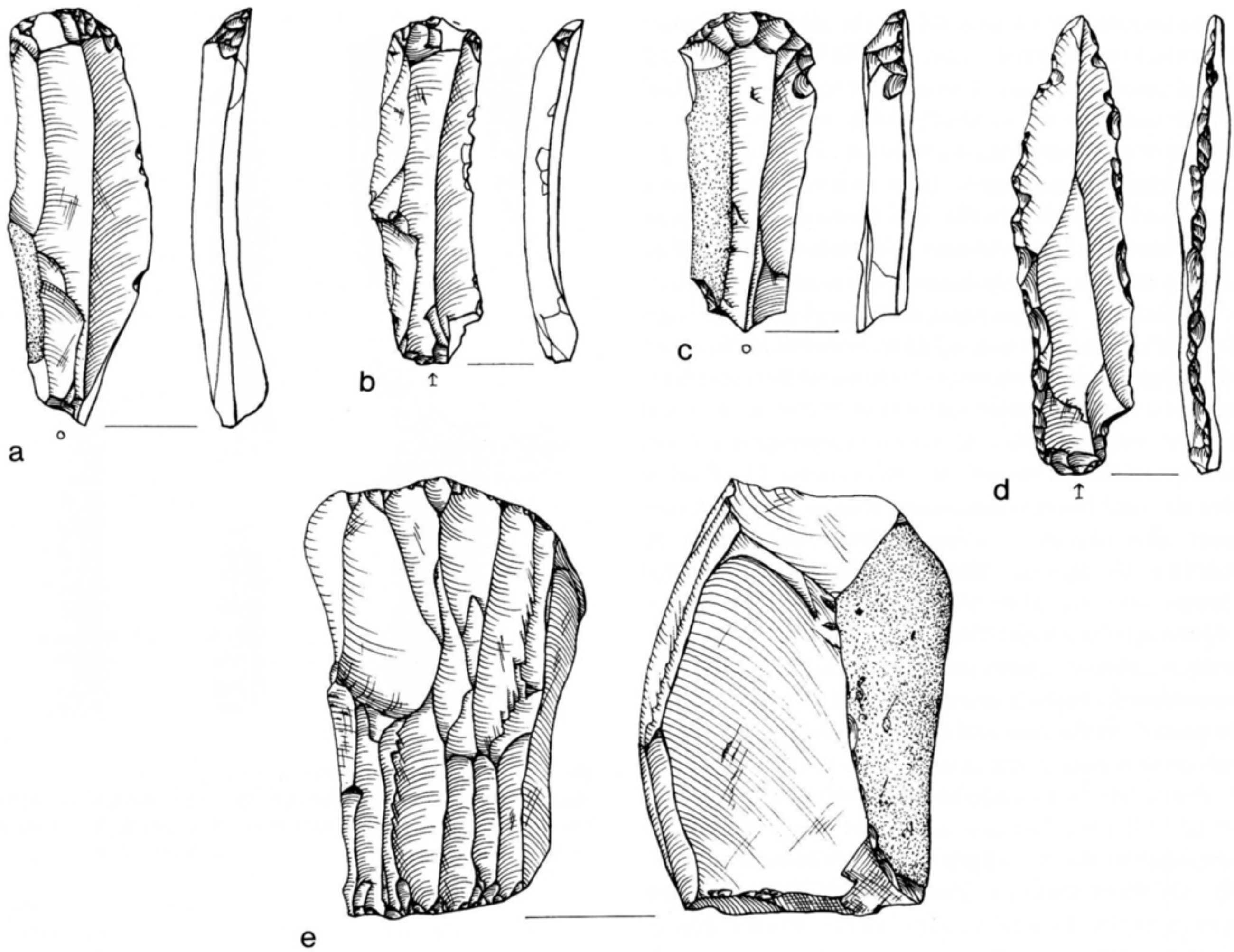


Fig. 15. Flint tools from submarine localities in Køge Bugt: "off Brøndby Strand" (a–c and e) and "off Solrød Strand" (d). Lykke Johansen *del.* 3:4.

THE LOCATION OF LATE-GLACIAL SITES ALONG REINDEER MIGRATION ROUTES

The new Ahrensburgian and Hamburgian finds from southwestern Lolland show that Late Glacial settlement in the eastern Danish young moraine area has left its mark. With regard to both age and richness these sites correspond fully to the well-known sites in northern Germany. The Sølbjerg finds and the Late Glacial settlement remains from Knudshoved and Køge Bugt are thought to be closely linked to a reindeer migration route running from southwest to northeast through Holstein and eastern Denmark.

It was important for the reindeer hunters to position themselves along the animals' migration routes. Reindeer are normally very faithful to their usual routes and the animals migrate year after year down the same worn and trampled paths, which are easy to recognize in the landscape. The route described in detail above is one of several migration routes through southern Scandinavia (fig. 8). "The Cattle Road" (Oksevejen) which runs along the Weichselian end moraine down through Jutland, was almost certainly trampled into existence by the feet of countless reindeer.[30] Further to the east, there were probably important migration routes around the eastern end of a presumed elongated lake basin in the western Baltic, up over Langeland and Ærø.[31] The easternmost route possibly ran over the land bridge from Dars to Gedser, along the western shore of the Baltic Ice Lake. The many Late Glacial stray finds in the area around Saaler Bodden south of Dars on the German Baltic coast are almost certainly linked with that route.[32]

We know very little about the changes in the landscape which took place in Late Glacial times, but it is not unthinkable that reindeer migration routes during the whole of the Period from the Older Dryas to the end of the Younger Dryas were more or less fixed.[33]

At the transition to the Pre-Boreal Period there was a dramatic emptying of the Baltic Ice Lake, which left the floor of the lake high and dry in the area lying between northern Germany, Zealand, Scania and Bornholm. This drastic change in the relationship between land and sea and the rapidly improving climate meant decisive changes in the reindeer migration patterns and as a consequence also in the hunters' settlement strategy.

The study of possible reindeer routes through southern Scandinavia has revealed many blank areas on the map of the Late Glacial landscape. There is a great need for further mapping of both the submarine and terrestrial terrain, as a better knowledge of these will make it more attractive for archaelogists carrying out survey to leave the flint-rich lake shores and turn their attention instead to the windswept ridges, watersheds and passages between former wetlands, where the reindeer migrated and the hunters of the tundra lived the best part of their lives.

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NOTES

1. The fragment of reindeer antler which was earlier dated to the Older Dryas/Hamburgian Culture (Mathiassen 1938), has been shown by accelerator dating (Uppsala Ua 347 + 348) to be recent.
2. Blue or white colouration (desilicification) of the surface is often seen on flint implements from chalk-rich surface sediments in the coastal zone, *køkkenmøddinger*, and surface peat layers (K. Andersen *et al.* 1982:36). Mesolithic flint from sandy localities can also acquire a blue or white ("bleached") colouration. In the authors' experience at Sølbjerg and other Palaeolithic sites, the characteristic of Palaeolithic flint is that the discolouration is uneven, so that one side of the flint, presumably the side which lay uppermost (towards the light?) when the site was abandoned, is more heavily bleached than the other. In the Late Glacial landscape with little bioturbation and scant vegetation, flint could have lain exposed to light and drifting chalk dust for decades. This, in combination with precipitation, could have created a basic desilicifying coating on the surface of the flint.
3. Most of Sølbjerg is today not under cultivation, but according to the present owner, Kurt Hovgård Jensen, the area was ploughed and attempts were made at cultivation after the Second World War. Gravel quarrying has meant that only 60% of the original surface of the hill is still intact.
4. The trial excavations took place in May 1990, with further investigations being carried out in October 1990 and July 1991. The investigations were carried out by the National Museum in collaboration with *Lolland-Falsters Stiftsmuseum*. Archeology students from the extramural departments of the Peoples' University of Copenhagen and West Lolland took part in the investigations. The finds are kept at the National Museum, Copenhagen, under file no. 6973/89.
5. Finds with more than one Ahrensburgian point are reported from Bonderup (Fischer 1982), Hjarup Mose (S.H. Andersen 1977), and Eskebjerg (Rasmussen 1972).
6. The two layers with finds, the plough soil and the humus-rich sand which lay below, were excavated in fields measuring 0.5 × 0.5 m. All the excavated soil was wet-sieved through a 4 mm sieve.
7. Taute's criterium (Taute 1968:12–13) that the length of an Ahrensburgian point should be less than 5.5 cm is normally adequate to separate Ahrensburgian and Brommian points. All the Sølbjerg I points satisfy this criterium. Fischer's suggestion that the use of the term Ahrensburgian point should be limited to pieces which have the point located at the proximal end (Fischer 1978:34) is unnecessarily restrictive. If this criterium is followed, it would mean "rejection" of nearly all the Sølbjerg points plus those from Eskebjerg.
8. In April 1992 the finds from surveys at Sølbjerg included 109 *Zinken* and 11 points of Hamburgian type.
9. Further geological investigations are necessary to determine whether there was a shallow Late Glacial lake in the area to the north of Sølbjerg.
10. During excavations in connection with the building of the former Novo factory in Copenhagen, a piece of worked antler was found which was dated by pollen analysis to the Allerød Period (Degerbøl & Krogh 1959:12).
11. Henning Thing, biologist at the Danish Polar Centre, is thanked for important information regarding the behaviour, feeding habits and migration of reindeer.
12. The report "HAVBUNDSUNDERSØGELSER, Råstoffer og fredningsinteresser. SMÅLANDSHAVET. Oversigt" published by the Department of Forestry and Nature (Skov- og Naturstyrelsen), describes the results of geological coring in the Smålands Sea. The Late Glacial landscape, fig. 9, represents a provisional interpretation based on information from the report named above.
13. There are at least 25 Brommian points from Fejø, mostly in private ownership. The majority come from a site at Skovnakken on the north side of the island. From Femø there is reliable information about five finds of single Brommian points from the eastern part of the island. In addition there are three points for which the find locality is unknown, these are similarly in private ownership. Bent Fugl Petersen is heartily thanked for information about these finds.
14. Bo Madsen is thanked for drawing the authors' attention to this piece in the National Museum's collections (A 51123).
15. Most of the Late Glacial finds from Knudshoved are unpublished. The material lies in private collections.
16. The Ahrensburgian points illustrated here were kindly lent by Sydsjællands Museum, Vordingborg, and by amateur archaeologists Bent Fugl Petersen, Axel Johansson and John Rasmussen.
17. Core 232–09–510120, *cf.* "HAVBUNDSUNDERSØGELSER, Rå-

stoffer og fredningsinteresser. SMÅLANDSHAVET. Oversigt" published by the Forestry and Nature Agency (Skov- og Naturstyrelsen), 1987.

18. The point (fig. 10b) was found by Axel Johansson at Trollesgave on the southwestern side of Holmegårds Mose. It is in the finder's private collection.
19. Information about the circumstancs of the find at the most important site "off Solrød Strand" is imprecise. Stoker E. Wagner, who made the first submission, described the find location thus in a letter to the Zoological Museum "A couple of kilometres off Solrød there is a large peat bog at a depth of 5–7 m. At the edge of this bog we pumped some good gravel". As to whether the bones come from the bog or the gravel on the edge of the bog is not stated. After talking to another submitter Captain G. Olafsson, museum curator Hans Norling Christensen noted that the finds were pumped up from 2–3 m under the sea floor and at a point where the water was c. 8 m deep (National Museum file no. 3522/81).
20. In the report "Køge Bugt. Ressourceundersøgelser. Fase 1. Geoteknisk rapport. Nr. 4. ref. Nr. 4742–183. Dato 1987–02–27. Geoteknisk Institut" The Forestry and Nature Agency (Skov- og Naturstyrelsen) 1987, the results are reported of geological coring and seismic analysis of the sea bed. The Late Glacial landscape (fig. 13) represents a preliminary interpretation based on the report mentioned above.
21. Bones of Late Glacial animals from the following localities in Køge Bugt (fig. 13) are stored at the Zoological Museum:

    1) *"Off Solrød Strand"*. Numerous bones of reindeer, horse, elk, aurochs, roe-deer, wild-boar, sheep, domesticated cow, red deer, grouse – pumped up from the sea bed from a depth of c. 8 m. The Zoological Museum, University of Copenhagen (ZMK), 18/1935, 11/1936, 9/1938, and 5a 1961.

    2) *"Trekosten" at the approaches to Kalvebod Strand*. Bones of reindeer, red deer, roe-der, cattle and great auk. Pumped up from gravel ridges of limited extent together with endless amounts of wood from a depth of more than 6 m. ZMK 220/1943.

    3. *"Off Mosede harbour"*. Jawbone of giant deer, dredged up in the 1950s. ZMK 24/1987.

    4. *"About 3 km off Vallø"*. Bones of several reindeer, taken up by the sand pumper "Baldur". ZMK 62/1947.

    5. *"Off Køge Sønakke"*. Bones of reindeer, taken up by sand pumper. ZMK 35/1948.

    6. *"Køge Sønakke off Bøgeskoven"*. Bones from at least four reindeer, taken up from a depth of 7–8 m by the sand pumper "Cap Vilano". ZMK 3/1981.
22. The authors would like to thank Kim Aaris-Sørensen, Director of the Zoological Museum, and Dr. Henrik Tauber, formerly head of the Copenhagen Radiocarbon Dating Laboratory for permission to cite the four radiocarbon dates for the bone material from Køge Bugt.
23. In June 1947 the newspaper headlines read "10.000 year old settlement on the bottom of Køge Bugt" (Socialdemokraten), "Settlement from Tundra times on the bottom of Køge Bugt" (Roskilde Avis), and "Settlement eight metres under Køge Bugt" (Fyns Stiftstidende).
24. Norling Christensen wrote the following in a letter to Captain Olafsson on the 11 June 1947: "With regard to the dating of the finds, it is presumed that they belong to the Ertebølle Period".
25. Jørgen Holm is presently engaged in an investigation on behalf of the National Museum at a Late Glacial settlement complex at Slotseng in southern Jutland. In 1991 a kettle hole was located which contained reindeer antlers and bones (Holm 1993, this volume).
26. The "groove and splinter" technique is traditionally linked with the Hamburgian Culture, whereas the finds from Stellmoor show that reindeer antler in Ahrensburgian times was normally fractured using coarser methods such as blows and splitting. A few well-dated finds show however that the "groove and splinter" technique was also known in the Younger Dryas (Taute 1968, 206).
27. The Late Glacial finds from Køge Bugt and their possible relationship to the Baltic Ice Lake's submerged coastline were discussed by Peter Vang Petersen in a lecture "New information about the early Stone Age in the Øresund – results of an interdisciplinary study" given to a meeting of "Det Kongelige Nordiske Oldskriftselskab" on 15 February 1983.
28. After finishing this manuscript we received from the AMS Laboratory, Institute of Physics and Astronomy, University of Aarhus, the date 12140±100 b.p. (AAR-1036) of the antler with "groove and splinter" technique. This result shows that man operated along the shores of the Baltic Ice Lake in the Late Bølling, and that we can expect to find Hamburgian sites as far northeast as North Zealand and perhaps in Scania.
29. The finds from Køge Bugt are stored at the National Museum: A 42009–21, A 44452, A 51165, and A 51166. It is clear that the material has undergone significant sorting and large intact pieces are in the majority. The fact that not all flint was collected is revealed by Captain G. Olafsson in a letter to the National Museum dated 15th June 1947, in which he writes "We are still pumping up more small blades but unfortunately no larger ones".
30. The Hamburgian sites of Jels and Slotseng in Jutland (Holm & Rieck 1987; Holm 1993) lie on opposite sides of Oksenvad Cattleford Parish.
31. The Ommelshoved find (Holm 1972) is very reminiscent in its composition of the Brommian finds from Knudshoved (Fischer 1991, fig. 13:8 and 22).
32. See Taute 1968 maps 3–4, localities 177–186 in Kreis Ribnitz-Damgarten.
33. The drainage of the Baltic Ice Lake through Øresund appears to be unchanged from about 12700 b.p. until about 10300 b.p. (Bergstein & Nordberg 1992).

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Møllegabet II –

A Submerged Mesolithic Site and a "Boat Burial" from Ærø

by OLE GRØN and JØRGEN SKAARUP

TOPOGRAPHY AND HISTORICAL DATA

What is today an open bay between the two north and north-west oriented headlands, Ommelshoved and Urehoved, was at the time of habitation a protected inlet, oriented SE-NW and measuring 2 by 3 km, with its narrow mouth pointing to the north (fig. 1). This situation was due to a contemporary water level which lay 4–4.5 m below that of today.

The deep, narrow run connecting salt and brackish water was surrounded by good hunting and gathering grounds and not surprisingly this resource-strategically optimal zone was subject to intense habitation in the later Mesolithic. Langelands Museum's systematic surveys have revealed several sites here.

Finds of large amounts of preserved organic material on the eastern side of the run "Møllegabet", focused attention on a small west-oriented prominence. The material derived partly from the Late Ertebølle kitchenmidden, Møllegabet I and it's nearby 1 m thick gyttja layer, which was deposited when the water level lay approximately 2.5 m below that of today, and partly from the Late Kongemose/Early Ertebølle settlement and waste zone, Møllegabet II and it's adjacent 2 m thick gyttja layers, which were laid down when the water level lay approximately 4.5 m below today's zero.

The excavation of Møllegabet I took place in the period 1976–1980 under the direction of Jørgen Skaarup, Langelands Museum, as the first systematic excavation of a submerged Stone Age settlement in Scandinavia (Skaarup 1980).

Møllegabet II – the subject of this paper – revealed itself at an early stage but unfortunately went unnoticed by the archaeological authorities. As the dredger "Dragen" in the early 20's was removing the westernmost point of the prominence to straighten out the approaches to Ærøskøbing, the crew observed "two intact ape skeletons" appear with the material from the bottom. With our present knowledge of the locality, there can be little doubt that these "apes" were Mesolithic human skeletons from destroyed graves. The campaigns of later years have yielded fragmented human bones where the bottom was dredged down to the underlying clay.

In 1987 the sighting at the locality of fresh flint, faunal remains and human bones recently washed out of the gyttja, prompted a new series of investigations in this "lower" coastal zone under the direction of the authors.

In 1988 information about the character of the site and heavy damage to the layers caused by the passage of the Ærøskøbing-Svendborg ferry in the run, was collected through systematic survey. In collaboration with Professor Jens Tyge Møller, The Laboratory of Geomorphology, University of Aarhus, seismic profiling of the soft sediments was attempted with a 33 and 270 kHz sediment echo-sounder. However, in most places a layer of sand covering the deposits prevented the penetration necessary for obtaining more detailed information about the sediments.

A return to the site in 1990 was intended as a campaign of settlement excavation, but already on the first day it changed to the rescue excavation of a dug-out canoe – the boat grave – exposed by erosion of the gyttja (Skaarup & Grøn 1991). The remains of the boat and a few square meters around it were excavated, and two E-W profiles were investigated by coring.

Excavation of a further 20 m^2 around the boat was carried out in 1991. Due to extremely bad weather, the excavation progressed slowly, and a trench intended as a section through possible preserved settlement layers did not reach the area of interest.

The excavation of the gyttja around the boat was carried out in 3 by 3 metre units with injectors mounted with 6 mm meshes on the discharge tubes. Attempts were made to register wood, bone, antler and tools three-dimensionally. Waste flint, seeds and nuts were related to the 3 by 3 metre units.

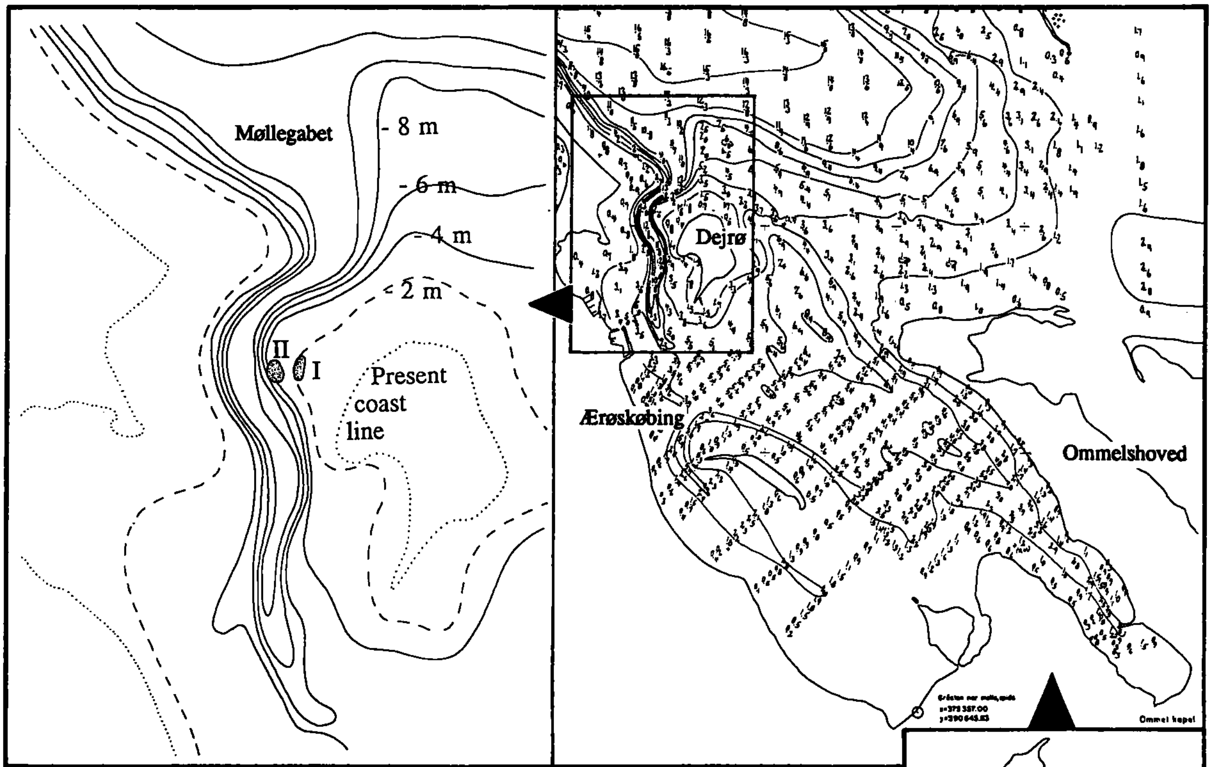

Fig. 1. The narrow run Møllegabet with the two sites Møllegabet I and II. Depth curves at 2 m intervals.

This paper is intended as a preliminary publication of aspects of this site, the oldest submerged settlement and refuse layer known in the area (Skaarup 1983), which is still far from being fully excavated. It is also a more comprehensive presentation of the important find of a presumed human burial in a dug-out canoe, which took place either in the marshy coastal zone or in shallow water outside the settlement area.

THE GEOLOGICAL SITUATION

The profiles

To get an impression of the geological situation, cores were taken along a 30 m long E-W-oriented profile a few meters to the south of the boat (fig. 2).

The whole area is covered by a layer of redeposited sand containing various kinds of cultural remains, shells and small organic particles deriving from the gyttja. Generally this layer is 20 cm thick, but to the west, close to the deep run, it's thickness increases rather suddenly to 1.5 m.

In the higher part to the east, a layer of clayey grey sand containing many small stones was observed under the redeposited sand. This layer may possibly represent the remains of a settlement surface.

The gyttja layer starts approximately 10 m from the profile's eastern end, and assumes a thickness of 2 m, 10 m from it's western end. It seems to proceed with this thickness further to the west. Here the redeposited sand was too thick to penetrate with the borer.

The underlying substrate in the area consists of blue clay.

A more northerly 35 m long, E-W-oriented section, following the central line of the prominence, showed an

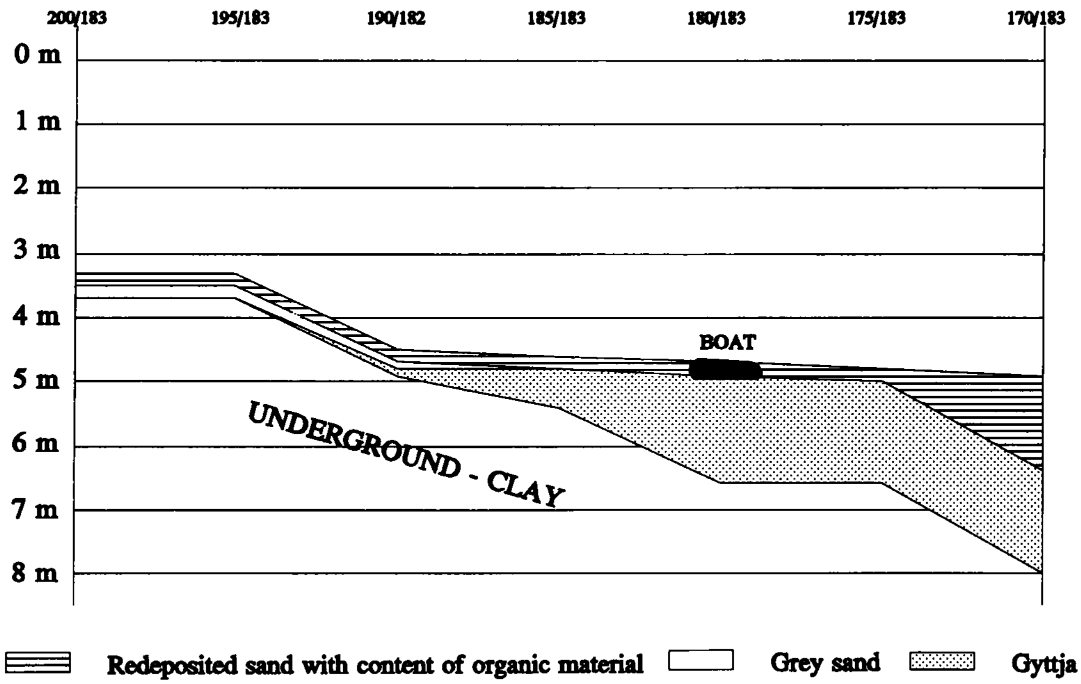

Fig. 2. The southernmost E-W profile. X-values increasing to the E.

extremely level surface of exposed clay substrate, probably created artificially by the dredger. The gyttja layer beyond its western point was found to be only half a meter thick.

This indicates 1) that the main deposits of gyttja were sedimented in calm water to the south of, and protected by, the small prominence and 2) that the surface of the westernmost 15–20 m of the latter, were removed mechanically.

The position of the culture layer

In the area excavated around the boat burial, the finds were concentrated in the upper 20–30 cm of the gyttja. Thus the main part of the waste layer was deposited on top of a more than 1 m thick, older gyttja layer. Burnt hazel-nut shells found at a depth of almost 1.10 m in the gyttja, 4 m to the SW (in point 175/183), may indicate either another waste layer here or that the layer dips rather steeply in this direction.

The grey sand layer observed in the eastern part of the profile may be a partly-preserved settlement surface. Small pits excavated here in 1990 around point 190/182 showed that, whereas the main part of the flint from the redeposited top sand generally was rolled and more or less patinated, the flint from the grey layer was totally fresh and unpatinated.

TYPOLOGICAL RELATIONS AND CHRONOLOGY

The flint

The flint found on the surface contains both Late Kongemose/Early Ertebølle and Late Ertebølle types. However, the Late Ertebølle types are all clearly rolled and patinated, whereas the early types are fresh with little if any patination. Fragments of pottery were only found at the surface. Indicators of later activity are absent from the gyttja layers. Obviously material, which is fortunately easily distinguishable, has been washed down from the upper site, Møllegabet I. Unless otherwise stated, this later material is excluded from the following description.

A characteristic of Møllegabet II is the appearance of numerous large flakes of fresh, high quality flint. They often measure as much as 10 by 10–15 cm and are several centimetres thick. One wonders who could afford to discard good raw material in such amounts.

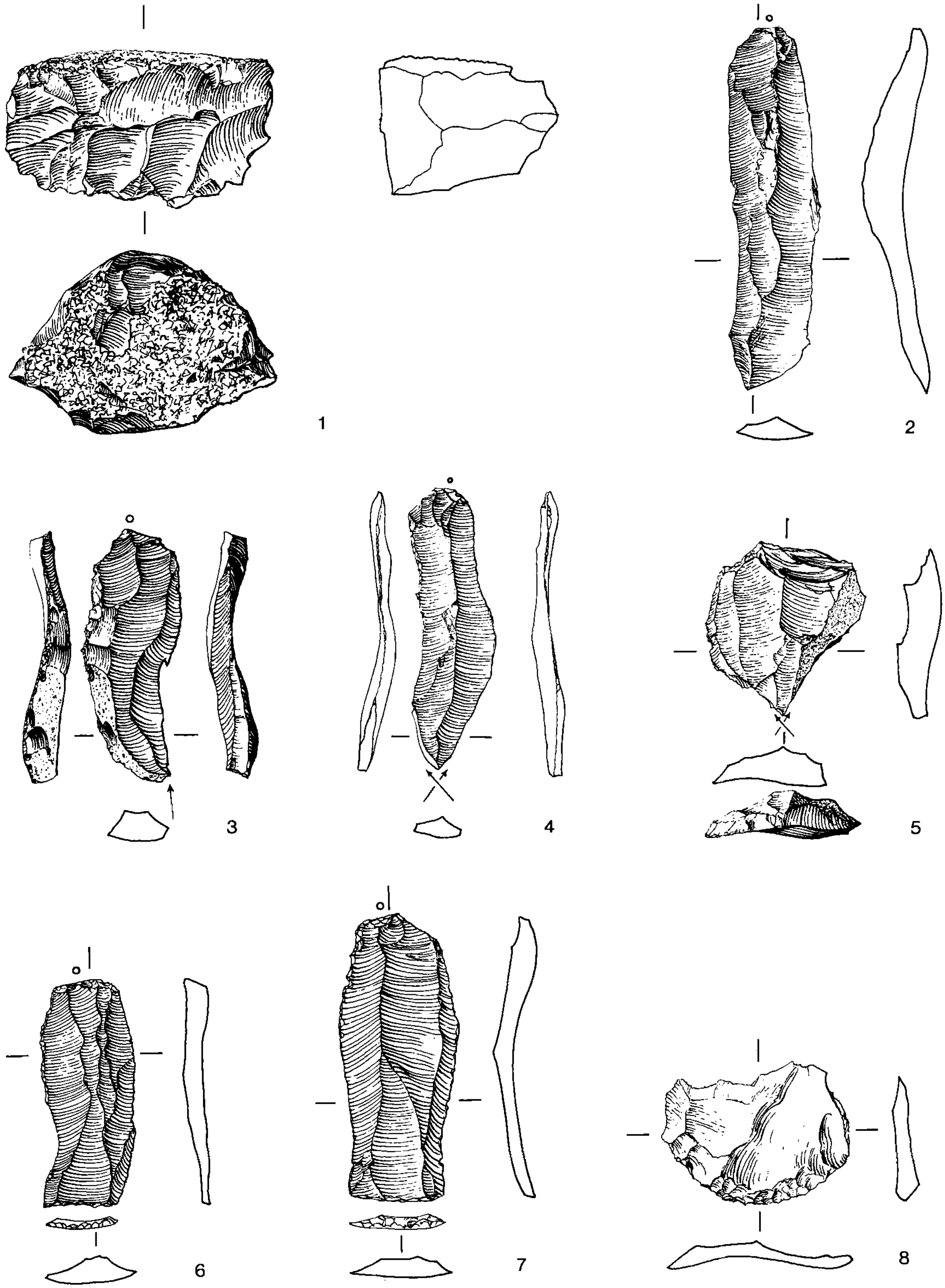

Fig. 3. 1: core; 2: blade; 3–5: burins; 6–7: obtuse tronchatures; 8: edge resharpening flake. Jens Korterman *del.* 2:5.

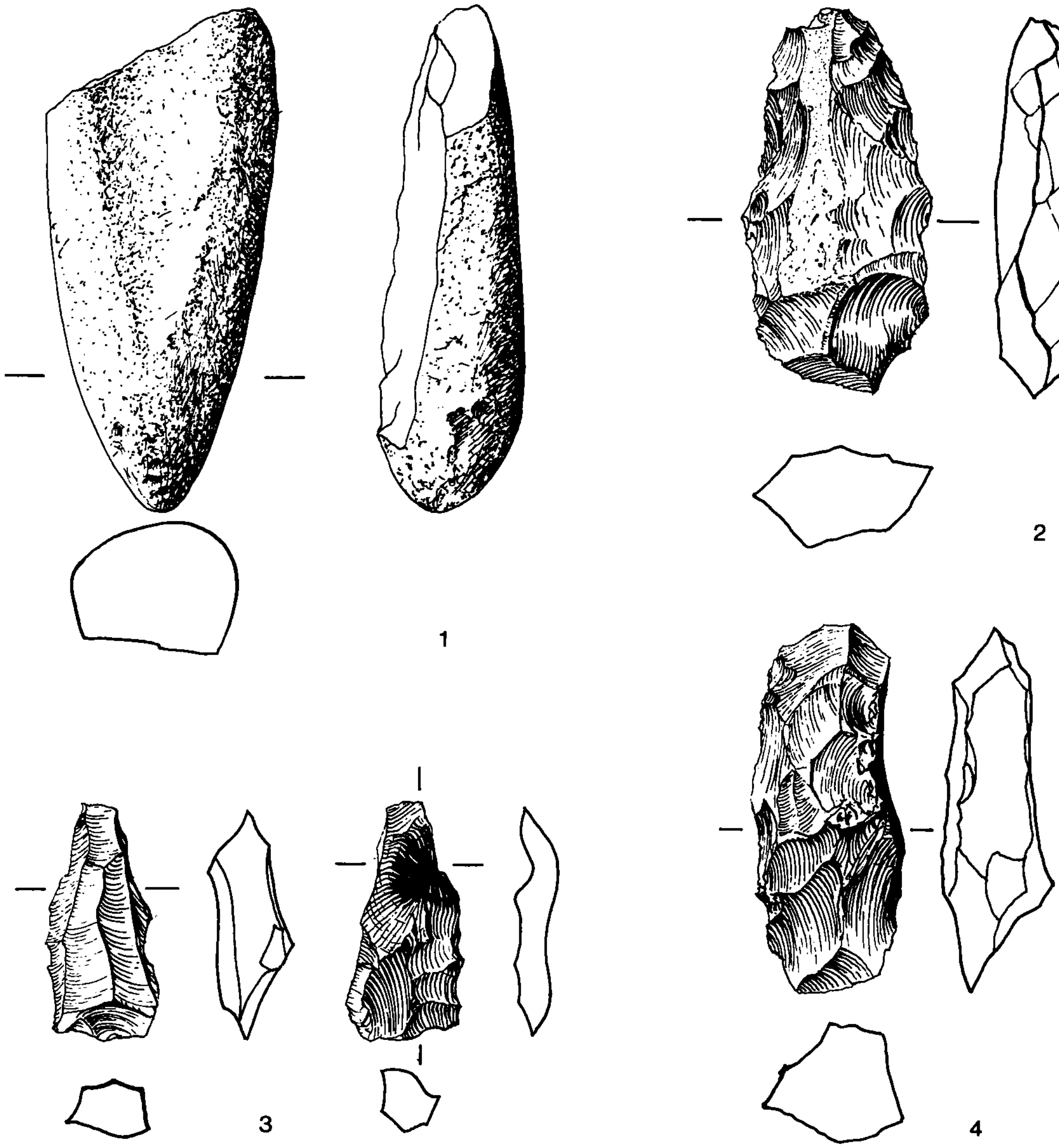

Fig. 4. 1: fragment of a greenstone axe; 2–4: core axes (3 a little insert). Jens Korterman *del.* 1:2.

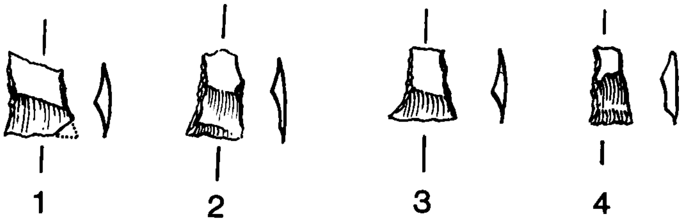

Fig. 5. 1: unpatinated arrowhead from Møllegabet II; 2–4: rolled and patinated arrowheads. Jens Korterman *del.* 1:1.

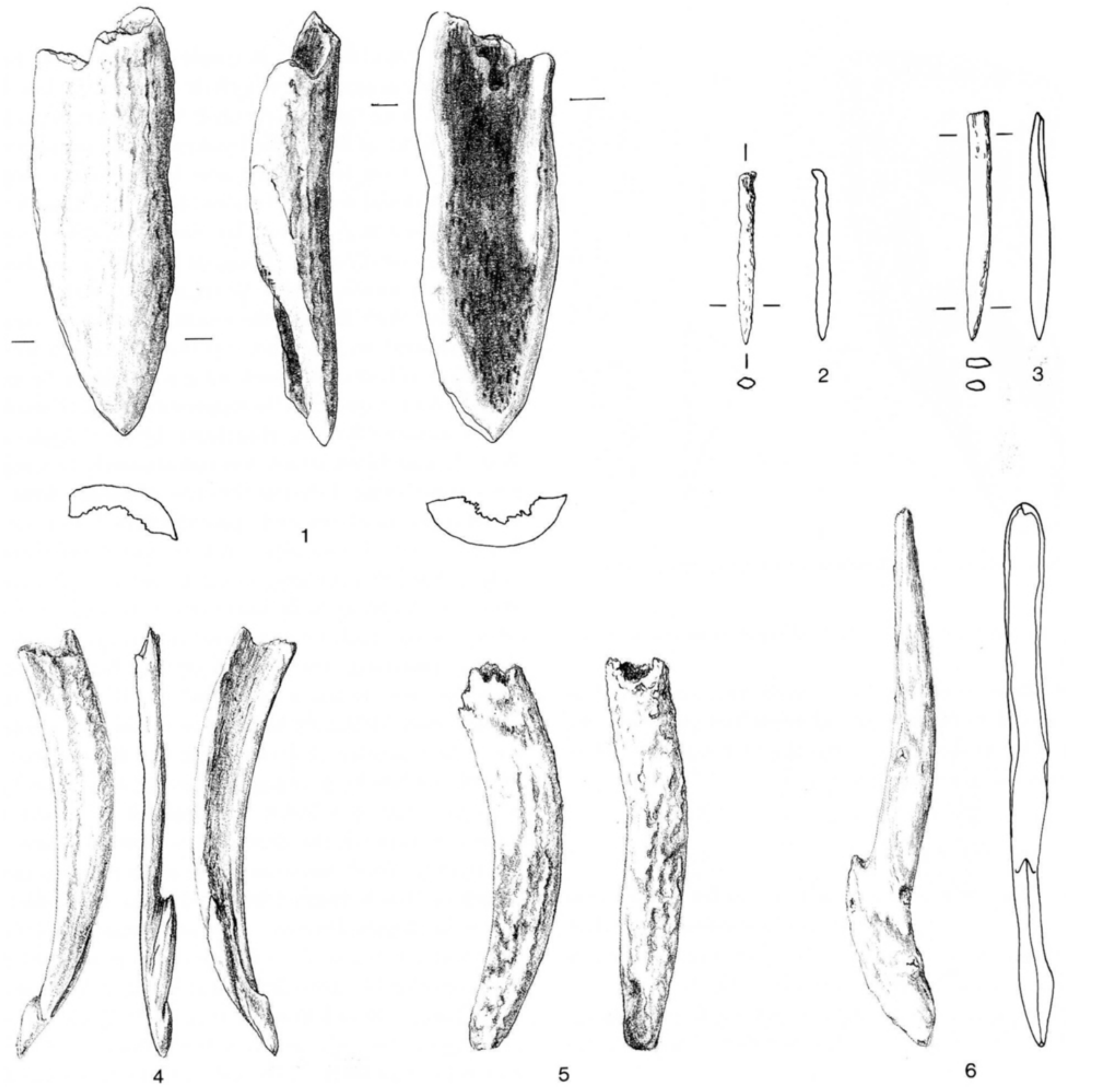

Fig. 6. 1: edge fragment of antler mattock; 2–3: awls; 4: presumed harpoon or waste from production of bone splinters; 5: flint flaker; 6: leister prong of hazel. Jens Korterman *del.* 1:2.

The intact blades are generally 10–15 cm long (fig. 3:2), slightly curved and with two ridges lying quite close to each other. They correspond to what one would normally consider as typical Kongemose/Early Ertebølle blades.

The numerous axes are all core axes (fig. 4:2–4), 6–15 cm long and none of them with a specialized edge. They include one small insert (fig. 4:3). Flake axes are absent. The chipping traces on the boat fragment indicate the use of axes 8–9 cm broad. Since a resharpening flake from a core axe of these dimensions was actually found (fig. 3:8), at least some of the core axes found must be worn out and repeatedly resharpened items.

Typical flint artefacts are obtuse tronchatures (fig. 3:6–7), burins on obtuse tronchatures and other burin types (fig. 3:3–5), generally made from large well-formed blades. Both large flake- and core borers are present.

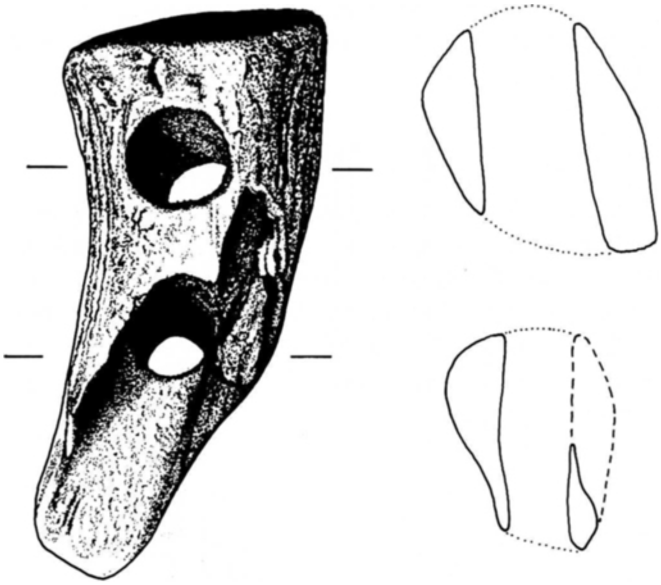

Fig. 7. Red deer antler mattock with two shaft-holes. Ole Grøn *del.* 1:2.

Scrapers, regular knives and oblique tronchatures are absent.

Four arrowheads were found on the site. 3 are of a clear symmetrical Ertebølle type, all rolled and patinated (fig. 5:2–4). One fresh and unpatinated item meanwhile exhibits a rhombic tendency (fig. 5:1).

Items of bone and antler

Finds of bone and antler include a number of awls typically made out of the metatarsus of a roe-deer or red deer or of bird bones (e.g. fig. 6:2–3). They also include one flint-flaker made out of an antler tine (fig. 6:5).

A presumed harpoon (fig. 6:4) may in fact be the remains of an antler tine with a number of splinters removed.

A red deer antler mattock with two shaft holes (fig. 7) is an interesting find. Apparently the first shaft hole was damaged and a new one was made behind it. Due to resharpening and wear, the edge is quite close to the original hole. An edge fragment of an antler mattock of indeterminable type was also found (fig. 6:1).

Wooden items

As was the case during the excavation of Møllegabet I, a number of leister prongs were found (fig. 6:6). They do not however deviate from the ones already published (Skaarup 1983:148–149). A couple of more exotic items did however appear. These include a small bow, less than one metre long, and an axe shaft made from an angled branch. Some of the pointed stakes located measured as little as 2–3 cm in diameter and had regularly shaped points hardened by fire. In some cases they may be interpreted as a kind of spear, but since several were found thrust into the gyttja, in a similar fashion to the thicker stakes, they must generally be regarded as stakes.

The axe shaft (fig. 8) was found immediately outside the excavated area, sticking up from the gyttja on the bottom. It is badly preserved but it is thought to be made of wood from a species of the Apple sub-family (*Pomoideae*) which includes Rowan, Hawthorn, Quince, Apple and Pear. It was found intact, but unfortunately this fragile piece was damaged during the critical transfer from the water to the platform, and approximately 3–5 cm of the shaft were lost. It now consists of two pieces, one consists only of shaft, 59.5 cm long, with a diameter of 5.0–5.8 cm. With the exception of the lower end, which has been cut off by an axe, and the upper end close to the head, the shaft is unworked. The 21 cm long head forms an angle with the shaft which is very close to 90°. It has been shaped more delicately with an axe, but still seems to have the character of a rough-out. Its flat top was intended as a bed for attachment of an axe which may have been mounted in a socket as suggested by Brinch Petersen, or between the head and a piece like those interpreted by Troels-Smith as halves of intermediate pieces or helves (Troels-Smith 1960:112–115) or as handles for knives by Brinch Petersen. The total length of the axe shaft was 73–75 cm. A similar find, made of hazel, but with considerably more finish, was found at Maglemosegårds Vænge (Brinch Petersen *et al.* 1979:62–65, 78), and yet another parallel find, also made from hazel, is reported from an undated context in Christiansholms Bog (Troels-Smith 1960:125).

The small, slightly bent bow of Dogwood (*Cornus sanguinea* (fig. 9)) is only 86 cm long. One end has a clear horn shape, whereas the other seems to be a more straightforward point. According to Andersen this is not uncommon for mesolithic bows (Andersen 1981:128). In contrast to most other known mesolithic examples, the bow from Møllegabet II is not made from a split piece of wood (e.g. Becker 1945:65; Brinch Petersen 1979:74, 75) but has a round section with a maximum diameter of 2.6 cm, which follows the surface of the original branch. The surface has been carefully prepared but a couple of lateral

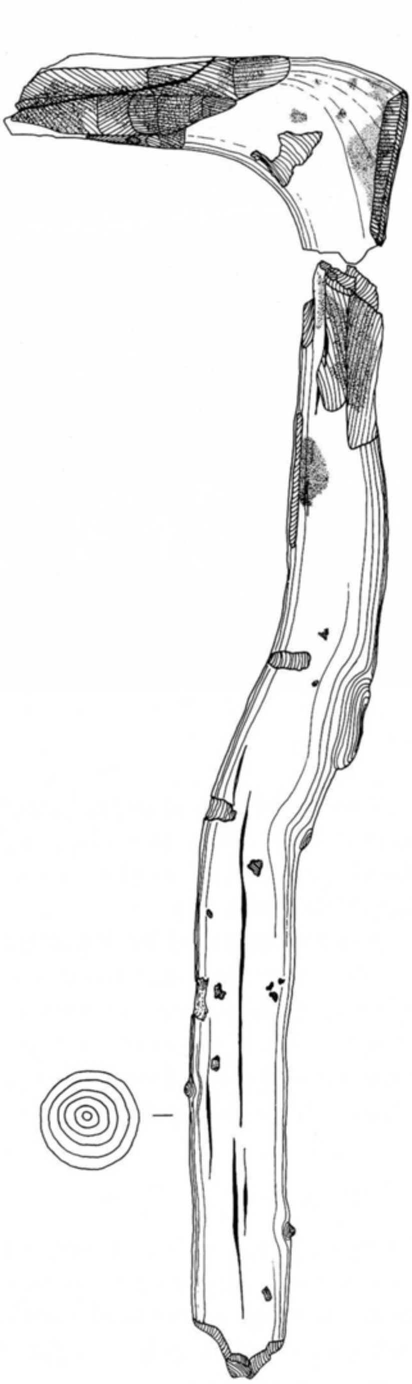

Fig. 8. Axe shaft. Simon Botfeldt *del.* 1:4.

Fig. 9. Bow. Simon Botfeldt *del.* 1:4.

shoots were left protruding up to 5 mm from it. It is obvious that the piece would have been weakened had they been removed.

Chronology

From a traditional typological point of view the material indicates a date lying at the transition between the Kongemose and Ertebølle Cultures, around 4000 (conv.) / 4850 (cal.) B.C. (Andersen & Malmros 1966:86–91, 95).

A radiocarbon date of 3960±75 (conv.) / 4790 (cal.) B.C.[1] has been obtained from the boat positioned in the top of the gyttja.

SITE ECONOMY

The site has yielded important information on different aspects of the contemporary economy: hunting, fishing and gathering of plant resources.

Plant resources

During the excavation, material was sieved through a net with a 6 mm mesh. Three samples of seeds, fruits, and other plant remains from different areas of the refuse layer have been analyzed by David Robinson, The Danish National Museum. The report (NNU no. A7148), which is summarized in the following, states that the three samples have very similar relative compositions.

Hazel-nuts were well represented. Only four whole nuts were observed, three with worm holes and a fourth gnawed by a rodent. Large amounts of half or even more fragmented shells were found, none of which showed worm holes or gnawing traces. The discarding of bad nuts together with empty shells must reflect conscious handling of food items. A number of shell fragments showed traces of heating/burning, and must be taken as indicators of the well-known mesolithic tradition of hazel-nut roasting, best documented at Duvensee W.6 (Bokelmann 1981:181–183).

A similar tendency can be observed in the acorn remains, which appear in rather more restricted numbers. Large intact acorns are absent, whereas empty cups and small unripe fruits intact in their cups were recorded.

Stones of Dogwood (*Cornus sanguinea*) and specially hawthorn (*Crataegus monogyna/oxyacantha*) appeared in large numbers, most of them lacking the surrounding fruit

Fig. 10. The boat immediately after it was discovered. Photo Ole Nielsen.

flesh – this may have been eaten or was possibly just not preserved. A handful stones of Dogwood were also recorded from the floor of hut I, Ulkestrup (Andersen *et al.* 1982:12).

One seed of Fat Hen (*Chenopodium album*) was found in the samples. This plant grows typically on disturbed nitrogen-rich soils, for example around middens on dry land.

Due to the large mesh size used during the excavation, information about the smaller seeds and other plant remains has been lost. It is planned to take a better sample as soon as possible.

Hunting

Mammal and fish bones were analyzed by Kim Aaris-Sørensen and Knud Rosenlund respectively, both of The Zoological Museum of Copenhagen University.

Many bones of red deer (*Cervus elaphus*), wild pig (*Sus Scrofa*), some of roe-deer (*Capreolus capreolus*), and several large antlers of red deer with heavy burin traces show that these animals were the main game. Pine marten (*Martes martes*), otter (*Lutra lutra*) and porcupine (*Erinaceus europaeus*) are represented by a few bones each.

Dogs, which were most likely used for hunting, appear in two sizes: a little spitz which is slightly larger than a Lapp-spitz and a somewhat larger animal the size of a Greenland sledge-dog.

A large fragment of the left under-jaw of domesticated ox (*Bos taurus*) was registered at a depth of at least 30 cm in the gyttja in a clearly mesolithic contest. A likely explanation is that it fell unnoticed from the redeposited coversand. On the day this item was excavated the underwater visibility was almost zero.

Marine resources

Mollusca appear to have played no role at all as a source of nutrition. A few small oyster shells (*Ostrea edulis*) were found in the gyttja, but mostly with the upper and lower half lying together, indicating that the animals had suffered a natural death.

The fish bones from the waste layer were totally dominated by vertebrae, of which 95% are from cod (*Gadus morhua*). Piked dogfish (*Squalus acanthias*), mackerel (*Scomber scombrus*) and flatfish (*Pleuronectidae*) make up 5%, and eel (*Anguilla anguilla*) is represented by only one vertebra. The poor representation of eel is probably due to the fact that bones from this fatty fish are generally found badly preserved.

Of the numerous stakes found within and outside the excavated area a large proportion probably represent the remains of large permanent fishing structures. Excavation of larger areas would probably make it possible to distinguish regular patterns in the positions of the stakes. The prongs of fishing leisters for catching eels underline the importance of this fish.

The bones of mute swan (*Cygnus olor*) and other indeterminable bones from duck/goose/swan, show that such birds were hunted.

Grey seal (*Halichoerus grypus*) is documented in the material, whereas some unspecifiable seal bones may derive from other species.

THE BOAT BURIAL

In the uppermost part of the gyttja, close to the shore, the stern of a dug-out canoe was uncovered in 1990 (fig. 10). The nearly 2.5 m long boat section lay with the stern pulled close to the prehistoric coast and with its long axis at an oblique angle to the latter. Pointed stakes were found at both ends of the boat fragment. Other stakes, found in the gyttja at deeper levels, may derive from demolished fishing weirs.

Like nearly all dug-out canoes known from the old Stone Age (Christensen 1990; Andersen 1990), the boat was made from a large straight lime trunk, shaped by a combination of cutting with axes and cleaving (LMR no.12123, NM VIII no.A7148). Due to the lack of bow, port side and edge of the starboard gunwale, it is impossible to determine the original dimensions of the craft. The breadth however, can hardly have been less than 60 cm. The sides and bottom were fashioned with astonishing craftsmanship and had been shaved down to a thickness of less than 1.5 cm.

The stern was cut off at an oblique angle to the long axis. A few centimetres from its edge three conical holes had been bored, 6–7 cm apart, in order to attach a removable stern-bulkhead.

The central part of the boat fragment was badly burnt (fig. 11). The charred areas start 0.5 m from the stern and can be observed over more than 1 metre in the direction of the bow. The fire had burnt through the bottom in several places. Whether the burning reflects ritual handling of the boat after it had been discarded and placed where it was found, or – more prosaic – whether an already burnt out boat was used for the purpose is difficult to decide. The extension of the charring and the find of a partly-charred leister prong on the burnt part of the boat fragment is consistent with the former possibility.

In order to cut under the boat and take it up, it was necessary to excavate a 0.5 m broad, 0.5 m deep ditch around it. In the course of this some more leister prongs and a few flint artefacts appeared. Most exciting however, was the find immediately to the north of, and at the same level as, the boat, of a human sacrum along with some associated caudal vertebrae and several human rib fragments. They had probably been washed out of the boat. During the conservator's excavation of the boat in the laboratory, it was found to contain a large fragment from the right side of a human skull and a human finger bone. None of the bones were burnt.

The excavated human bones can be supplemented by a fragmented right humerus, a fragment of the right half of a pelvis, a damaged right femur, a right tibia and some further rib fragments found washed out on the bottom immediately around the boat during the initial surveys in 1987–88.

Anthropologist Pia Bennike has examined the human bones (LMR no.12123; Laboratory of Anthropology, Copenhagen, AS 21/90). There is nothing to contradict the supposition that they all originate from one individual, determined as a strong built young adult male, approximately 25 years of age. The skull fragment shows the healed traces of a 4 cm long lesion, probably the result of an axe-blow.

The uncovering of the dug-out canoe also led to other interesting observations. Along the starboard side a more than 1 m long coherent piece of bark (preliminarily determined as elm (*Ulmus sp.*)) was found lying partly under the boat. Fragments of the same piece of bark found in the gyttja over the boat indicate that a larger piece had originally been folded to cover the boat and its contents.

Directly under the boat's badly damaged western end, a very thin spade-shaped piece of wood appeared lying across the long axis of the boat, probably the remains of a paddle. Fragments of another paddle lay in the gyttja over the central part of the boat. Two antlers of red deer and one of roe-deer, each heavily worked with burins, were located a little to the south and east of, and at the same level as, the stern.

During the past 15 years a series of informative excavations from Zealand, Scania and Jutland (Albrethsen &

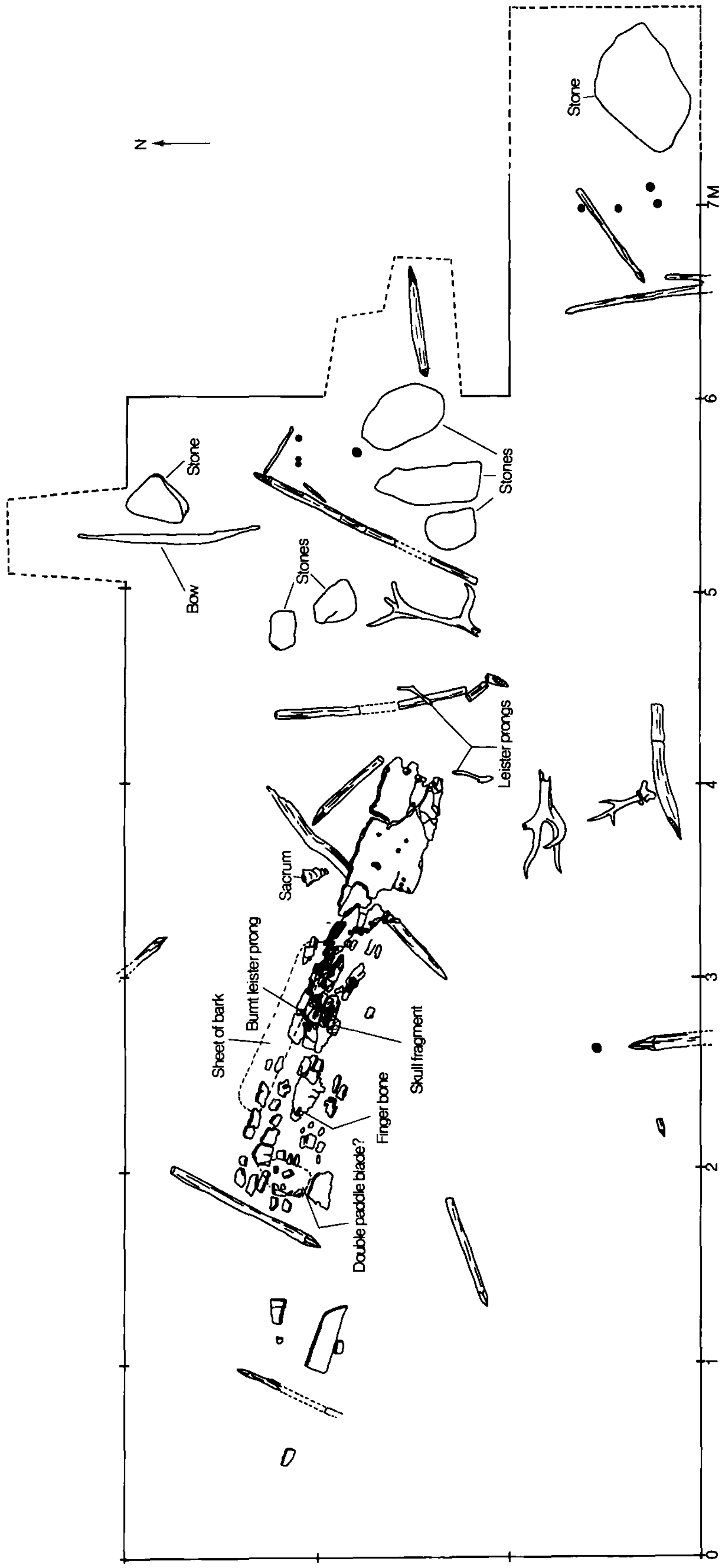

Fig. 11. The excavated area with boat, stakes, wooden tools, some human bones and the large stones.

Brinch Petersen 1976; Brinch Petersen 1990; Kannegaard 1991; Larsson 1988) have revealed a number of cemeteries from the later Mesolithic. The graves generally appear in close association with settlements. Their arrangement and equipment reflect a hunter/fisher population, subject to a complex set of death rituals.

The boat from Møllegabet II, radiocarbon dated to 4790 B.C.,[1] confirms the picture established to date, but also sheds light on a hitherto unknown aspect of these burial customs by showing that the coastal zone outside a settlement was also employed as a cemetery. Apparently one of the younger men from the settlement was buried here in the badly burnt rear part of a dug-out canoe, placed close to the coast and held in position by stakes thrust down into the gyttja. A row of large boulders in the top of the gyttja to the east of the boat have been placed deliberately and may have served as stepping-stones from the shore to the burial. The body seems to have been at least partly wrapped in, or covered by, sheets of bark. The cause of death is impossible to determine on the basis of the extremely fragmented skeleton. The healed skull lesion indicates times of unrest and the unpatinated transverse arrow-point, found with the boat, need not be a funeral gift, but may have been shot into the corpse. Since antlers are found in several of the contemporaneous graves, under or above the deceased, and most often in the head-end, those found close to the stern are likely to belong to the burial.

The boat burial was apparently not the only burial on the site. As mentioned above, two human skeletons were brought up by dredging at the westernmost point of the prominence near the settlement. A small cemetery belonging to the settlement appears to have been located there.

Contemporary parallels to the boat burial from Møllegabet are few and uncertain. During dredging in the cove Korsør Nor in 1943 a burial was found which showed some similarities to that at Møllegabet II (Norling-Christensen & Bröste 1945). In this case the deceased was also a man with healed lesions in the skull and he was covered by a layer of bark. Under the corpse there was another bark layer and at the sides there were two long "laths". This part of the construction was interpreted by the excavator as a kind of bier, but may actually be the remains of a bark canoe used in a similar fashion to the dug-out canoe from Møllegabet. The shadow of decomposed wood or bark around the body of a 40 year old man at one of the cemeteries at Skateholm, southeastern Scania, have been recently interpreted as the remains of the severed prow end of a boat (Larsson 1988:112).

The closest parallel however, is a find from Øgårde in the large bog Åmosen on Zealand. During the Second World War a 7 metre long dug-out canoe of lime tree was uncovered during industrial production of peat litter (Troels-Smith 1946:18f.). In the stern a small hearth was located on a layer of clay, a feature known from other boat finds, and possibly connected with the use of the vessels for fishing/flaring eels. The long canoe was held in position by hazel rods, thrust into the mire along its sides. In front of the boat lay the skeleton of a man, who seems originally to have been placed in it. The situation is very similar to the burial at Møllegabet, but the radiocarbon date is 3360 B.C.[2] (Christensen 1990:122), i.e. early in the Neolithic and nearly 1500 years younger.

The large interval of time between the two closely-related burial ceremonies reveal the arbitrary nature of the preserved finds, and gives a hint regarding the start of the Nordic tradition of boat burials, which is so tenacious that it can be traced right up into the Late Viking Age at about 1000 AD.

The use of boat burials is not specifically Nordic. It is known from numerous ancient cultures all over the world, and has for instance until this century been widespread among the aboriginal populations of the Pacific Islands (Turner 1884:306; Blackwood 1935:494f.).

The ethnographer H.A. Bernatzik, who studied the Mok of the Malayan peninsula, observed that each group from ancient time had its own special island of the dead, to which the corpses were transported. If the deceased had owned a vessel (a canoe), people severed it in the middle, broke off the gunwales, placed the corpse wrapped in mats in the one half, and arched the other half over it as a coffin-lid, whereafter it was secured by ropes. The corpse was placed with the head to the west, "because this is where the sun dies every evening". Personal belongings such as fishing spear, jars, personal ornaments, axes, which indicate the sex of the deceased, were placed beside the corpse (Bernatzik 1943:37f.).

Behind the boat burials there seems to be a common religious conception, independent of time and place, of the boat as a suitable means of transportation for the final journey – to the land of the dead.

CONCLUSION

The site Møllegabet II is a very informative locality with regard to the Late Kongemose/Early Ertebølle Period. The information obtained concerning Late Mesolithic boat burials is essential to the understanding of the complexity of ritual in this phase. The good preservation of vegetable food remains is important, since economic aspects are rarely elucidated, despite their undoubted importance.

It is regarded as crucial now to find out whether the settlement surface is preserved at the site. With the large costs inherent in underwater archaeology, and our present knowledge of well-preserved Mesolithic waste layers, it is logical to focus on locations which also yield information about life in the settlements. The justification for the increased costs must be increased output.

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Acknowledgements

We wish to thank David Robinson, Claus Malmros and Charlie Christensen, The Natural Science Department of the Danish National Museum, Kim Aaris-Sørensen and Knud Rosenlund, The Zoological Museum of Copenhagen University, and Pia Bennike, The Laboratory of Anthropology at the Panum Institute, Copenhagen, for their help in analyzing the various aspects of the material from Møllegabet II. Simon Botfeld, Langelands Museum, identified the species of wood used to make the axe shaft and the bow on the basis of its anatomy. We also wish to thank the amateur divers who participated in the excavations as volunteers and who solved many practical problems associated with producing high quality photo and video documentation. The radiocarbon date K-5640 was performed by the radiocarbon laboratory of the Danish National Museum, Copenhagen 30.3.1991. Financial support was obtained from the State Antiquary. The English text was revised by David Robinson.

NOTES

1. K-5640. The date is 5910+/-75 b.p. in C-14 years. Calibrated date (Pearson *et al.* 1986): 4790 B.C., with +/- 1 standard deviation 4900–4730 B.C.
2. K-1165. The date is 4590+/-120 b.p. in C-14 years. Calibrated date (Pearson *et al.* 1986): 3360 B.C., with +/- 1 standard deviation 3510–3100 B.C.

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Journal of Danish Archaeology vol. 10. 1991, pp. 51–58.

Body Size Trends of Roe Deer (Capreolus capreolus) *from Danish Mesolithic Sites*

by PHILIP JENSEN

INTRODUCTION

During the climatic amelioration following the last glaciation, numerous mammalian species underwent marked reduction in mean body size as reflected in bone dimensions (*e.g.*, Kurtén 1959, 1965, 1968; Davis 1977, 1981; Boessneck & von den Driesch 1978; Uerpmann 1978; Guthrie 1984; Klein & Cruz-Uribe 1984).

Davis (1981) pointed out that the Late Pleistocene – Holocene size diminution seen in most mammalian lineages was probably world-wide. Examples of this kind of body size change have been termed "post-Pleistocene dwarfing" (Marshall & Corruccini 1978).

Kurtén (1959) emphasized that there is no need to invoke genetic change as a factor underlying dwarfing of Late Quaternary mammals and that size changes may be "a characteristic of the environment rather than of the animals themselves".

Although the reasons for the initiation of size reduction are still not fully understood, it is generally assumed that adverse environmental conditions were responsible for the Late Pleistocene-Holocene trend of size decline of mammals. In this context, mammalian remains recovered from dated archaeological sites have proved valuable in monitoring body size changes within a chronological framework.

Skeletal remains of roe deer *(Capreolus capreolus)* have been found in substantial numbers associated with Danish Mesolithic sites covering the period 9000 to 5000 radiocarbon years b.p. (before present), indicating that this species formed an important part of the diet of the Mesolithic hunter-gatherers. With the advent of agriculture and animal husbandry, hunting became less important and thus from the Neolithic period onwards, roe deer remains are either absent, or present only in insignificant numbers, in archaeological context.

Møhl (1971, 1987) and Aaris-Sørensen (1976), working on faunal remains from selected Danish Mesolithic sites, noted a size discrepancy between subfossil and recent roe deer.

These findings are in accordance with similar studies from other parts of Europe. Boessneck (1958), in an analysis of roe deer remains from archaeological sites throughout central Europe in comparison with recent material, showed that Mesolithic and Neolithic specimens grew to a larger size than their present-day conspecifics. Likewise, Requate (1957) reported on roe deer of considerable size from Mesolithic sites in Schleswig-Holstein.

Although temporal variation of roe deer has been established, the timing of the size reduction has not been documented in detail. Thus, the purpose of the present paper is to investigate whether significant changes in mean body size of Danish roe deer occured during the Mesolithic period in relation to changing environmental conditions. Recent data have been included for control purposes.

MATERIAL AND METHODS

Mesolithic sites from which subfossil material has been examined are shown in Table 1. The chronology of the sites mentioned is given in relation to chronozones and cultures.

According to Mangerud *et al.* (1974), the Boreal chronozone covers the period 9000 to 8000 radiocarbon years b.p., whereas the Atlantic chronozone covers the period 8000 to 5000 radiocarbon years b.p.

The Danish Mesolithic period is divided into three archaeo-cultural stages (Maglemose, Kongemose and Ertebølle) named after their archaeological type-sites. Cultural assignment follows Brinch Petersen (1973).

The subfossil material mentioned in Table 1 is kept at the Zoological Museum, University of Copenhagen

(ZMUC) with the exception of the bone material from Tybrind Vig, which is deposited at the Institute of Prehistoric Archaeology, University of Aarhus.

Mensural data from published faunal lists include Lundby-II (Rosenlund 1980), Sværdborg I-1943 (Aaris-Sørensen 1976) and Ulkestrup Lyng Øst (Richter 1982).

Mensural data from unpublished faunal lists include Vedbæk Boldbaner, Maglemosegårds Vænge, Henriksholm-Bøgebakken, Maglemosegård (Aaris-Sørensen *in litt.*) and Tybrind Vig (Trolle-Lassen *in litt.*).

Due to the fragmented state of the archaeo-zoological material, only measurements of frequently-occuring skeletal elements have been included in the present study. The measurements defined below were taken on subfossil and recent material. The following six parameters have been measured according to definitions given by von den Driesch (1976):

Parameter 1: length of the lower third molar (M3)
Parameter 2: greatest length of the glenoid process of the scapula
Parameter 3: greatest breadth of the distal humerus
Parameter 4: greatest length of the astragalus
Parameter 5: greatest breadth of the astragalus
Parameter 6: greatest length of the fused calcaneus

The number assigned to each parameter is referred to in Table 1.

In order to achieve comparable results, only measurements of skeletal elements from adult roe deer should be included. Age analyses of archaeo-zoological material are generally based on eruption and wear of teeth and epiphyseal fusion (Payne 1972).

The length of the lower third molar (parameter 1) and the greatest length of the fused calcaneus (parameter 6) are considered to be age-independent since these measurements can only be taken on adult specimens (Payne 1972; von den Driesch 1976). Referring to recent roe deer, Noe-Nyegaard (1988) points out that the epiphyseal union of the proximal and distal ends of various bone elements takes place at different ages and that the same skeletal element may fuse at different times in the two sexes. As to the measurements of the scapula (parameter 2) and humerus (parameter 3) only ossified epiphyses have been measured. According to Davis (1981), increase in epiphyseal widths following ossification of the embryonic cartilaginous model is assumed to be minimal. Payne (1972) argues that it is unwise to use a measurement such as the length of the astragalus in investigating body size changes, as this bone is measurable from birth and grows substantially thereafter. Nevertheless, astragalus measurements have proved valuable in demonstrating temporal variation in roe deer (Boessneck 1956; Aaris-Sørensen 1976). As the astragalus lacks epiphyseal sutures, von den Driesch (1976) has suggested using the degree of compactness of this bone as a criterion of age. In the present study, measurements (parameters 4 & 5) were taken on astragali with hard shining surfaces. However, as von den Driesch (1976) points out, measurements of astragali of young specimens cannot be avoided altogether.

Skeletons of recent Danish roe deer were examined in the collections of ZMUC and the Game Biology Station, Kalø. In total, 31 female and 23 male adult roe deer were measured. The majority of these specimens were shot in Jutland. In the following, the sexes have been pooled as the degree of sexual dimorphism was found to be negligible (see Appendix).

The subfossil material cannot be sexed on the present available evidence.

A Mauser digital sliding calliper was used throughout the present study.

The molar measurement was taken to the nearest 0.5 mm whereas the measurements of the post-cranial elements were taken to the nearest 0.1 mm.

The subfossil and recent material were subjected to statistical analysis. The arithmetic mean ($\bar{x}$), standard deviation (s.d.), and 95% confidence limits of the mean (95%) have been computed as a means of estimating differences between samples. In addition, Dice-Leraas diagrams were constructed for all six parameters. These diagrams facilitate graphic comparison between samples derived from normally distributed populations and are useful for demonstrating temporal clines. Sample means whose 95% confidence limits do not overlap may be considered different at the 0.05 level of probability or below. In this way 95% confidence limits may be used as a partial replacement of Student's t-test. In cases of overlap, however, it is necessary to apply Student's t-test in order to establish whether differences between sample means are statistically significant. The statistical methods employed in this study follow Simpson *et al.* (1960) and Klein & Cruz-Uribe (1984).

	1.	2.	3.	4.	5.	6.	Chronoz.	Culture
Lundby I	4	17	12	11	11	4	Boreal	Maglemose
Lundby II (Rosenlund 1980)	0	6	6	0	0	0	Boreal	Maglemose
Maglemose	7	10	7	3	3	4	Boreal	Maglemose
Holmegaard V	1	2	6	1	1	2	Boreal	Maglemose
Sværdborg I-1917	4	18	35	21	21	10	Boreal	Maglemose
Holmegaard IV	2	10	10	6	6	5	Boreal	Maglemose
Holmegaard I-1922	7	15	17	7	7	2	Boreal	Maglemose
Holmegaard I-1923	1	2	1	2	2	1	Boreal	Maglemose
Sværdborg I-1923	3	51	36	28	28	11	Boreal	Maglemose
Sværdborg I-1943 (Aaris-Sørensen 1976)	0	0	0	26	24	0	Boreal	Maglemose
Sværdborg II-1946	2	0	1	1	1	2	Boreal	Maglemose
Ulkestrup Lyng Øst (Richter 1982)	0	1	4	5	5	1	Boreal	Maglemose
Villingebæk	0	4	3	0	0	2	Atlantic	Kongemose
Gislinge Lammefjord	1	2	3	0	0	1	Atlantic	Kongemose
Argusgrunden	0	0	0	0	0	2	Atlantic	Kongemose
Vedbæk Boldbaner (Aaris-Sørensen in litt.)	0	11	17	1	1	1	Atlantic	Kongemose
Maglemosegårds Vænge (Aaris-Sørensen in litt.)	2	1	1	2	2	4	Atlantic	Kongem./Erteb.
Henriksholm-Bøgebakken (Aaris-Sørensen in litt.)	1	5	3	1	1	1	Atlantic	Kongem./Erteb.
Maglemosegård (Aaris-Sørensen in litt.)	18	6	18	11	11	7	Atlantic	Kongem./Erteb.
Nivå	20	19	36	26	26	13	Atlantic	Kongem./Erteb.
Bloksbjerg*	5	28	14	17	17	14	Atlantic	Kongem./Erteb.
Godsted	3	11	3	15	15	15	Atlantic	Ertebølle
Bergmandsdal	1	0	1	0	0	1	Atlantic	Ertebølle
Salpetermosen	22	46	45	40	40	26	Atlantic	Ertebølle
Ølby Lyng*	0	5	1	8	8	1	Atlantic	Ertebølle
Flynderhage	0	12	2	0	0	3	Atlantic	Ertebølle
Dyrholmen	0	11	16	6	6	10	Atlantic	Ertebølle
Ertebølle 1893-97*	12	28	14	34	34	21	Atlantic	Ertebølle
Kråbbesholm	1	0	0	1	1	0	Atlantic	Ertebølle
Bjørnsholm	8	5	8	4	4	5	Atlantic	Ertebølle
Sebber	1	0	1	0	0	1	Atlantic	Ertebølle
Aamølle	0	0	1	6	6	2	Atlantic	Ertebølle
Fannerup*	1	1	0	1	1	0	Atlantic	Ertebølle
Kolind*	0	1	1	0	0	1	Atlantic	Ertebølle
Mejlgaard*	7	2	6	8	8	6	Atlantic	Ertebølle
Brabrand	0	0	0	0	0	1	Atlantic	Ertebølle
Ordrup Næs	0	0	0	1	1	0	Atlantic	Ertebølle
Klintesø*	6	16	8	7	7	6	Atlantic	Ertebølle
Faarevejle*	0	0	1	5	5	5	Atlantic	Ertebølle
Kassemose*	17	25	33	20	20	31	Atlantic	Ertebølle
Tybrind Vig (Trolle-Lassen in litt.)	5	2	4	3	0	2	Atlantic	Ertebølle
Havelse*	4	7	4	8	8	8	Atlantic	Ertebølle
Vester Ulslev	1	5	1	2	2	3	Atlantic	Ertebølle

Table 1. Mesolithic sites studied in approximate chronological order. Numbers 1-6 refer to measurements defined in the text. N = number of specimens.

*) In addition these sites may contain Early Subboreal material. However, in all border-line cases the bulk of the bone material derives from Mesolithic layers.

RESULTS

The Boreal sample is regarded as being representative of the continental Danish roe deer population, whereas data from the Atlantic chronozone subsequent to island formation have been divided into two geographically distinct samples, one from Jutland and the other from the Danish islands. In the following, the sample from Jutland will be referred to as the mainland Atlantic sample/population and the Danish island sample as the insular Atlantic sample/population. Dice-Leraas diagrams of the subfossil and recent material for parameters 1-6 are shown in Fig. 1. Accompanying descriptive statistics of the measurements are given in Table 2.

It can be seen that the mean values of the subfossil material in all parameters studied are greater than those for the recent material. This observation confirms that the roe deer during the Mesolithic period were larger than their present-day conspecifics.

In general, the pattern of change is very uniform in all six parameters. Applying the convention of the use of 95% confidence limits as a partial replacement of Student's t-test, it is noted that the Boreal sample in all cases differs significantly from the insular Atlantic sample. On

	N	range	x	s.d.	95%
1					
Boreal	31	14.5-17.0	15.84	0.64	0.23
Mainland Atlantic	30	14.5-17.0	15.77	0.75	0.28
Insular Atlantic	106	13.5-17.4	15.19	0.70	0.13
Recent	54	12.5-16.0	14.45	0.65	0.18
2					
Boreal	132	25.0-32.4	29.39	1.36	0.23
Mainland Atlantic	60	26.6-33.4	29.46	1.36	0.35
Insular Atlantic	193	24.5-30.6	27.77	1.27	0.18
Recent	54	23.1-30.3	27.08	1.19	0.32
3					
Boreal	135	25.9-32.0	29.13	1.23	0.21
Mainland Atlantic	49	26.7-32.0	28.68	1.20	0.34
Insular Atlantic	196	24.3-31.6	27.82	1.29	0.18
Recent	54	24.2-29.0	26.22	1.00	0.27
4					
Boreal	111	27.5-34.7	31.06	1.40	0.26
Mainland Atlantic	60	27.1-33.2	30.90	1.22	0.32
Insular Atlantic	167	26.8-32.4	29.44	1.25	0.19
Recent	54	25.8-30.4	27.84	1.01	0.28
5					
Boreal	109	17.1-22.3	19.65	0.90	0.17
Mainland Atlantic	60	18.0-21.6	19.76	0.87	0.22
Insular Atlanic	164	17.0-21.0	18.79	0.88	0.14
Recent	54	16.3-19.9	17.83	0.74	0.20
6					
Boreal	42	61.3-70.7	66.55	2.81	0.88
Mainland Atlantic	50	60.2-74.2	64.81	2.42	0.69
Insular Atlantic	143	55.7-68.5	61.29	2.68	0.44
Recent	54	54.8-65.8	58.66	2.28	0.62

Table 2. Parameters 1–6: Descriptive statistics. For details see text.

the other hand, only one parameter (greatest length of the fused calcaneus) shows no overlap between the Boreal and the mainland Atlantic samples. Thus the remaining parameters have been subjected to Student's t-test in order to determine the degree of significance between the sample parameters. The results of the t-tests are shown in Table 3. It appears that the comparison of the Boreal-mainland Atlantic samples may be considered different at the 0.05 level of probability in two parameters (greatest breadth of the distal humerus and greatest length of the fused calcaneus), whereas the Boreal-insular Atlantic samples differ significantly in all six parameters. Furthermore, the difference between the two geographically distinct samples of the Atlantic chronozone is significant in all six parameters.

	T	d.f.	P	result
Parameter 1	0.4043	059	>0.05	not significant
Parameter 2	0.3150	190	>0.05	not significant
Parameter 3	2.1743	182	<0.05	significant
Parameter 4	0.7346	169	>0.05	not significant
Parameter 5	0.7547	167	>0.05	not significant

Table 3. Selected t-tests: comparison between Boreal and mainland Atlantic sample parameters.

Summing up, it can be said that a gradual decrease in mean body size of Danish roe deer during the Mesolithic period has been ascertained in the Boreal – insular Atlantic samples. However, the Boreal – mainland Atlantic samples do not show the same reduction in mean body size. Since both Atlantic samples differ significantly from the present-day sample in all six parameters, the reduction in body size of roe deer continued into post-Mesolithic times.

DISCUSSION

In looking for factors underlying changes in mean body size of Mesolithic roe deer, an attempt has been made to correlate evidence of environmental changes with the observed size development of the species in question during the Boreal and Atlantic chronozones.

The isolation of the Danish islands from Jutland and Scania, which took place at the beginning of the Atlantic chronozone as a result of the Littorina transgressions, had an important bearing on the distribution and evolution of the terrestrial mammalian fauna (Aaris-Sørensen 1980). The changes in the land-sea configurations resulted in faunal impoverishment on the Danish islands, with the extinction of brown bear *(Ursus arctos)*, polecat *(Mustela putorius)*, badger *(Meles meles)*, lynx *(Lynx lynx)*, elk *(Alces alces)* and aurochs *(Bos primigenius)* during the Atlantic-Early Subboreal chronozones (Aaris-Sørensen 1980, 1985). In contrast to the situation on the islands, a continental Boreal-type of mammalian fauna was retained in Jutland and Scania during the Atlantic chronozone (Aaris-Sørensen 1980).

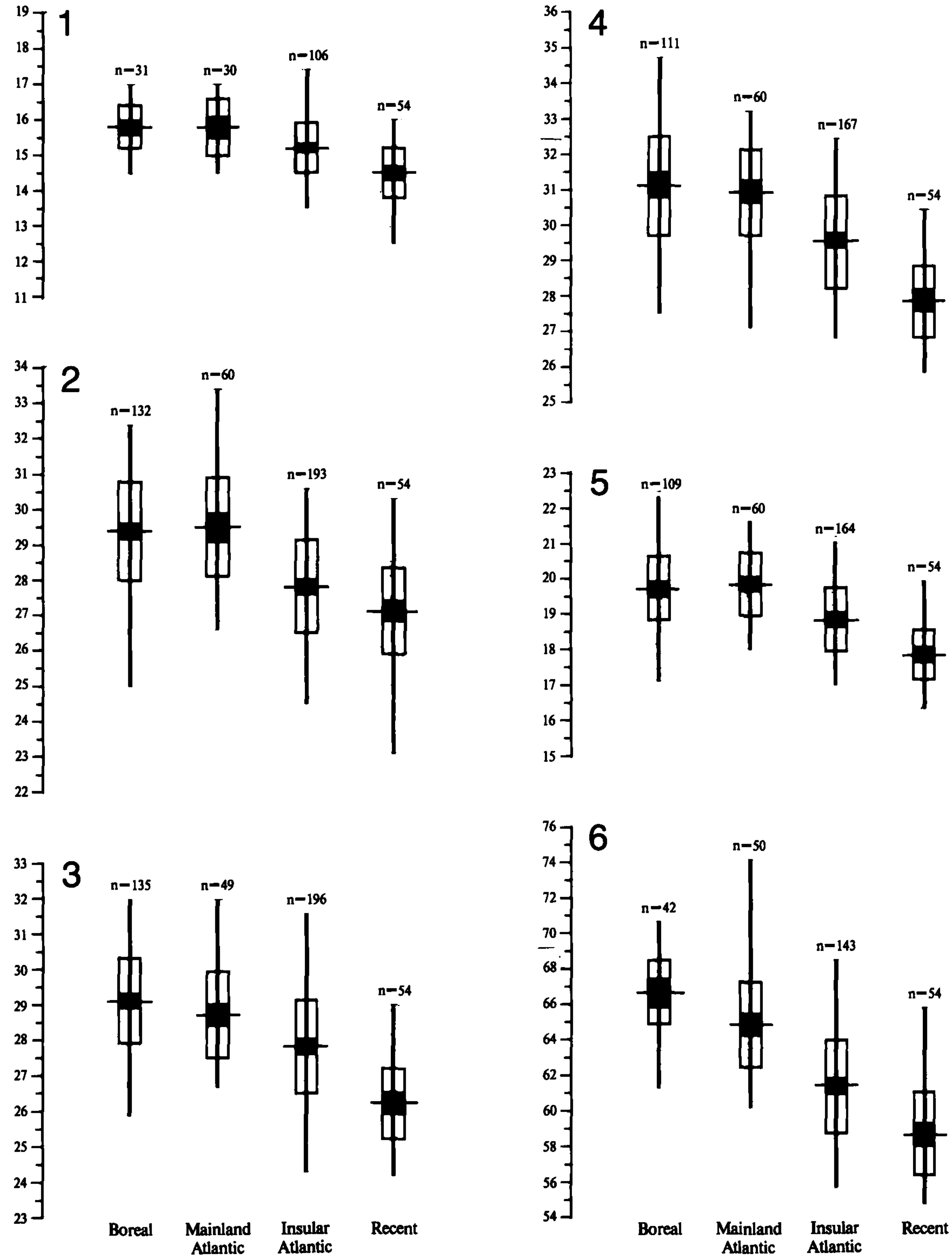

Fig. 1. Parameters 1–6: Dice-Leraas diagram showing temporal variation. For details see text.

Regional differences in mean body size of Mesolithic roe deer have been observed concurrent with the faunal impoverishment of the insular mammalian fauna. Although showing some fluctuations in two parameters, the body size of the mainland Atlantic population remained relatively stable compared to that of Boreal roe deer, whereas the insular Atlantic population experienced a marked decline in body size.

Foster (1964), in a study on body size trends of recent mammals on islands as compared to mainland conspecifics, noted that insular ungulates tend to become dwarfed. Foster suggested that all morphological changes of insular mammals are adaptive and that island adaptations are probably attained more rapidly due to the smallness of the gene pool and the restriction of gene flow from other populations. Foster envisaged limited food supply as a factor causing size decrease of mammals on islands. Kurtén (1965, 1968), working on size development of Late Quaternary mammals, suggested that insular dwarfing represents an adaptation which enables the maintenance of viable populations in spite of severe limitations in habitat and/or food resources. Similarly, Marshall & Corruccini (1978) stress that by decreasing body size, chances of survival through periods of environmental perturbations are significantly increased.

On the basis of the interpretation of Danish pollen diagrams Iversen (1973) proposed a general reduction in the alimentary base of the ungulates at the Boreal-Atlantic transition. The open hazel-pine woodlands of the Boreal provided abundant quantities of forage for ungulates, as opposed to the closed Atlantic climax forest, dominated by shade-tolerant deciduous tree species, which only offered favourable food conditions for wild boar *(Sus scrofa)*. According to this scenario, roe deer and red deer *(Cervus elaphus)* decreased in numbers, and elk and aurochs disappeared from the faunal record on the islands due to reduced availability of fodder. However, the decrease in population of the larger game animals during the Atlantic chronozone has been questioned by Aaris-Sørensen (1988). Moreover, numerous finds of roe deer and red deer remains associated with Kongemose and Ertebølle sites in Jutland and on the islands cast doubt on the validity of Iversen's (1973) assumption. It therefore seems that the postulated population decline of the two species is based on inconclusive evidence. Hence it follows that it is not possible to establish whether limited food supply was the main factor that triggered off the observed decrease in body size of the Boreal – insular Atlantic roe deer. A re-assessment of the potential environmental carrying capacity of the Atlantic climax forest is needed to clarify these matters.

It is well-known that changes in temperature through time may influence body size of mammals in agreement with Bergmann's rule. Several authors (*e.g.*, Kurtén 1965, 1968; Davis 1977, 1981; Klein & Cruz-Uribe 1984) have correlated the observed size decrease of a number of mammalian species to the Late Pleistocene – Holocene temperature elevation. Taking into consideration the marked size differential between the mainland and insular roe deer populations of the Atlantic chronozone, it seems most unlikely, however, that temperatures acted as a body size-determining factor in this particular case. The mean July temperatures during the period under review averaged 2 degrees Celcius above those of today, rising slightly towards the end of the Atlantic chronozone (Iversen 1944, 1973). The summer temperatures have been inferred from finds of mistletoe *(Viscum alba)* and ivy *(Hedera helix)* pollen (Iversen 1944) and from subfossil occurences of European pond terrapin *(Emys orbicularis)* and other thermophilous vertebrate species beyond their present-day northern limits (*e.g.*, Degerbøl & Krogh 1951; Iversen 1973; Aaris-Sørensen 1988). Although the July temperatures were stable during the Mesolithic period, the climate itself underwent changes. The Boreal was associated with a dry, continental climate, but as a consequence of the formation of the North Sea and the sea-level rise in the western Baltic Sea, humidity rose, resulting in an oceanic-type of climate at the beginning of the Atlantic chronozone (Iversen 1973). Whether the climatic changes during the Mesolithic period had any influence on the body size of roe deer is, however, doubtful.

Klein & Strandgaard (1972) studied differences in body size of recent Danish roe deer and showed that size is most directly related to population density. The largest deer today are those from areas with lower population densities, lower ratios of agricultural land to forest, and poorer soil fertility. The mechanisms by which population density influences body size are social pressure and intraspecific competition during spring and early summer. At this time, high quality forage is limited, but the dietary requirements of roe deer are greatest. Klein & Strandgaard also noted that the smaller European subspecies occur in association with intensive agriculture, abundance of food, and high population densities, unlike the Siberian subspecies, which are found in areas with more extensive forests and frequent food shortages, coinciding with low population densities. Extrapolating their findings backwards in time, Klein & Strandgaard suggest that size reduction in Danish roe deer took place after the introduction of agriculture. The latter brought about great increases in the abundance of forage and in turn led to greater population densities than those of pre-Neolithic times. Although the above model may hold true with regard to the reduction in body size during the Neolithic and later periods, it is considered unlikely that population densities were the decisive factor responsible for the observed body size trends of Mesolithic roe deer.

As a corollary, it is proposed that factors other than population density were involved in the regulation of the body size of roe deer during the period under consideration. Bearing in mind the geographical size differential in the Atlantic chronozone, the above discussion indicates that the body size of roe deer was not controlled by any one factor. At least, the environmental evidence does not support such a view. Thus, changes in body size of roe deer during the Mesolithic period should be viewed rather as a result of several environmentally-induced factors working together on the phenotype. Prevented from gene exchange with adjacent populations from Jutland and Scania, direct environmental stress due to the effects of insularity probably accounted for the size decrease of the insular Atlantic roe deer population.

Further studies on body size changes of other game animals recovered from Danish Mesolithic sites such as red deer and wild boar may reveal whether the observed geographical size differential of roe deer is an isolated phenomenon pertaining only to this particular species or whether it is a general trend.

Acknowledgements

The present work was submitted in 1989 as a partial fulfilment of a M.Sc. degree at the University of Copenhagen and carried out at the Zoological Museum (ZMUC).

I am grateful to my supervisor Kim Aaris-Sørensen for valuable comments in the course of the study. Tine Trolle-Lassen and Kim Aaris-Sørensen kindly placed their unpublished mensural data at my disposal. I am indebted to Dr Helmuth Strandgaard for permission to measure skeletons of recently-shot roe deer in the collections of the Game Biology Station, Kalø. I would also like to thank Arne Redsted Rasmussen for valuable discussions, Michael Andersen for helping with the statistical calculations, and Knud Rosenlund for technical assistance and encouragement.

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Appendix

Sexual dimorphism in recent roe deer *(Capreolus capreolus)*:

	Male (N=23)	Female (N=31)	Difference
M_3	14.54	14.38	1.1%
Scapula	27.31	26.90	1.5%
Humerus	26.56	25.96	2.3%
Astragalus 1	28.04	27.68	1.3%
Astragalus 2	18.16	17.58	3.2%
Calcaneus	58.81	58.22	1.0%

Difference between male and female means expressed as a percentage of male mean.

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Journal of Danish Archaeology vol. 10. 1991, pp. 59–96.

Bjørnsholm. A Stratified Køkkenmødding on the Central Limfjord, North Jutland

by SØREN H. ANDERSEN
with a contribution by KAARE LUND RASMUSSEN

INTRODUCTION

The Bjørnsholm shell-mound, or *køkkenmødding*, is located in the central Limfjord area in Northern Jutland (fig. 1). Today it is our largest *køkkenmødding* with levels of occupation from the Late Mesolithic Ertebølle and the Early Neolithic Funnel Beaker Culture. From 1985–1992 a series of excavations were undertaken, partially in the shell-mound and partially in the area behind it.[1] The following is a survey of the preliminary results of these new investigations, with special emphasis on the structure and stratigraphy of the *køkkenmødding*.

HISTORY OF RESEARCH

Denmark is one of the classic areas for prehistoric studies of shell-mounds – a tradition which goes back to the 1850's. One of the main areas in Denmark for *køkkenmødding* research is the central Limfjord in Northern Jutland. The oldest records in the National Museum are from 1837 and report on excavations in the Krabbesholm shell-mound. From 1893 to 1897 the large *køkkenmødding* at Ertebølle was investigated (fig. 2). It later became the type site, *locus classicus*, of this culture (Madsen *et al.* 1900; S. H. Andersen & E. Johansen 1987).

The Bjørnsholm site was partially excavated in 1931 by the National Museum (unpublished).[2] Subsequent to this investigation, an area of the best preserved southern and southwestern part of the *køkkenmødding* measuring 30×30 m was protected by law. The excavation produced a large number of artefacts, but the record lacks information as regards stratigraphy, etc. The site therefore only played a minor role in descriptions and discussions of the Ertebølle Culture and was only mentioned briefly in the literature (Brøndsted 1938:98, 333; Mathiassen 1940:40–41; Mathiassen *et al.* 1942:54–56; Becker 1947:99, 145, 149).

In the 1950s, two Neolithic graves, one from the Middle Neolithic and one from the Late Neolithic, were excavated by the National Museum to the west and southwest of the *køkkenmødding*.[3] Finally an Early Neolithic grave with a timber construction was found and investigated in 1988–89 (S.H. Andersen & E.Johansen 1992; S.T.Andersen 1992).

The main aims of the new investigations at Bjørnsholm were to get an up-to-date sample of the artefact assemblage, together with faunal remains in association with a well-defined stratigraphy and a cultural and chronological context, to obtain information on the site itself with regard to stratigraphy, structures, size and type of midden, the timespan it covered, and to determine the character of the settlement. A secondary aim was to compare Bjørnsholm with Ertebølle in order to answer the question whether there was any relationship between the two sites – the two largest Danish *"køkkenmøddinger"* – and if so, what the nature of this relationship was.

EXCAVATION PROCEDURE

The investigation started with a 1 m wide and 28 m long trench running through the thickest part of the shell-mound (the protected area) and perpendicular to the prehistoric beach. Later, additional squares and smaller sections were investigated, but it was not possible to open up larger squares within the protected area. Outside the protected area, to the rear of the *køkkenmødding*, c. 800 square metres were excavated in order to find traces of habitation (S. H. Andersen & E. Johansen 1992, fig. 17).

Most squares of the midden were excavated by following the stratigraphy and recording everything in a three dimensional coordinate system and with plans drawn for every 1–2 cm. Other squares were dug in 5 or 10 cm

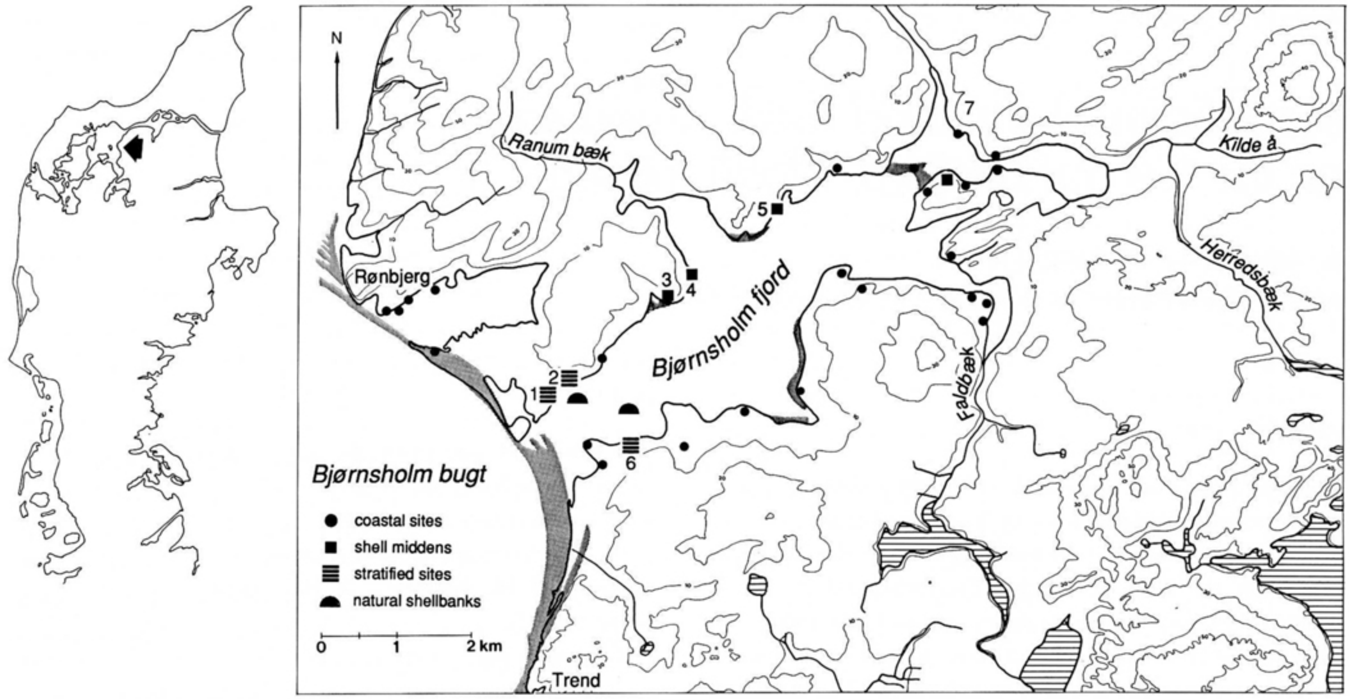


Fig. 1. The location of shell-mounds and other coastal sites in the Bjørnsholm Fiord: 1) Bjørnsholm. 2) Åle. 3) Siggård. 4) Østergård. 5) Egsminde. 6) Lundgård. 7) Trindbjerg.

horizontal layers. Finally a few square metres through the shell-mound were taken back to the laboratory as large column samples for later excavation and laboratory analysis by various specialists in Aarhus. All excavation was performed with extreme care and all the debris was sieved through a 2–3 mm mesh. Both wet and dry sieving were used, and flotation was used to retrieve charred materials from around the fireplaces for analysis. Samples for dating, scientific analysis, etc. were taken at several different locations, and in all excavated areas sections were measured and drawn.

As was the case with other Danish *køkkenmødding* excavations, the new investigations were performed by a group of archaeologists and scientists, *i.e.* a quaternary geologist, a botanist, palynologists, zoologists, icthyologists, and a specialist in marine molluscs and foraminifera. The present paper is a preliminary account of the results of this joint project.

The Bjørnsholm køkkenmødding

The *køkkenmødding* is situated on a headland facing south along the northern shore of a former fiord, which opens up into the modern Limfjord (figs. 1–2). Today the site lies between the contours for 5–6.5 m above present sea level, thus giving an impression of the geological uplift in this region since the Atlantic – Subboreal periods (K. S. Petersen 1985b:19). In the Stone Age the fiord was c. 8.5 km long, between c. 0.7 and 2.5 km wide and oriented NE–SW (fig. 1).

The shell-mound has the shape of a narrow rectangle c. 325 m long (NE–SW), c. 10–50 m wide (E–W), and up to 1.2 m thick. The greatest dimensions are at the southern end, where the various excavations have taken place (the protected area). From here, the mound gradually becomes thinner and narrower towards the north. The actual settlement area (as defined by flint scatter on the modern surface) is, however, much larger – c. 4–500 m long and c. 30–50 m wide, and it continues to the northeast in form of the Åle *køkkenmødding* which is c. 150 m long and c. 25 m wide (fig. 3). The Bjørnsholm complex (the Bjørnsholm and Åle *køkkenmøddinger*) is, therefore, the largest preserved shell-mound area in Denmark today.

The Bjørnsholm *køkkenmødding* is one of the *stratified* shell-mounds which are characterized by a series of lower, Mesolithic levels, belonging to the Ertebølle Culture, capped by Neolithic levels from the Funnel Beaker Culture. In this respect it is of the same type as Krabbesholm on the Limfjord (unpublished, but mentioned in S. H. Andersen 1991:25 and fig. 12), Norsminde in East Jutland (S. H. Andersen 1991), and Sølager on Zealand (Skaarup 1973:61–67).

Such sites are of special importance for the study of the Mesolithic-Neolithic transition – not only in Denmark, but in the whole South Scandinavian area. Because they are characterized by thick, stratified formations of shells with a rapid accumulation rate, they allow more detailed analyses of stratigraphy and chronology than other contemporaneous settlements. It is therefore possible, within the same controllable environment, to describe and "measure" the different types of changes from a hunting/gathering to a farming economy. The rapid accumulation rate also "seals" surfaces representing very short occupational phases. Activities which on other settlement sites are "blurred" by secondary habitation-phases, are preserved in the shell layers of the *køkkenmøddinger*, thereby offering the possibility of intra-site analysis such as refitting.

The Ertebølle settlement system in the Bjørnsholm area

The investigations have not concentrated on the Bjørnsholm *køkkenmødding* exclusively. On the contrary, the site has been studied *both* in its prehistoric, environmental context and as part of a larger Late Mesolithic/Early Neolithic settlement complex incorporating the fiord and the surrounding area (figs. 1–2).

Parallel with the new excavations, a large-scale survey of the whole coastal region of the northwestern part of Himmerland was initiated in order to obtain information about the Late Mesolithic and Early Neolithic settlements and settlement pattern. This survey has now been going on for several years and it is planned to continue for some years yet.

Today about 30 Late Mesolithic/Early Neolithic coastal sites have been registered along the shorelines of the former Bjørnsholm Fiord and the nearest surroundings. Of these, only 7 sites are *køkkenmøddinger* (fig. 1). The settlements are distributed all along the coastline, most sites being found in the fiord and along the north coast on promontories facing south and at river outlets.

Based on their topographical location several different types of coastal sites could be distinguished: 1) Settlements on beach ridges facing an exposed coast; 2) settlements on capes facing south – near the opening of the fiord; 3) as type 2 settlements, but in the central area of the fiord; 4) settlements at river outlets; 5) settlements on islands – either in the fiord or in more open waters. The largest site in this area is the Bjørnsholm *køkkenmødding* (fig. 1).

The fact that several of the *køkkenmøddinger*, including the largest of them, are located close to the mouth of the fiord is not accidental. It most probably reflects the position of the largest and richest natural shell-banks which were dependent on fresh, nutrient-rich water. As several of these sites show clear evidence of secondary marine erosion it is to be assumed that the number and size of the coastal sites (including *køkkenmøddinger*) and their size could originally have been greater.

A number of these settlements have been investigated, for example the three shell-mounds at Åle, Siggård, and Lundgård, and the Trindbjerg site (fig. 1). At three of these settlements stratigraphic sequences from the Late Mesolithic to the Early Neolithic were recorded, *e.g.* Bjørnsholm, Åle, and Lundgård – all of which are located close to the mouth of the fiord. All of the shell-mounds have been radiocarbon dated:

At Bjørnsholm the Ertebølle layers have been dated to 5050–4050 B.C. (K-5304, K-5068) – while the Early Neolithic phase is dated to 3960–3530 B.C. (K-5516, K-5721).

The Lundgård *køkkenmødding* has been dated to 4500 B. C. (K-5522).

The Åle *køkkenmødding* is dated to 4650–4580 B.C. (lower Mesolithic level) and 4230–4170 B.C. (upper Mesolithic level) (K-5061 and K-5060); the Early Neolithic level at this site has been dated to 3990 B.C. (K-5303).

The Siggård *køkkenmødding* is dated to 4890–4850 B.C. (lower Mesolithic level) and 4340 B.C. (upper Mesolithic level) (K-5521 and K-5520).

The large number of finds from the latter three sites have not yet been analyzed, but it is obvious that all the sites are smaller than Bjørnsholm and that they clearly reflect variations in both size and artefact composition.

Long-distance contacts between this area and the Continent are indicated by new discoveries: An Early Neolithic grave at Bjørnsholm containing, *i.a.* a stone axe-blade imitating a Central European copper axe (S. H. Andersen & E. Johansen 1992:46) and a new find of a typical Danubian shaft-hole axe at the Åle shell-mound is the first of this type from Northern Jutland (*cf.* Fischer 1982:10 and fig. 3). These finds clearly underline the importance of the settlements in this region compared to other Ertebølle – Early Neolithic settlements in Northern Jutland.

Environmental analysis: Geology

The geology of this area has been described by H. Gry and K. Strand Petersen (Gry 1979; K. S. Petersen 1976, 1985a and b, 1986 and 1987).

The subsoil consists of chalk which is covered by morainic clay (especially towards the north), while smaller, local areas particularly to the south are characterized by glacial meltwater sand and gravel (S. H. Andersen & E. Johansen 1992, fig. 2). The topsoil closest to the Bjørnsholm site is sandy humus (leached morainic clay). To the east the meltwater deposits also dominate around the fiord. It is probable that the fiord was originally a large freshwater lake (in the Late Glacial and Early Postglacial periods). Later – in the Early Atlantic c. 6800–5500 B.C. – the sea inundated the area and transformed it into a part of the Limfjord, the Bjørnsholm Fiord. From the Limfjord to the north there was access through the Hanherred out into the Skagerak and the North Sea. The region has risen at least 6 m since the Stone Age (Mertz 1924; K. S. Petersen 1979). Today the fiord is a relatively dry meadow, c. 3 m above modern sea level, filled by thick marine deposits, which to the east are covered by younger freshwater levels. The marine deposits contain shells of oyster *(Ostrea edulis)*, cockle (*Cardium* or *Cerastoderma edulis)*, mussel *(Mytilus edulis)*, and periwinkle *(Littorina littorea)*, even in the narrow easternmost parts of the fiord. At two locations, natural shell-banks have been found and radiocarbon dated (fig. 1). 1.25 km east of the Bjørnsholm *køkkenmødding*, a natural shell-bank has been investigated by K. Strand Petersen and dated to 2920 B.C. (K-5863), and on the seaward side of the Åle *køkkenmødding*, a shell-bank has given a date of 3250–3100 B.C. (K-5354). Food may very well have been collected on these banks in the Stone Age. Both in the Atlantic and Subboreal periods water in the fiord had a salinity and nutrient content such that oysters could live relatively far into it.

The entrance of the fiord and the whole beach region towards the Bjørnsholm Bay is characterized by a c. 0.5–2.5 km wide system of beach ridges running from Trend in the south to Rønbjerg in the north (figs. 1–2). Finds of *in situ* settlement sites from the Ertebølle Culture in these beach ridges indicate that they formed during the Atlantic period.

Towards the north, the area has a "natural" topographical limit at the narrow passage of the Limfjord at Aggersund situated 11–14 km away. Towards the south, at a distance of c. 4 km, the Trend river valley (also a fossilized Stone Age fiord) forms a natural topographical border (fig. 2).

Towards the west lie the waters of Bjørnsholm Bay and Løgstør Bredning, which together form the largest area of open sea in the Limfjord, with water depths ranging from 7 to 10 m. Here lies the island of Livø (7 km) with the reef Livø Tap (5 km), and further to the W-SW is the larger island of Fur (11 km).

In an easterly direction, the catchment area is naturally delimited by a hilly area c. 10 km away (fig. 1).

The *køkkenmødding* is located only c. 600 m from the entrance of the fiord and c. 300 m from the open sea (as the crow flies). The distance from Bjørnsholm across the fiord to the opposite shore is c. 1.25 km (fig. 1).

The shell-mound stretches NE–SW along the edge of a flat morainic hill which slopes gently downwards to the fossil fiord, and ends in a low slope – the prehistoric coastline, which lies between 4.00–5.50 m above sea level.

The *køkkenmødding* lies just above and follows this shallow cliff; its deepest part is between 4.80–6.50 m.a.s.l., while the surface is 5.40–6.60 m.a.s.l.

The area adjacent to the midden is a level plateau (7 m.a.s.l.) which gradually rises towards the N–NE (15 m.a.s.l.). It is first c. 2 km further to the north that the terrain becomes more hilly and reaches heights of c. 30–50 m. East of the fiord the surrounding areas are also level and flat; the surface rises very slowly to c. 10 m and it is first 5 km to the SE that the terrain becomes more hilly and reaches altitudes of c. 40–50 m. The transition from raised marine floor to dry land is gradual everywhere, but at some places marine erosion has formed steeper cliffs.

In the immediate neighbourhood of the *køkkenmødding* there are no river outlets today; the nearest is c. 2.5 km to the northeast (Ranum Bæk). Further to the east there are several larger rivers, Kilde Å, Faldbæk, and Herreds Bæk, of which Faldbæk (6 km to the east) and Herreds Bæk (9 km to the east), have connections to freshwater lakes (4–5 km SSE). However, this part of Himmerland is very poor in freshwater lakes, and they are all very small. Within a c. 10 km radius there is only one lake area (to the SE) (figs. 1–2).

There was ready access to good quality flint; in the immediate vicinity of Bjørnsholm, chalk bedrock with large nodules of flint is frequently found at the surface.

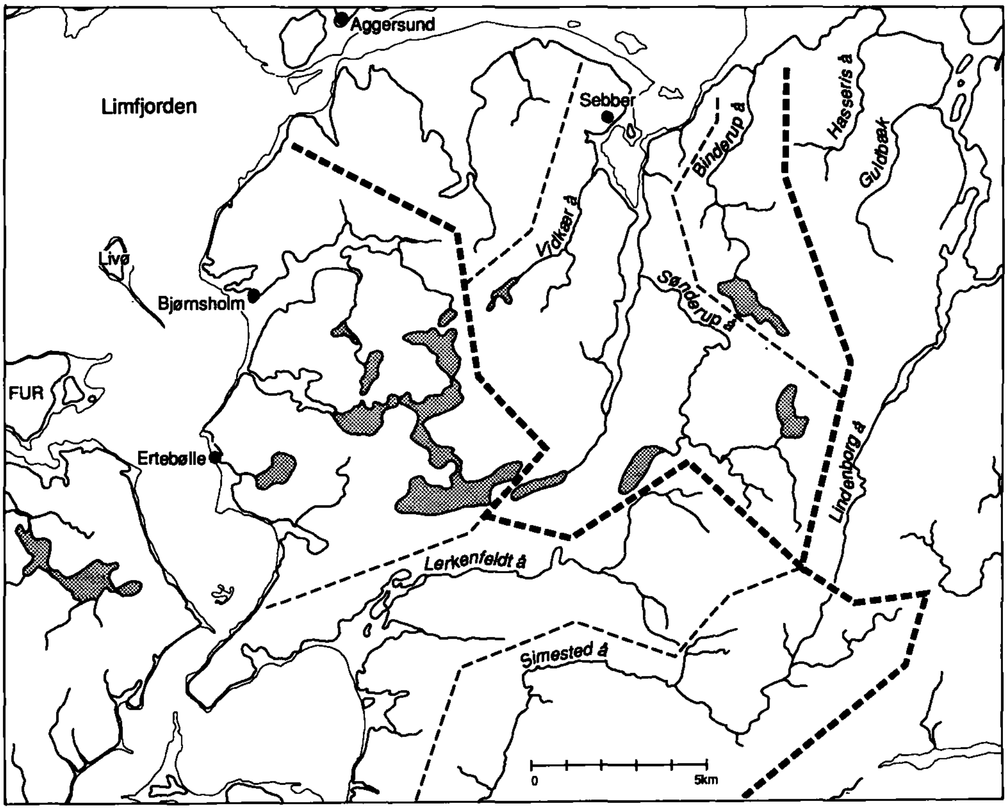


Fig. 2. The Bjørnsholm and Ertebølle *køkkenmøddinger* in relation to the freshwater drainage system in the northwestern part of Himmerland. Modern and Mesolithic coastlines are marked by a thin and a broad line, respectively. The larger water sheds are marked by a dotted line. – Elsebeth Morville *del.*

The environment during the Late Mesolithic

During the Atlantic period, c. 50% of the area within a 5 km radius of the Bjørnsholm site was open sea, c. 9% fiord and c. 40% was dry land (S. H. Andersen & E. Johansen 1992, fig. 1).

The coastline was relatively even; only in the central area were there larger bays. Nothing indicates the presence of islands, but maybe the shallow bank "Holmen" in the centre of the fiord was originally an island; which later was eroded. This was also the case at Ertebølle, where a similar topographic situation has been recorded (S. H. Andersen & E. Johansen 1987:33).

In the Stone Age the opening of the fiord was c. 1 km wide, but already in the Atlantic period it gradually became closed off by a large system of N–S running beach ridges (Gry 1979). It is clear that this gradual closing off of the fiord must have had effects on the local environment, but at present it is not possible to give a closer description of these conditions.

Erosion by the Littorina Sea is evident at several positions along the prehistoric beaches, but the cliffs are generally low compared to the more exposed coastal areas in the central Limfjord. The fact that some beach ridges are also found far into the fiord, especially where the coasts have been exposed towards the longest free distance (towards SW and W), is a good illustration of how strong wave action and currents were in this fiord, which was most probably also strongly affected by tidal action. It is not possible to determine the prehistoric water depth. As the whole region has risen c. 6–7 m since the Stone Age it is reasonable to assume a depth equal to, or exceeding this.

The many river outlets in the eastern part of the fiord open up the possibility for seasonal movement of ana- and catadromous fishes. The fact that all these rivers had their outlets in the fiord must have caused a mixing of the sea water with, and dilution by, freshwater from land drainage. This must have influenced the environment, such that sea-water was more brackish to the east. This hy-

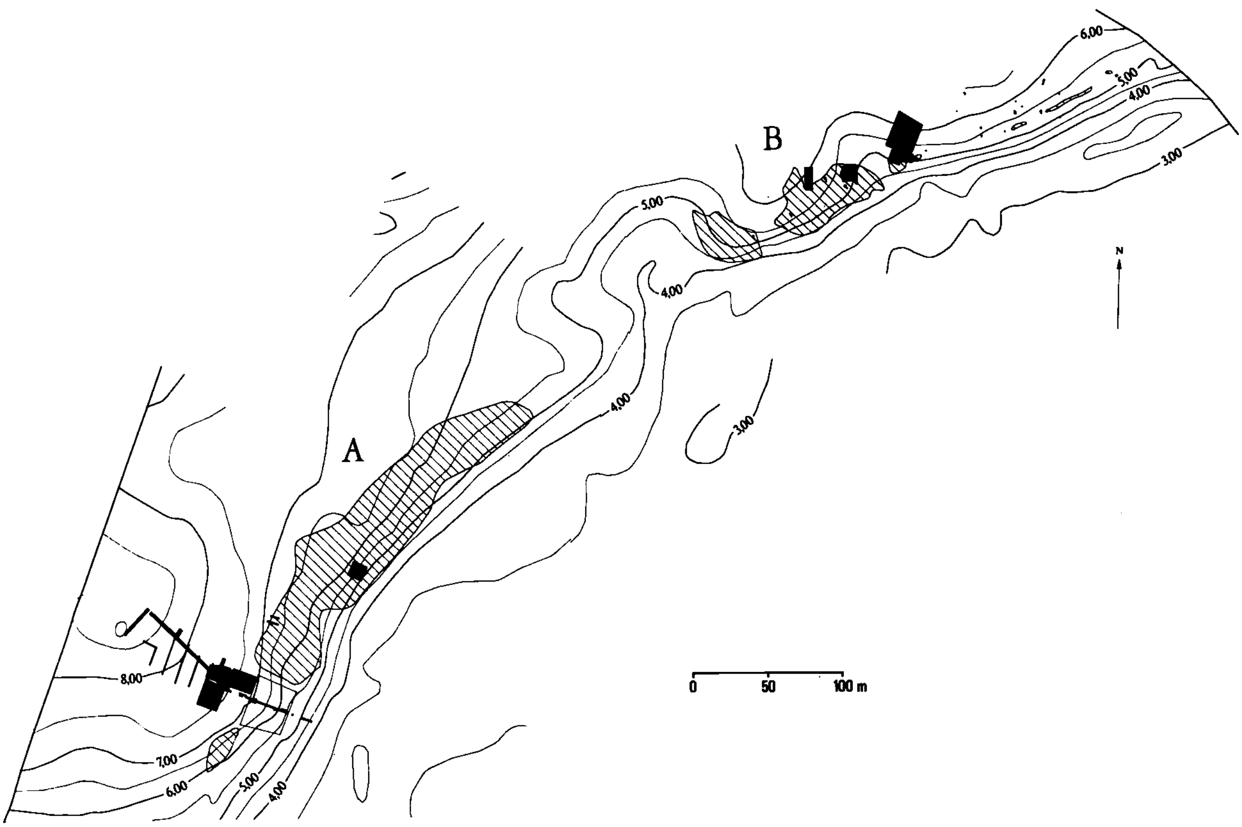


Fig. 3. Contour map showing the Bjørnsholm (A) and Åle (B) *køkkenmøddinger* situated along the prehistoric coastline. Areas on dry land with worked flints are shaded. Excavated areas are shown in black. – Jan S. Carlsen *del.*

pothesis is supported by investigations of oyster shells from the *køkkenmøddinger* at Bjørnsholm and Siggård. The oyster shells from the Siggård site, which is located c. 2.5 km further into the fiord, are both substantially smaller and thinner than the contemporary oyster shells from Bjørnsholm – an indication of less favourable living conditions for this species at Siggård.[4]

The Bjørnsholm fiord was an estuary during the Atlantic period. Estuaries are regarded as being the coastal habitat type having the highest biomass production (Paludan-Müller 1979:124). This probably explains why there were so many settlements in these areas in the Atlantic and Early Subboreal periods, and why the settlements were so large. We may thus assume that the Bjørnsholm fiord in the Stone Age was an estuary with a high biological productivity. The numerous layers and banks with marine shells – even at the far eastern end of the fiord – demonstrate that there was an ample exchange of fresh sea-water with the open Limfjord.

The coastal climate in the Atlantic period is generally described as moist and temperate with a mean summer temperature of 20°C and a mean winter temperature of 1°C, which is higher than today (Iversen 1967:407). The higher temperature and the greater salinity of the sea-water due to stronger tides, created very favourable living conditions for components in the marine food chain. The local wind conditions have also played a role in determining the local habitat. The area around Bjørnsholm is exposed to the Limfjord and the North Sea to the west and north, and this area must have been much more exposed to storm and wind than for example the east coast of Jutland.

As for vegetation, pollen analysis has not yet been completed. However, the analysis of charcoal from the Mesolithic *køkkenmødding* suggests a landscape covered by oak *(Quercus)*, hazel *(Corylus)*, apple family (apple, rowan, thorn) *(Pomoidea)*, willow *(Salix)* , elm *(Ulmus)*, and birch *(Betula)*, with oak as the absolutely dominant species (c. 70%).[5] This vegetation reflects an environment and climate which may have been similar to the modern assemblage seen today around this part of the Limfjord.

Animal life is also well represented, as documented by the list of fish species from the 1931 excavation (Rosenlund 1976:29)[6] and by the new lists of species by B. Bratlund (1993, this volume) and I. B. Enghoff (1993, this volume).

The position of the Bjørnsholm site was ideal. Within a 10 km radius of the settlement several different resource types were present: Open coast, islands, beach ridges, narrow straits, freshwater, river outlets and dense forest.

Investigations behind the køkkenmødding

Due to the large numbers of artefacts recovered, earlier Danish *køkkenmødding* excavations have concentrated exclusively on the shell deposits themselves, while the surrounding areas were not investigated. It has not, therefore, been possible to determine whether a shell-mound was to be regarded as the actual settlement site or whether it was simply part of a settlement, being the waste area or "midden".

In order to shed light on this question, it was decided that the area behind the Bjørnsholm *køkkenmødding* should be investigated. This area was chosen because the flat plateau just behind the shell-mound seems well suited for habitation (fig. 1), and because surface reconnaissance revealed Mesolithic flint on the surface up to c. 15 m behind the shell-mound. The latter indicates that activities *had* taken place, although the frequency of finds was not very high.

After scraping away the plough soil from an area of c. 800 m^2 it was clear that a primary cultural layer was present in the area immediately to the rear of the central and thickest part of the shell-mound (the protected area). It was possible to follow this layer continuously from the edge of the shell-mound up to c. 10 m west of the mound and over a distance of 20 m N–S. Outside this area two smaller clusters with flint and potsherds of Early Neolithic origin were recorded (S. H. Andersen & E. Johansen 1992:55, fig. 17). The layer was c. 20 cm thick and consisted of black sandy earth with charcoal, shells lying scattered and in heaps, some fire-cracked stones, many flint tools and flint debris, pottery, and a few animal bones. It was evident that this thick cultural layer represented several occupations, but it was not possible during excavation to distinguish any separate units. However, the vertical distribution of typical artefacts clearly demonstrated that the lower part of the layer was dominated by Ertebølle artefacts, while the upper level was characterized by Early Neolithic material. In the topmost level of

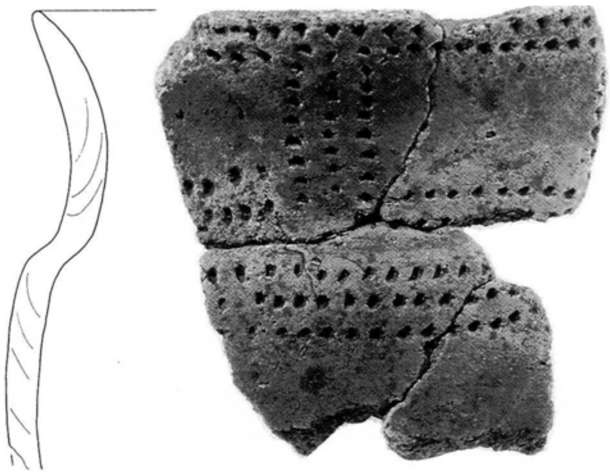


Fig. 4. Fragment of an Early Neolithic funnel beaker from the cultural layer to the rear of the *køkkenmødding*. 1:2. – Photo P. Dehlholm.

this layer, some scattered finds from the early Middle Neolithic Funnel Beaker Culture also appeared. After removing this cultural level, several postholes and some small pits were observed in the subsoil, but unfortunately they formed no recognizable pattern.

In terms of the horizontal distribution, the finds reflect diffuse flint concentrations measuring 3–4 by 3–4 m. At present this material has not yet been sufficiently analyzed as to reveal the true nature of these clusters. However, it is reasonable to assume that this cultural layer represents occupation of the site – first by people of the Ertebølle and later by people of the Funnel Beaker Culture.

Among the many potsherds found in the Early Neolithic level in this area was a fragment of a funnel beaker decorated with series of dots forming a chequered pattern (fig. 4). A small funnel beaker with a similar type of decoration is known from the Early Neolithic level in the nearby shell-mound (fig. 30). Such ornamentation is very rarely found on Early Neolithic funnel beaker vessels in Denmark; a related sherd is known from the Early Neolithic site Siggeneben Süd in Holstein (Meurers-Balke 1983, taf. 23 no. 8).

As regards the Ertebølle occupation, it is very difficult to ascertain the nature of this cultural layer. Both its vertical and horizontal extent (and its thickness) seem very restricted. This is contrary to what one would expect, when taking the size and thickness of the midden layers into account. A similar situation was observed at Ertebølle. The excavation behind the Ertebølle *køkkenmødding*

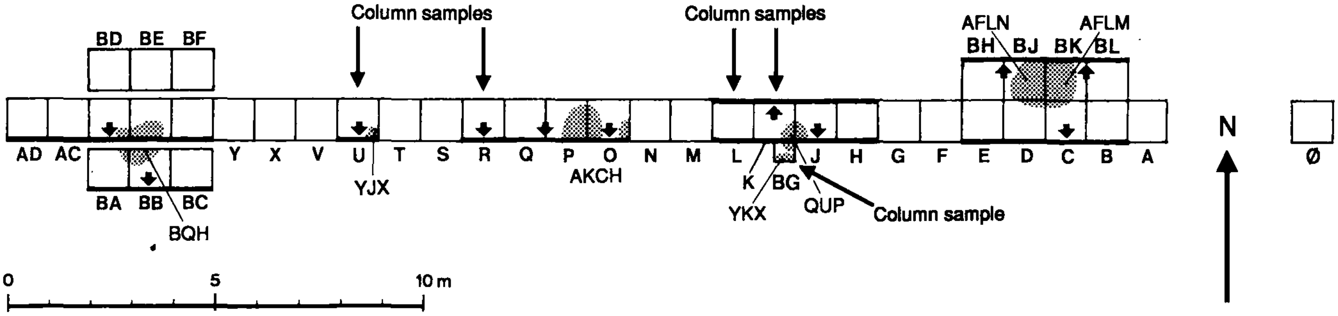


Fig. 5. The excavated trench through the *køkkenmødding*. Hearths in the Mesolithic shell layer are marked by shading. – Sv. Kaae *del*.

revealed only few sporadic traces of habitation, one of which was a flint knapping area measuring 15 by 6 m (S. H. Andersen & E. Johansen 1987:35–40).

Marine erosion could be an explanation for the lack of substantial settlement structures from the *Ertebølle period* to the rear of the midden, these having been washed away during the Late Atlantic transgression. Such heavy erosion *is* possible but does not fit observations made at the shell-mound, which has an undulating surface and is not covered by any marine sediments, despite the fact that it was situated 1–2 m lower than the plateau behind it.

It is more likely that traces of structures are absent, either because no large scale activity took place there, or because activities were simply of a type which were not preserved in the archaeological record.

As regards the *Early Neolithic* habitation, the pattern of finds at the Bjørnsholm site indicates a settlement area with an associated *køkkenmødding* situated c. 20–40 m away at the seashore.

At the Norsminde shell-mound, where no marine erosion has taken place, the same observations were made: No traces of Ertebølle occupation outside the area of the shell-mound were documented. On this site – just like at Bjørnsholm – an Early Neolithic habitation area was discovered on higher, drier ground c. 50 m from the midden on the beach (S. H. Andersen 1991:17).

Fig. 6. Section SPH through the *køkkenmødding*. South section of square K. Compare with the section on fig. 9. – Photo E. Johansen.

Stratigraphy of the køkkenmødding

The base and surface of the midden is plane and slightly curved and follows the sloping subsoil towards the east. The delineation of the *køkkenmødding* is well defined in all directions – especially to the east, where it is abrupt and bears clear evidence of secondary marine erosion.

In the excavated section, the maximum thickness of the *in situ køkkenmødding* is c. 1.2 m, and the cross-section (E–W) is lenticular/semi-circular (fig. 7). The greatest thickness is in the centre and the eastern end of the trench (down towards the prehistoric beach). To the west the midden gradually fades out, and over large areas it is only 10–20 cm thick; the shell layer finally disappears 5–6 m west of the protected area (fig. 7).

The subsoil (layer 6) consists of chalk with a covering layer of 1–3 m of chalky morainic clay – of which the top level (0.5 m) is more sandy because of secondary outwash of the clay particles. The western part of the *køkkenmødding* is deposited upon this sandy morainic clay, while the central and eastern part rests upon marine sand and

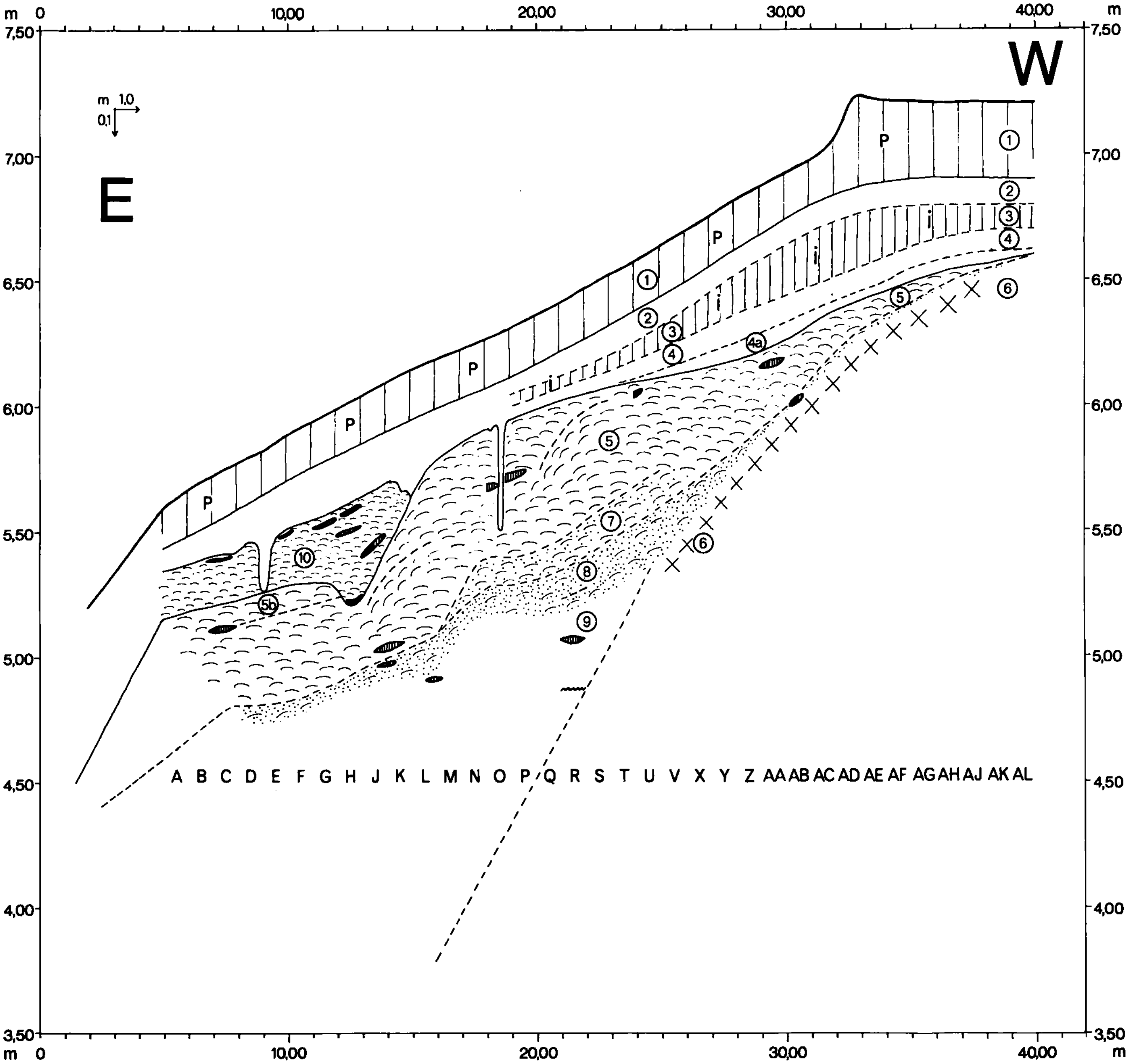


Fig. 7. Section (E–W) of the Bjørnsholm *køkkenmødding*. – 1) Modern plough soil. 2) Brown earth. 3) Iron Age cultural layer. 4) Brown, sterile sand. 4a) Black sand with gravel, flints, and pottery. 5) Mesolithic/Ertebølle *køkkenmødding*. 5b) Ertebølle shell-mound with sand and crushed shells. 6) Subsoil, morainic, sandy clay. 7) *Køkkenmødding* with many marine molluscs. 8) Black sand with cultural remains, i.e. flints and bone. 9) Marine sand with marine molluscs and water-rolled flints and bone. 10) Neolithic *køkkenmødding*. Metres are given above modern sea level; hearths are shaded. Elsebeth Morville *del*.

gravel (layer 9), formed after an erosion of the morainic deposits. In square U it is possible to follow this marine sand up to a level of c. 5.4 m above present sea level, where a small slope is to be found. Compared with other observations from the Limfjord area, for example at Ertebølle, it is most likely that this erosion took place during the Early Atlantic or at an early stage of the High Atlantic transgression (S. H. Andersen & E. Johansen 1987:41–

42). The same sea level has also been documented at another, more northernly position in the Bjørnsholm midden, and at the Lundgård site on the opposite shore of the fiord (fig. 1).

A radiocarbon date for shells from the highest level of the marine sand was 5050–5000 B.C. (K-5304) probably a *post quem* for the final stage of this sea level. Intermixed in this marine sand layer are several 2–5 cm thick horizontal layers of more coarse grained sand, gravel and small stones, water-rolled and patinated flint debitage and flint tools, a few animal bones, shells, and fragments of marine molluscs – predominantly oysters, cockles, and mussels. One of these levels is a c. 10 cm thick layer characterized by many shells and shell fragments of marine molluscs – most probably a redeposited shell-mound; this layer (layer 8) has been radiocarbon dated to 4770–4730 B.C. (K-5071). Collectively, this material demonstrates that these layers are either part of an older *køkkenmødding* redeposited by the sea or "waste" from a nearby site.

In squares L and R two small hearths built of stones were encountered in the sand – indicating that the layer was periodically dry enough for habitation. Artefacts from the marine sediments which belong to the Early Ertebølle Culture, are in accordance with the radiocarbon dates which demonstrate that the deposition took place during the High Atlantic transgression.

After this time the sea gradually receded to a level of c. 4.3 m.a.s.l., which is the basal level of the lowest part of the shell-midden. During this process more sand was deposited (layer 7) – black sand with a high content of charcoal powder and mixed with scattered shell fragments, flint debris and tools and fire-cracked stones. This level (10–20 cm thick) is only found in the central area of excavation and measures c. 9 m (E–W). It is obviously a cultural layer – still very close to the sea-shore. The stratigraphic position clearly indicates that it represents the oldest *in situ* occupation level at Bjørnsholm; it is radiocarbon dated to 4670–4620 B.C. (K-5070).

Similar cultural layers below the shell-mounds have frequently been observed at other Ertebølle sites; they always represent the first habitations which are without shell deposits, *e.g.* the *køkkenmøddinger* at Ertebølle (S. H. Andersen & E. Johansen 1987: 41–42) and Norsminde (S. H. Andersen 1991:20).

In the central part of the section there then follows a c. 10 cm thick sand layer, which is a mixture of shells and fine sand with flint tools, flint debris, and animal bones. The content is clearly dominated by shells and fragments of shells and is very similar to a "normal" *køkkenmødding*. The presence of relatively large quantities of sand in this layer may either be explained by the fact that the sea was still very close to the settlement or it may be due to secondary wind and water transport of sand from higher ground to the west.

On top of this layer the accumulation of the *køkkenmødding* took place – both in an eastern and western direction (layer 5). The midden was deposited on dry land; no levels of marine sand and/or gravel and water-rolled shell material were observed in the shell-mound – as was the case at Ertebølle (S. H. Andersen & E. Johansen 1987: 41–42).

The shell-mound seems to have expanded from the central area (*i.e.* around square R), where the deepest level is dated to 4650–4580 B.C. (K-5069). In the squares AB (towards the west) and L (towards the east) the deepest levels of the *køkkenmødding* are younger, 4350 B.C. (K-4689) and 4340 B.C. (K-4945) respectively.

The *køkkenmødding* could be divided in two main sections, layer 5 constituting the lower, and layer 10 the upper shell-mound (fig. 7).

The lower *køkkenmødding* is found through the entire excavation area and has a thickness of c. 70 cm in the central area from where it becomes thinner towards the east and west. Based on topographic and stratigraphic criteria the shell-mound layer could be divided into at least three fairly well-defined areas centred around hearths.

The shell-mound consists of a mixture of shells and fragments of shells of marine molluscs, mainly large oysters *(Ostrea edulis)*, cockles *(Cerastoderma edulis)*, mussels *(Mytilus edulis)*, periwinkles *(Littorina littorea)*, and *Nassa reticulata*. The most frequent type of mollusc is the oyster (up to 60–80%). Marine shells are the dominant component of the shell-mound, which also contains sand, flint debris, flint tools, fire-cracked stones (cooking stones), animal bones – in particular fish bones, charcoal, some potsherds, and many natural stones of varying sizes. The flints are not water-rolled, having sharp edges and being unpatinated.

The large number of natural unworked stones (normally 3–8 cm in diameter) in the layers is difficult to interpret, but they may be sinkers for fishing nets or they may indirectly reflect activities such as the collecting of seaweed.

During the excavation it was observed that the oyster

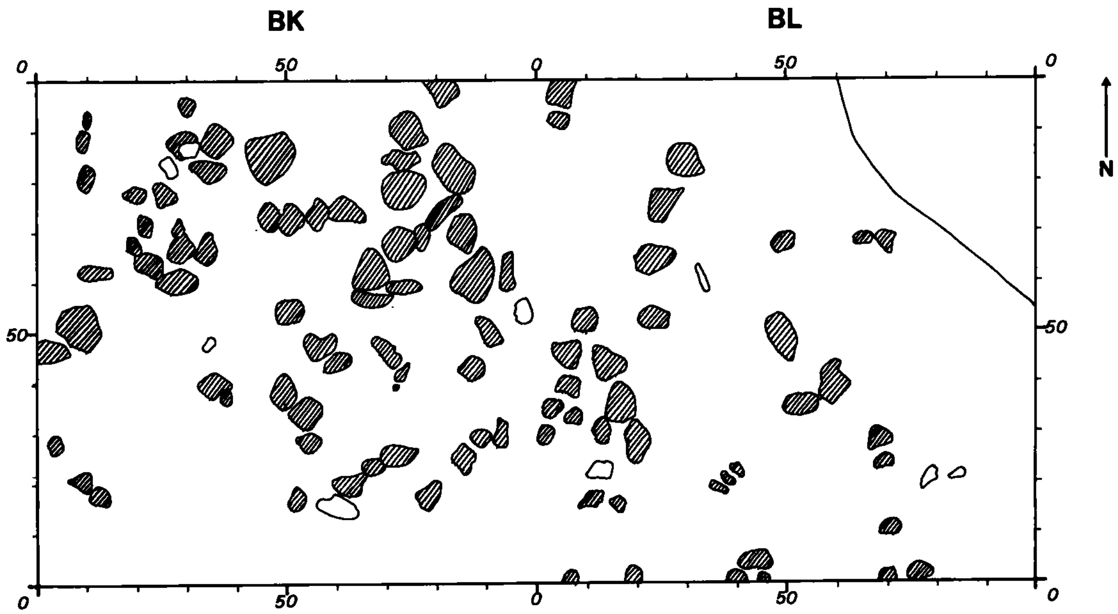


Fig. 8. "Dump" of cooking stones in the Early Neolithic level.

shells became smaller from bottom to top through the sequence in several squares (K and BH-BJ).

Hearths, layers of ash, and a few larger stones were also found.

In the eastern squares the shells of the uppermost 10–20 cm of the lower *køkkenmødding* are more crushed than those which lie below, and they are not so uniformly deposited in a horizontal manner (fig. 7, layer 5b, and fig. 10 left, layer 14, section AFZJ). In addition, the shells are mixed with more sand than in the lower levels of the shell-mound. This level could be an erosion level, or it may represent a surface of the shell layer which was exposed for a period.

The upper shell-mound is situated directly upon the lower levels in the central and eastern part of the section where there is a distinct boundary. This observation suggests that the layers must have been deposited at a steady, continuous rate. However, it is impossible to prove that there was no hiatus between the lower and upper shell layers. If such a hiatus existed, it must have been a very short break in deposition.

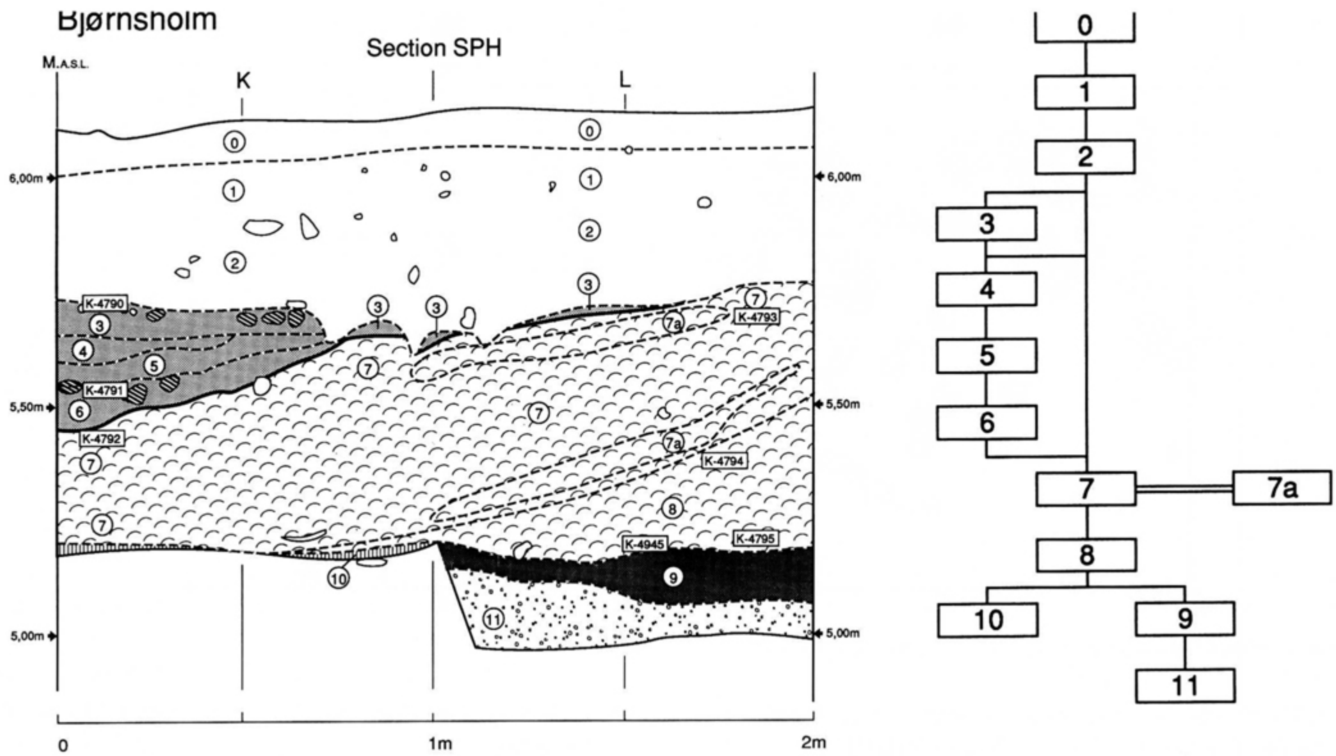
The upper shell-mound (fig. 7, layer 10) is only observed in the eastern and central part of the trench. Therefore, the width of this level is only measured as being 10–12 m in an E–W direction, the thickness being 20–40 cm. However, the layer extends horizontally over a long distance along the prehistoric coastline. Towards the NE, c. 100 m from the trench, an identical stratigraphy was recorded.

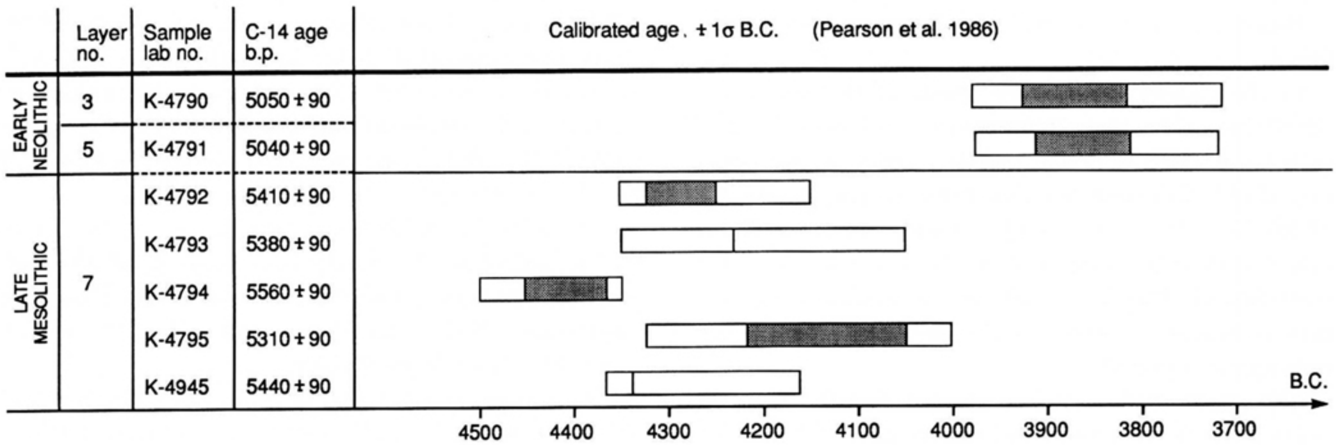
This younger shell-mound consists of a series of thin, alternating horizontal layers of black, sandy material, divided by layers of grey ash regularly intermixed with levels of shells, abundant shell fragments, charcoal, many burnt shells and fire-cracked stones (cooking stones). All these layers are only 1–5 cm in thickness. They contain some flint tools and debris (but less than in the lower layers), abundant fire-cracked flint, many potsherds, and some animal bones. The flints are not water-rolled and unpatinated. This layer of the shell-mound is also an undisturbed and *in situ* deposit.

The number of ash layers lies between 3 and 5, probably representing a similar number of occupational episodes. At Norsminde the number of ash layers was between 5 and 6 (S. H. Andersen 1991:23).

The cooking stones can be divided in three classes: Sandstone, quartzite, and granite. They clearly differ from the fire-cracked stones in the lower part of the shell-mound in being smaller and much more cracked. The cooking stones are very often found in heaps, usually measuring c. 1 m in diameter, and are most likely "dumps" from cooking activities (fig. 8).

In contrast to the lower shell-mound, the layers of the upper mound are generally dominated by shells of (small) cockles (*Cerastoderma edulis*), mussels (*Mytilus edulis*), and





	Layer no.	Sample lab no.	C-14 age b.p.
EARLY NEOLITHIC	3	K-4790	5050 ± 90
	5	K-4791	5040 ± 90
LATE MESOLITHIC	7	K-4792	5410 ± 90
		K-4793	5380 ± 90
		K-4794	5560 ± 90
		K-4795	5310 ± 90
		K-4945	5440 ± 90

Fig. 9. Left: Section SPH; south section of squares K-L. Laboratory numbers of radiocarbon samples are marked. The Early Neolithic level is shaded. – Right: Harris matrix of the section. – Bottom: Radiocarbon dates of section SPH. All dates are for oyster shells. – Elsebeth Morville *del.*

periwinkles (*Littorina littorea*). Because many of the cockles are very small (obviously too small for eating), it is highly possible that some of the components in these levels could be natural deposits in the form of beach ridges of shells. However, the content of oysters is also very high, and in several squares the layers are dominated by this species, like in the lower shell-mound. The content of oyster shells in the upper part of the Bjørnsholm shell-mound is clearly higher than in the contemporaneous, Early Neolithic *køkkenmødding* at Norsminde (S. H. Andersen 1991:23, 28 and fig. 23), where the cockles show absolute dominance.

The top level of the shell-mound sequence is a 1–1.5 cm thick level of compressed oyster shells.

The oldest part of the Neolithic shell-mound seems to have been located towards the west from where it grew towards the east where it has been secondarily eroded by the sea.

Above the Neolithic shell-mound there follows to the west a c. 10 cm thick layer of black sand rich in charcoal with many small stones (gravel), flint tools, flint debris, and potsherds (layer 4a). This layer could be followed up to c. 6.6 m.a.s.l. and probably represents a marine transgression after the deposition of the upper shell-mound. A layer of this kind, situated at this level, may have been deposited due to the Subboreal transgression, an interpretation which is in accordance with observations at Ertebølle (S. H. Andersen & E. Johansen 1987:39,43), Aggersund (S. H. Andersen 1979a:8–9), and other locations in the Limfjord region (K. S. Petersen 1979). Above this layer lies a 10–30 cm level of brown, fine-grained sterile sand – most probably windblown sand and humus from the higher areas to the west (layer 4).

Above this sand layer there is a 10–20 cm thick cultural level of black, fine-grained sand with abundant pottery, charcoal, and occasional layers of yellow clay (layer 3). The finds and features associated with this layer indicate that it is a cultural level with house floors belonging to a village from the Late Pre-Roman Iron Age. The Iron Age level is stratigraphically separated from the lower *køkkenmødding* by the sand layers 4 and 4a. From this Iron Age level several postholes penetrate the lower sand and shell layers and continue down into the subsoil. These later intrusions in the shell-mound were easily recognizable during the excavation, and did not cause any problems.

The top layer (layer 2) is a brown, fine-grained sterile sand level with a high humus content, which gradually becomes thicker towards the west.

Layer 1 is the modern plough soil.

Interpretation of the stratigraphy

The Bjørnsholm site is characterized by the following stratigraphy from bottom to top: The subsoil is a sandy morainic clay which has been eroded by the Early or High Atlantic transgression. During the regression, marine sand with redeposited cultural material belonging to the Early Ertebølle Culture was deposited. This sand forms the base under the central and eastern part of the midden. After the sea receded and the sand became a dry beach, intense activity took place, as indicated by a high concentration of charcoal, flints, bone, ash, and cooking stones. Shortly after, c. 4600–4500 B.C., the *køkkenmødding* started accumulating. About 4400–4200 B.C. the *køkkenmødding* increased rapidly both horizontally and vertically.

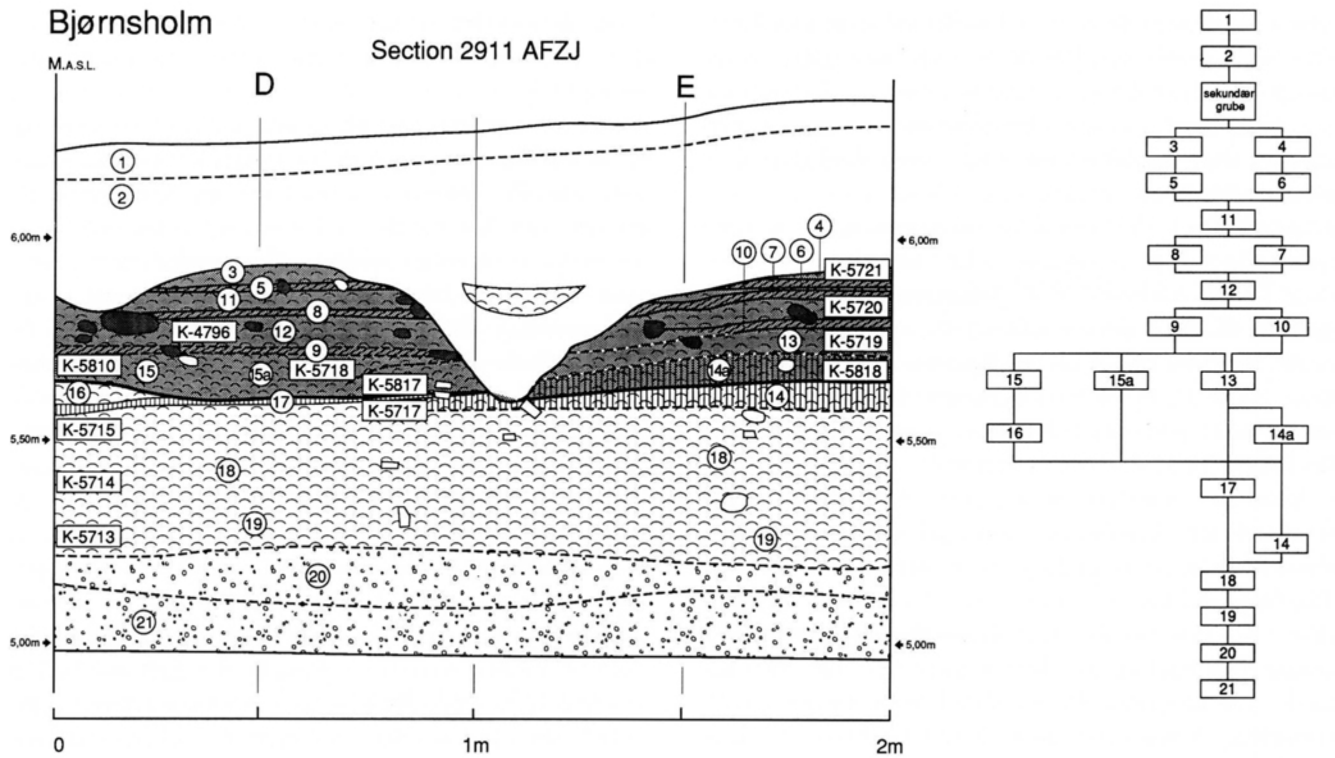
The *køkkenmødding* is made up of a lower series of shell layers, dominated by oysters, capped by an upper midden dominated by cockles, black sandy earth, and cooking stones. The lower shell-midden was deposited during the regression between the High and Late Atlantic transgressions, but we only find few traces of flooding of the lower midden. After the deposition of the upper shell layer the sea again flooded the site, thereby causing erosion on the plateau behind the midden. This resulted in the black sand and gravel layer covering the western part of the *køkkenmødding*. This transgression layer is followed by brown, sterile sand. Later, the sea withdrew and eroded the eastern edge of the midden. Finally the sea floor in front of the settlement gradually became transformed into a brackish bog. On dry land a cultural layer belonging to an Iron Age settlement was deposited, and finally, the site was buried under a thick deposit of sandy earth.

In an attempt to gain an impression of the stratigraphy and to locate a "waste" area in front of the site – something which is common at many Danish Mesolithic sites, both inland and coastal, *i.e.* Ringkloster, Tybrind Vig (S. H. Andersen 1975, 1985), etc. – a 19.4 m long (E–W) trench was excavated in the sediments in front of the site. However, all that was found were scattered animal bones and water-rolled and patinated flints of younger Ertebølle types, imbedded in marine sediments of sand and gravel. Above this there was freshwater peat with potsherds and the remains of a stone-built road dated by potsherds to the Early Iron Age.

The explanation for the lack of such a "waste" area at Bjørnsholm is most probably to be found in the topographic position of the site, which is very close to the opening of the fiord and in front of a long free stretch of open sea (towards the southwest). The site has therefore been exposed to wave action and sea currents etc., all of which would have washed away any waste dropped into the sea in front of the site.

The stratigraphy of the Bjørnsholm *køkkenmødding* is in most aspects similar to the sequence at Ertebølle, but we lack clear traces of The Late Atlantic transgression, and no marine layers were observed in the Bjørnsholm shell-mound such as was the case at Ertebølle. This is probably a reflection of the different topography at the two sites: The Ertebølle site was located on a lagoon facing a more exposed and open coast than that at Bjørnsholm, which lay in a more sheltered estuary/fiord.

Another difference is the Early Neolithic level present at Bjørnsholm but absent at Ertebølle, where only one – or maybe two – radiocarbon dates indicate an Early Neo-



	Layer no.	Sample lab no.	C-14 age b.p.
EARLY NEOLITHIC	4	K-5721	4760 ± 90
	12	K- 5720	4840 ± 95
		K-4796	4960 ± 90
	15a	K-5718	4860 ± 95
	15	K-5810	5210 ± 95
	13	K- 5817	5100 ± 95
		K-5719	5070 ± 95
	14a	K- 5818	5080 ± 95
LATE MESOLITHIC	14	K- 5717	5360 ± 70
	18	K- 5715	5360 ± 100
		K- 5714	5380 ± 70
	19	K- 5713	5320 ± 75

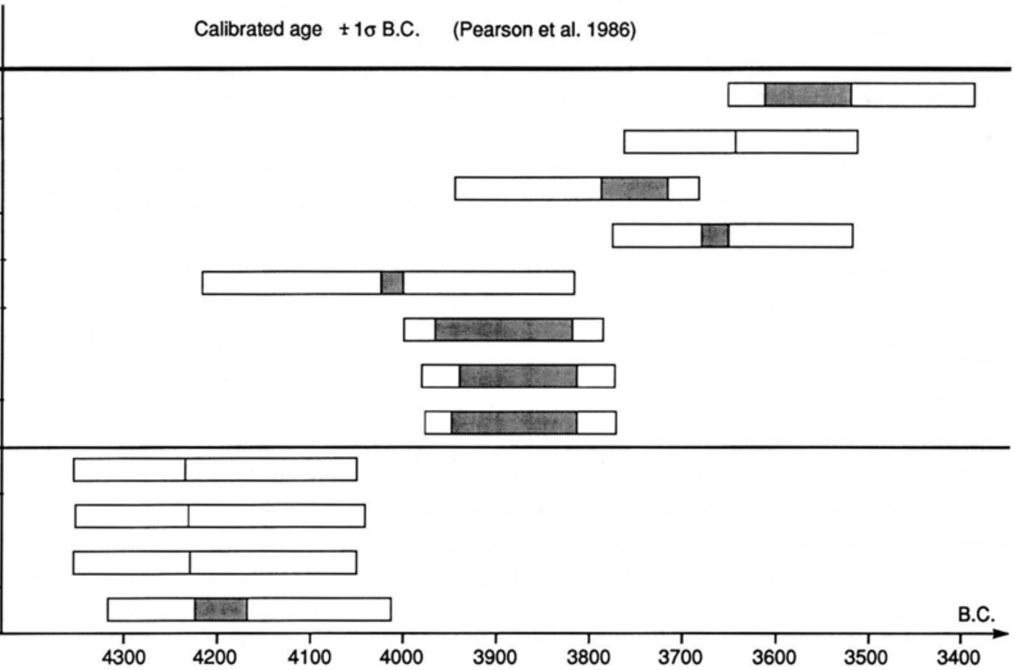


Fig. 10. Left: Section AFZJ. South section of squares D–E. Laboratory numbers of radiocarbon samples are marked. The Early Neolithic level is shaded. – Right: Harris matrix of the section. – Bottom: Radiocarbon dates of section AFZJ. All dates are for oyster shells. – Elsebeth Morville *del.*

lithic occupation (S. H. Andersen & E. Johansen 1987: 50–51). An explanation for the lack of a substantial Early Neolithic level at Ertebølle may be sought in the fact that this *køkkenmødding* was covered by one, or maybe two transgressions, which could easily have eroded such a sequence.

The composition of the shell-mound

In the *køkkenmødding* the shell composition of the deposits varies. Oysters dominate in the lower midden (up to 80%), followed by cockles, mussels, and periwinkles. In some areas of the upper midden oysters dominate, in other squares it is cockles and mussels that are most common. Over smaller areas, any one of these species may dominate completely – most probably representing waste from individual meals made up of a single species (fig. 6).

The distribution of cultural remains also varies. Some levels are characterized by numerous artefacts. The areas around the hearths are normally richer in finds than the rest of the midden. The richest level is the "black cultural layer" below the midden.

The content of artefact material in the shell-heaps is very uniform throughout the midden, suggesting that activities continued unchanged throughout the long occupation period.

Using differences in the micro-stratigraphy, *i.e.* the composition of shells, colour, density, and degree of decomposition, it was possible to divide the lower midden into between 5 and 25 sub-units. The stratigraphic analysis, the number of shell levels and the radiocarbon dates all indicate that the occupations at Bjørnsholm were probably few, but extensive. This opinion is also supported by the fact that the shell formation is rather loose. The shells generally lie horizontally, however, at three positions the layers are "dome-shaped" or make up "heaps". Just west of – and bordering – the hearths in squares O–P is a clear "heap", which obviously is connected with the nearby fireplaces. Also in the squares K–L there is a "heap" sloping in a westerly direction; finally the layering in square G also indicates a "heap". Maybe this heap is also associated with the previously mentioned hearths in the squares O–P, so that these hearths have functioned as the focal points for domestic activities with shell-heaps accumulating all around them.

The surface of the lower *køkkenmødding* is generally very flat and even, but in squares G, H and J there is a c. 4 m broad depression, which marks a border between two large shell-heaps, to the east and west of the depression, respectively.

The stratigraphy and radiocarbon dates demonstrate that the Mesolithic part of the *køkkenmødding* seems to have started in the central squares P–T and from there expanded both horisontally and vertically. This expansion was very rapid – the main part of the shell-mound was deposited within 100–200 years. The most intense accumulation took place about 4300 B.C.

There is a noticeable difference in sediment types between the lower and upper levels. Apart from differences in the types of sediment, the nature of accumulation must also have changed. The collection and deposition of molluscs decreased in the upper *køkkenmødding*; the shell layers are much thinner, more compressed, and very confined. Despite the fact that there are many hearths in the upper shell-mound these hearths do not seem to have influenced the way the shell-mound accumulated, as was the case in the Mesolithic (see later). Generally the shell material in this part of the *køkkenmødding* is more crushed and compressed than in the lower shell-mound, probably because of more activities on the surface during accumulation.

There are other significant differences between the two main levels in the Bjørnsholm *køkkenmødding*. No concentrations of fish bones are observed around the hearths in the upper layers. This may be a question of preservation, but bad conditions should also have affected small bones of other species in these layers, which nevertheless turn out to be well-preserved. The lack of fish bones seems rather to be a reflection of differences in economic activities.

Also the quantity of flint tools and debitage is noticably less in the upper level, suggesting that flint knapping did not normally take place on the shell-mound, as was the case in the lower layers. The only really abundant artefact type in the upper level is pottery. No structural remains, *i.e.* pits, house floors, postholes or graves were found in this level.

The archaeological sequence

An investigation of the vertical distribution of a series of characteristic artefacts, especially pottery, clearly indicates that the material of the lower midden belongs to the Ertebølle Culture (ETBK) (Early, Middle, and Late), and the upper part is associated with a very early stage of the Early Neolithic Funnel Beaker Culture (TRBK).

It is of special interest to define exactly the stratigraphic borderline between the Late Mesolithic and the earliest Neolithic. At other, contemporaneous and similarly stratified *køkkenmøddinger, e.g.* Norsminde, the transition was easily recognisable as a clear stratigraphical division between an oyster-dominated and a cockle-dominated part of the shell-mound (S. H. Andersen 1991: 20–23, 38 and fig. 23).

The transition from the Mesolithic to the Neolithic is most easily defined by plotting potsherds and other characteristic Ertebølle and Funnel Beaker types on the sections. In analogy with the similar stratigraphy at Norsminde, it was expected that the cultural transition at Bjørnsholm would also be congruent with the stratigraphic border between the oyster- and the cockle-dominated parts of the shell-mound. This *was* the case in some squares, but it was also evident, that in most squares Neolithic artefacts were found somewhat *deeper* than the change from the oyster-dominated to the cockle-dominated layers. This indicates that the typological transition took place *before* the change in deposition of molluscs. Thus, the change in artefact composition is not associated with a specific geological level, but is partially found in the previously mentioned layer of crushed shells in the upper part of the oyster-dominated shell-mound (layer 5b on fig. 7, and layer 14a on fig. 10). The earliest Neolithic artefacts occur below, and are older than, the cockle-dominated levels.

This sequence is firmly supported by the radiocarbon dates which show that the stratigraphically earliest Neolithic finds at Bjørnsholm are contemporaneous with the oldest Early Neolithic assemblages known from other sites in northern and eastern Jutland (and obviously older than the main part of the Early Neolithic assemblage at Norsminde). Compared with Norsminde, the stratigraphy at Bjørnsholm seems to be more complex.

It is also evident from the Bjørnsholm investigations – as was the case at Norsminde – that there is no "transitional" level, *i.e.* a layer with both ETBK and TRBK artefact types. On the contrary, at Bjørnsholm the two complexes are sharply divided.

Chronology

Twenty-eight samples from the *køkkenmødding* have been radiocarbon dated (see K. L. Rasmussen, pp. 93–96). All dates are based on oyster shells, and the samples have mainly been taken in stratigraphic series through the midden deposits, *i.e.* in squares D–E, K–L, and R or as scattered samples (figs. 9–13).

In general, the radiocarbon dates support the stra-

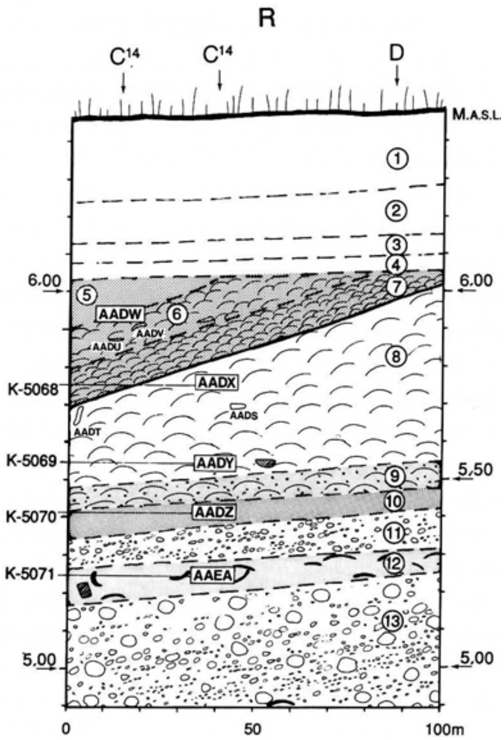
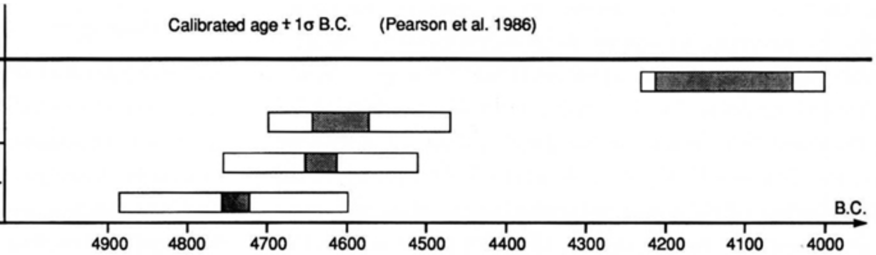


Fig. 11. Left: Section AADR; south wall of square R. Laboratory numbers of radiocarbon samples are marked. The Early Neolithic level is shaded. – Bottom: Radiocarbon dates of section AADR. All dates are for oyster shells. – Elsebeth Morville *del.*

	Layer no.	Sample lab no.	C-14 age b.p.
LATE ERTEBØLLE	8	K-5068	5300+90
		K-5069	5720+95
	10	K-5070	5770+70
EARLY ERTEBØLLE	12	K-5071	5840+95



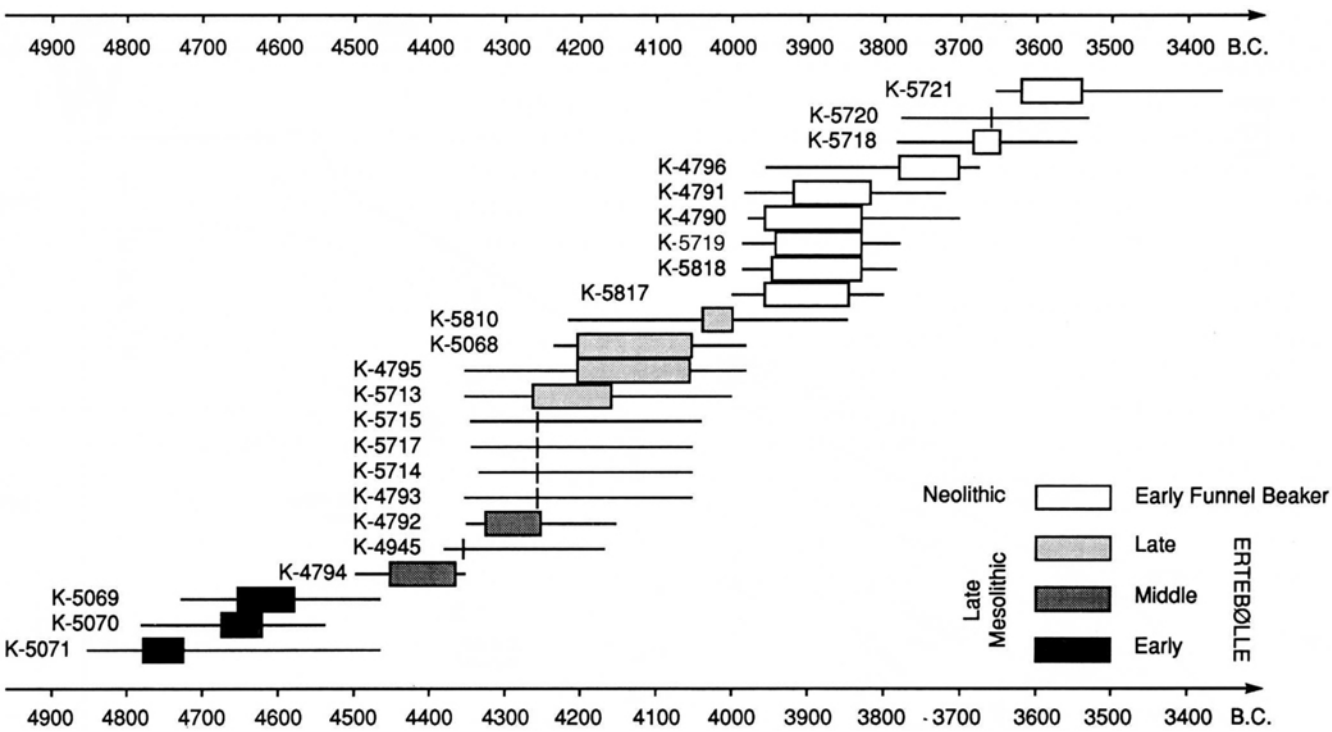


Fig. 12. All radiocarbon dates from the squares R, K–L and D–E given in calibrated ±1 standard deviation (Pearson *et al.* 1986).

tigraphical observations and reflect a gradual accumulation on the site from bottom to top. Only in two instances are the dates older than expected from the stratigraphy. They can best be explained as being due to disturbances or being the results of accumulation at high water level of older material in younger deposits.

The oldest dates are obtained from the marine sand under the midden: 5050–5000 B.C. (K-5304), and for the top level of this horizon 4770–4730 B.C. (K-5071).

The main part of the *køkkenmødding* belongs to the period 4400–4200 B.C. Within this timespan the dates indicate a rapid accumulation. At several sections through the *køkkenmødding* the layers seem to have been deposited contemporaneously from bottom to top., *e.g.* in square L (fig. 9).

In general the dates seem to become younger towards the east, following the sloping subsoil. The dates correspond well with those from the Ertebølle shell-mound, where the main part of the occupation also falls in the same period, *i.e.* 4400–4200 B.C. (S. H. Andersen & E. Johansen 1987:49–50) and the nearby Aggersund site (S. H. Andersen 1979a:42). All together these dates illustrate the richness of the marine biotope on the central Limfjord in the Atlantic period and the intense Mesolithic gathering activity on the shell-beds along the coasts.

At three positions (separated from each other) the toplayer of the Mesolithic section is dated to 4350–4240 B.C. (K-4688, K-5717) – indicating that the top level is contemporaneous over large parts of the section. The youngest Ertebølle level is found at two positions in the trench, in squares D and R, and is dated to 4240 B.C. (K-5717) and 4220–4050 (K-5068). These dates are the youngest from the section, however, they do not necessarily reflect the total duration of the Mesolithic occupation at the site.

All dates from the Early Neolithic level are very consistent and fall within a short timespan: 3960–3830 B.C. (K-5817) – 3620–3530 B.C. (K-5721), thereby placing it in the very earliest Neolithic and indicating that this level is a very short and intense depositional phase, although the layer is only 20–30 cm thick.

The stratigraphy may be interpreted as evidence of a continuous occupation of the Bjørnsholm site from the Late Mesolithic to the earliest Neolithic. However, when we look at the diagram (fig. 12), the dates seem to group

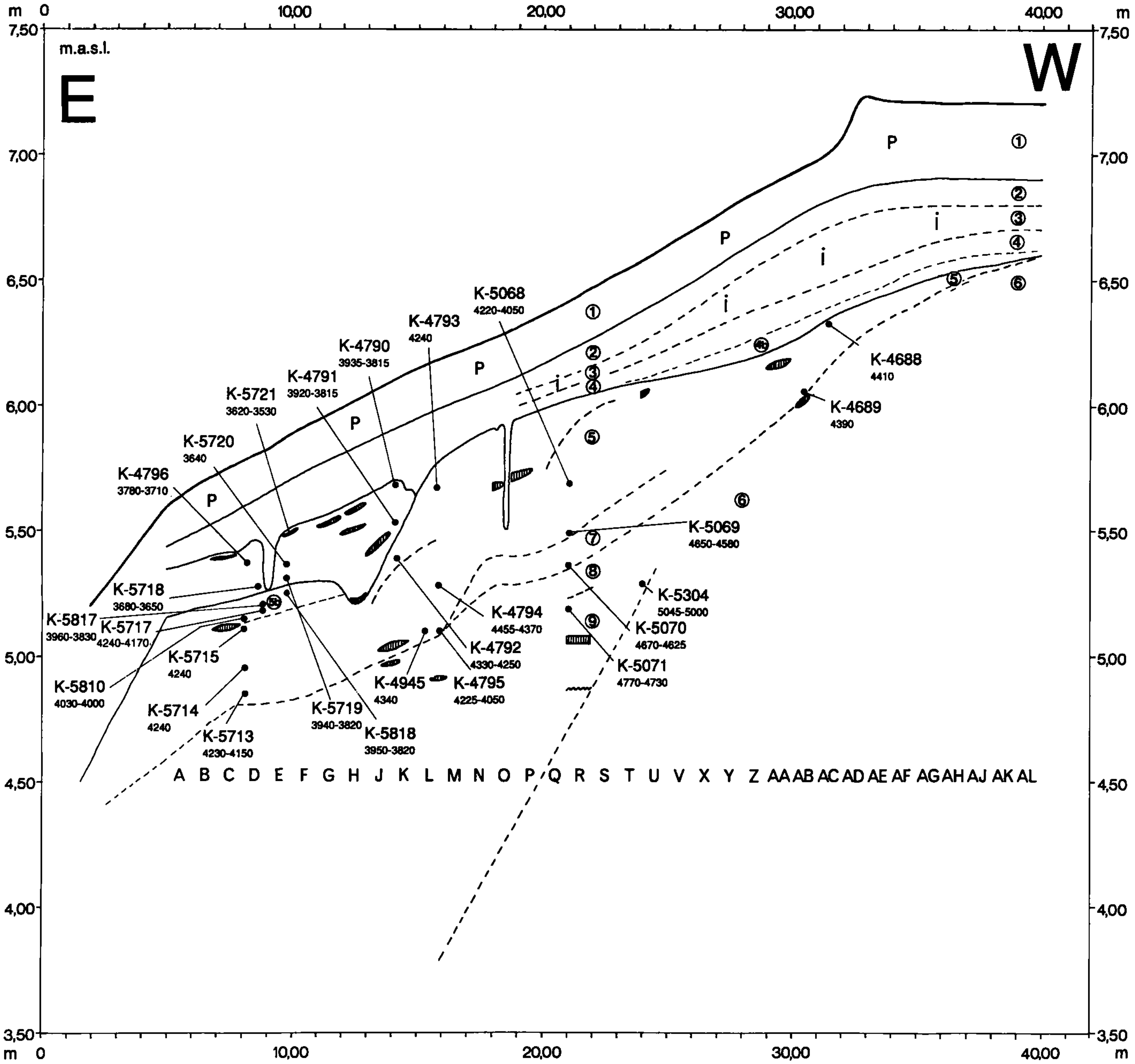


Fig. 13. The position of the individual radiocarbon samples in the section. – Sv. Kaae *del.*

in two clusters, one in the Late Mesolithic and one in the very Early Neolithic, perhaps indicating a short "hiatus" in the occupation of the site about c. 4000 B.C. The explanation for this could either be a *real* stop in habitation during the Late Ertebølle – or a break in sedimentation where this section is positioned – or a level of the shell-mound could have been eroded away by a rise in sea level (during the Late Atlantic transgression). When looking at the graph of the dates (fig. 12), it must be borne in mind, however, that the number of dates is also a reflection of the thickness of the layers. From this we must conclude that continuity of habitation seems to be the most probable.

It is of special interest to define the exact date of the

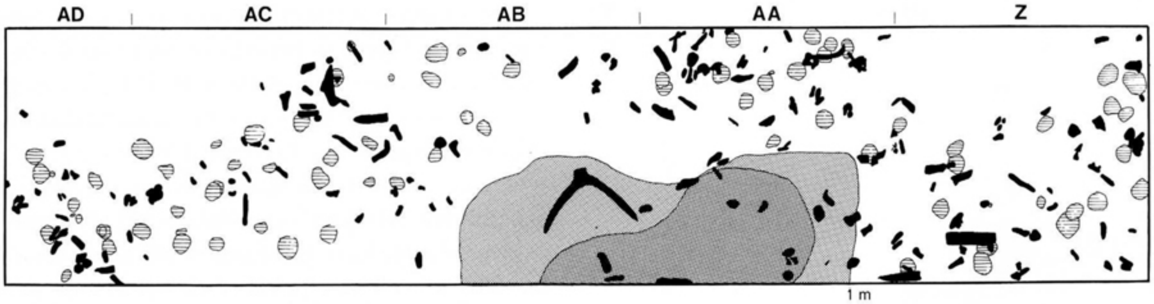


Fig. 14. The hearth (hatched) in squares AA-AB surrounded by animal bones (black) and small clusters of fish bones (shaded).

transition from the Late Mesolithic to the earliest Neolithic, from the Ertebølle to the Funnel Beaker Culture. It can be deduced from figs. 9–12 that this transition must have been of very short duration, occurring at c. 4000–3950 B.C. Perhaps this means that the transition took place over a period of less than a century.

The very early date of the Funnel Beaker level at Bjørnsholm is further supported by an AMS-date of 4040–3690 B.C. (AAR-802) from the timber construction at the east end of the Early Neolithic grave just west of the *køkkenmødding*. The grave contained pottery of the same type as was found in the Neolithic levels of the shell-mound (S. H. Andersen & E. Johansen 1992:52).

Hearths

In the *køkkenmødding* only hearths consisting of circular layers of a grey, greasy substance (burnt shell material and charcoal) have been found; they occur in all levels of the shell-mound. In the Mesolithic layer such hearths have been observed at 7 positions – evenly distributed through the shell-mound (fig. 5). Compared with Ertebølle there are many more hearths in the Bjørnsholm *køkkenmødding*, but the type is the same, circular, 1–1.5 m in diameter and dome-shaped. They consist of a grey substance mixed with very small grey-blue flakes of burnt shells. The centre is always of a light, yellow-grey ash and is surrounded by an up to 0.5 m wide brim of grey ash, followed by an outer black border c. 20–30 cm wide, rich in charcoal powder. The different colours reflect the different temperatures in the hearth. The thickness at the centre is 5–10 cm. Chemical analyses reveal that these hearths consist of pure chalk originating from flakes, small pieces, and powder of burnt shells. Modern experiments with oyster shells burnt in an open fire produce exactly the same type of grey-bluish powder which has turned out to be the main component of these hearths. Therefore, these "hearths", which were only found in the shell-mound, are not hearths in the usual sense, but they are obviously the *loci* where the shellfish were put onto the fire – to open them in an easy manner. Such a procedure is well known from ethnographic sources, *e.g.* from Australia (Meehan 1982:87–89, 102 and 108).

Around these hearths are concentrations of flint debris and animal bones, normally found c. 0.5–1 m from the periphery of the ash layer (fig. 14). In contrast to Ertebølle, no levels of fish bones have been observed in the Bjørnsholm *køkkenmødding* (S. H. Andersen & E. Johansen 1987:47).

Hearths of a different type are the stone hearths, probably with a more permanent function. They were not found in the shell-mound proper but are recorded from the subsoil (in square AB) and in the marine sand below the *køkkenmødding* in squares L and R (fig. 15). Also in square R – but at a somewhat higher level – a 2–4 cm thick level of charcoal was observed – probably indicating a hearth somewhere nearby.

These hearths are small, with a diameter of c. 0.50 m, built of a single layer of small, flat stones, and have a high charcoal content. None of these hearths are surrounded by concentrations of artefacts, flint debris, animal bones, or other types of "waste" – as is the case with all the other hearths in the shell-mound proper.

Within the shell-mound the hearths are found in groups (fig. 5) spaced horizontally within a few square metres – often in stratigraphic sequences – for instance in squares O–P, BG K–L, and C–D–BK–BL. Such a concentration

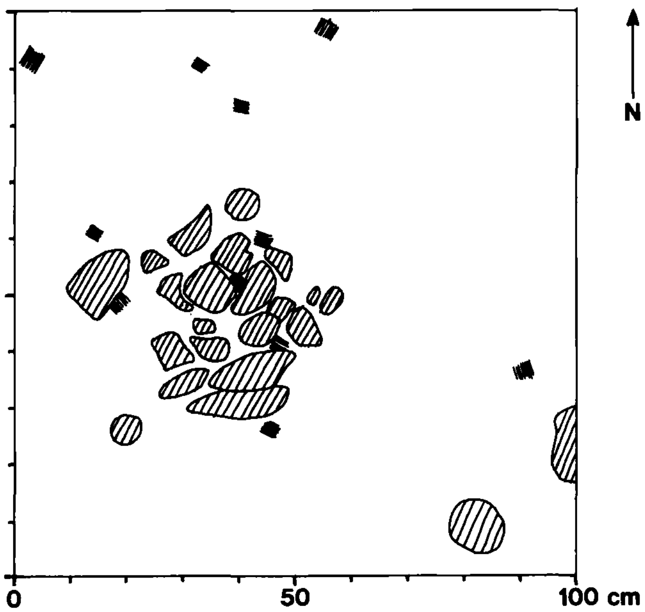


Fig. 15. Stone hearth (square R) in the marine sand below the *køkkenmødding*. Stones are shaded; charcoal marked by thin parallel lines.

of several hearths within a restricted area – a hearth *locus* – is most distinctly observed in squares K-R, where the hearths are surrounded by dome-shaped shell heaps. A similar pattern was also observed at Ertebølle (S. H. Andersen & E. Johansen 1987:47–48) and Norsminde (S. H. Andersen 1991:25). This observation must indicate that the position of the hearths has been fixed through time (in some cases through 2–300 years).

The continued use of these hearth *loci* may be due to local factors such as wind, growth of trees, etc., or it may reflect an organization of the shell-mounds as dump areas with some form of structure.

Also in the upper Neolithic shell-mound, hearths with burnt shells have been found in several cases, but they are much smaller and only 2–5 cm thick, and not always circular in outline as the Mesolithic ones are. In addition, they are not found in stratigraphic sequences as is the case in the Mesolithic levels, but are more evenly distributed horizontally and vertically. These hearths appear to have been more cursory than the Mesolithic ones and in contrast to the latter they are not surrounded by a great amount of debris.

At Ertebølle similar types of "grey" hearths of burnt molluscs were recorded (S. H. Andersen & E. Johansen 1987:47–48). However, the "cooking pits" observed at this site have not been found at Bjørnsholm.

The change in type of hearth from stone fireplaces in the bottom layers to hearths of burnt shells in the later phases took place at c. 4600–4700 B.C. A similar change in the type of hearth is frequently observed at many other *køkkenmøddinger* of the Ertebølle Culture, *e.g.* at Ertebølle, where two stone-lined hearths were recorded underneath the midden (Madsen *et al.* 1900:25–28). The stone hearths may originally have belonged to old living floors situated outside the area of an early shell-mound formation. After being abandoned, the hearths were covered by the accumulating shell-mound.

Other structures in the shell-mound

At Ertebølle a division of the midden in two areas was observed: One area close to the seashore which was characterized by domestic activities, and another area further away from the shore with shell-dumps (S. H. Andersen & E. Johansen 1987:44–45), but this was not documented at Bjørnsholm.

Layers of ash and charcoal were found around the hearths. In some areas the ash layers extended out 1–2 metres. Such layers enable us to connect contemporaneous surfaces within the midden. Furthermore, the extension of such ash levels clearly prove that the hearths were situated in the open air. If they had been inside huts, the ash would have been more confined.

In no case is there more than 4–5 m between the hearths. The hearths in squares O-P are surrounded by steep-sided shell-heaps within a distance of 1–1.5 m. The radiocarbon dates demonstrate that these shell-heaps are contemporaneous from bottom to top despite the fact that they are 60–80 cm in thickness. Such shell-heaps probably represent single, short episodes. The fact that they hardly contain any debris supports this assumption.

Only in one case are there indications of what may have been an open surface of longer duration in the *køkkenmødding* (layer 14a on fig. 10 and layer 5b on fig. 7). A similar surface was observed at Ertebølle (S. H. Andersen & E. Johansen 1987:44–45). Apart from this, both the stratigraphy and the radiocarbon evidence indicate that the main part of the Bjørnsholm *køkkenmødding* represents continuous accumulation.

Scattered human bones may be the remains of disturbed graves. In 1931 a burial with a skeleton was found lying in an extended position and oriented NE–SW.[7] The presence of Neolithic and Iron Age pottery in the grave fill as well as the stratigraphic observations indicate that this grave is considerably later than the Ertebølle occupation.

Finds from the Ertebølle layers

Artefacts occur throughout the midden. Activity areas are indicated by horizontal and vertical concentrations of artefacts. In terms of horizontal distribution, the material around the hearths is highly concentrated – there are not only tools, but also debris and animal bones. However, the densest concentration is found below the shell-mound, on the surface of the marine sand (the "black layer").

The majority of artefacts in the shell-mound are found in connection with the ash layer from the fireplaces, indicating that occupation took place for some time on the open surfaces.

Changes in the artefact inventory can be observed in relation to the stratigraphy. Some are gradual, minor changes, while others, such as the first appearance of ceramics, are more abrupt.

The tools are made of two different types of flint: 1) Small flint nodules with a grey, hard cortex probably extracted from the morainic deposits. 2) Flint nodules with a soft chalky primary cortex. This type of raw material must have come from areas where there is direct access to limestone or chalk bedrock with flint. Such

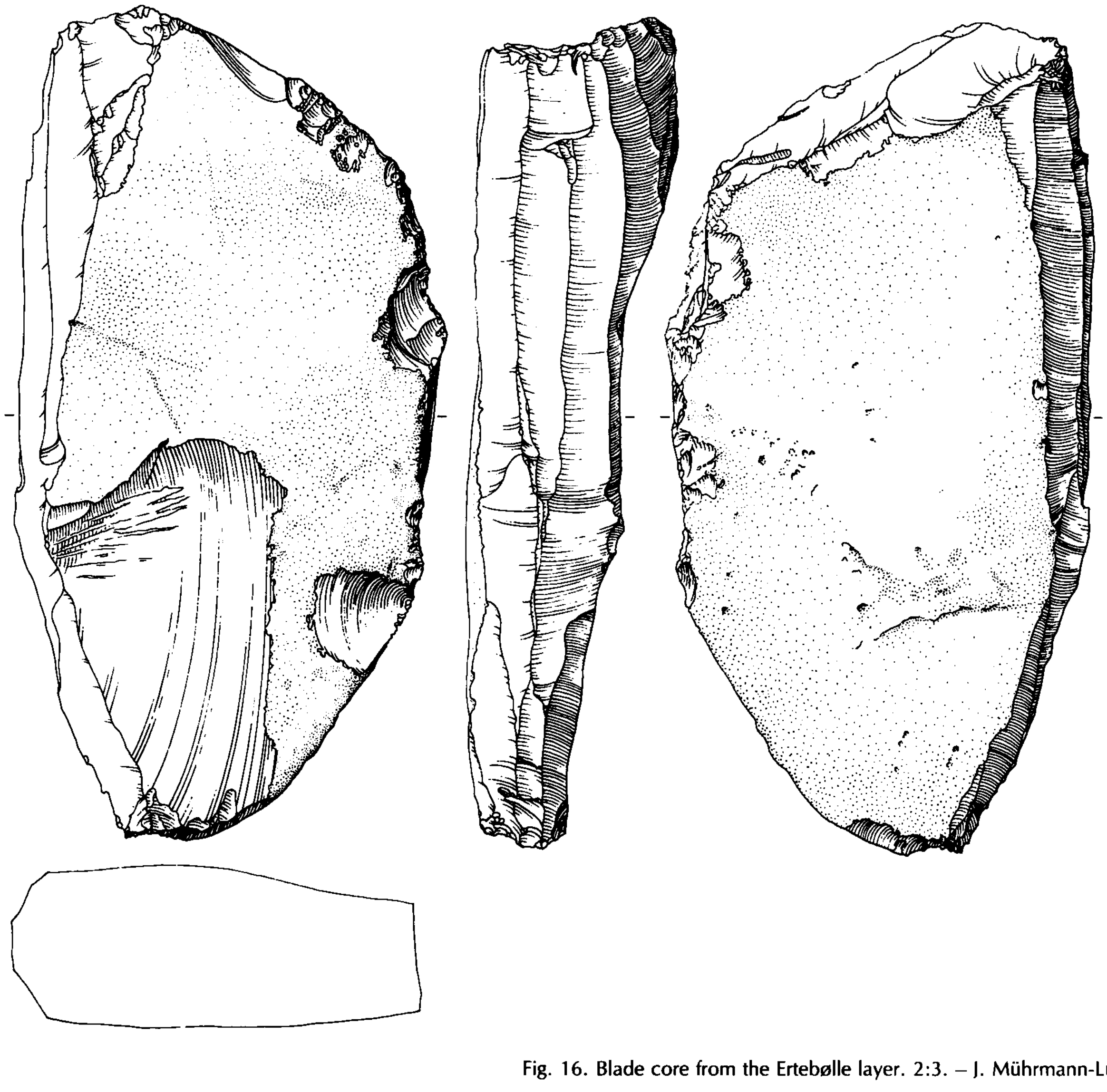


Fig. 16. Blade core from the Ertebølle layer. 2:3. – J. Mührmann-Lund *del.*

layers are common in the immediate neighbourhood of Bjørnsholm and in the area around Aggersund where the chalk bedrock very often is found on the surface.

The flint tools are very regular and well made compared to other contemporaneous Ertebølle sites on the Limfjord. These characteristics seem to be constant throughout the occupation.

From the contemporaneous, nearby Ertebølle site (fig. 2) there was access to the same types of raw material, but the tools differ stylistically. This may indicate that the two

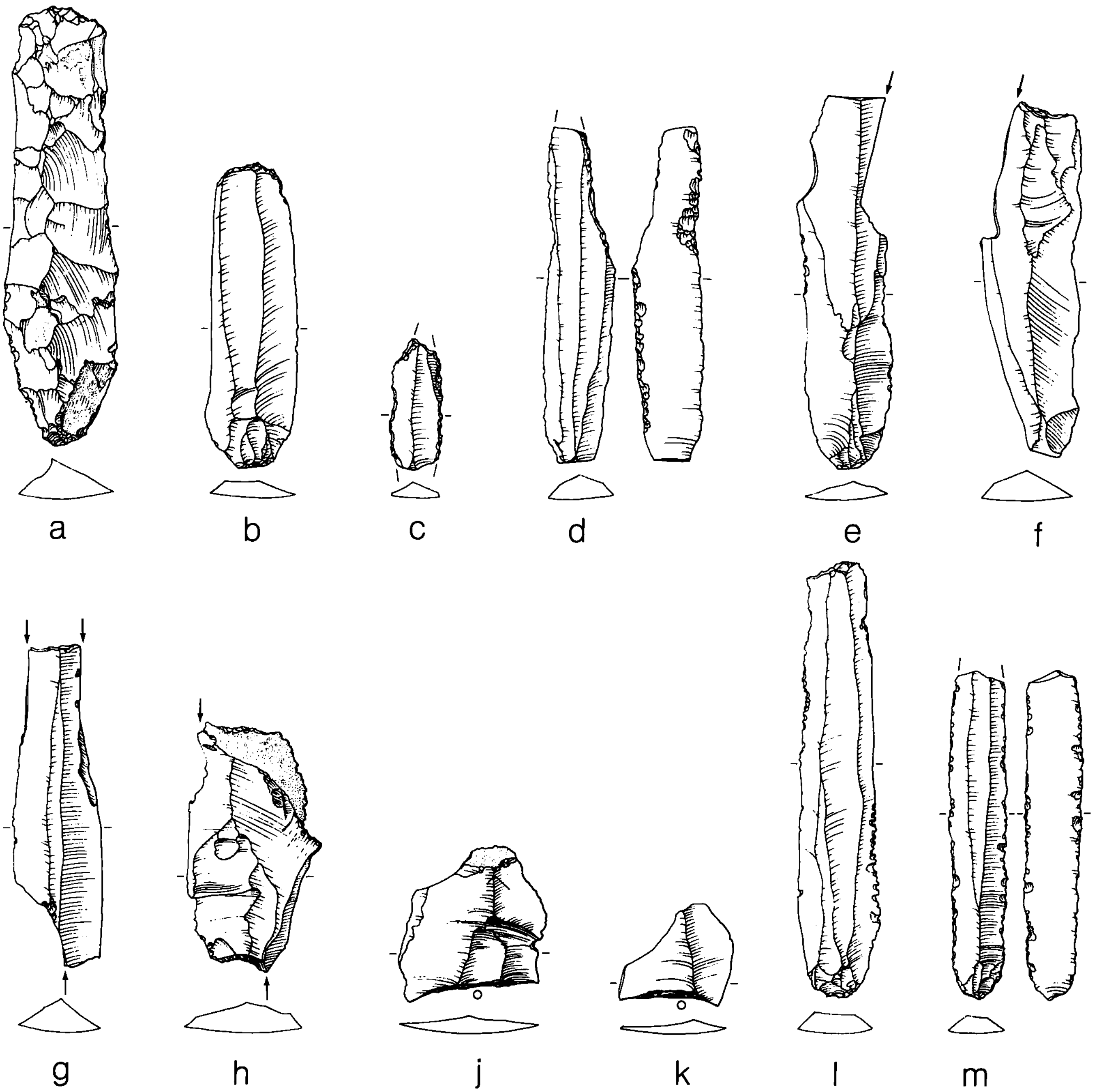


Fig. 17. Flint artefacts from the Ertebølle levels: a–b) Blade scrapers. c–d) Borers. e–h) Burins on a break (e) and truncation (f–h). j–k) Flakes with truncation, preproduction for transverse arrow-heads. l) Blade saw. m) Denticulated blade. 2:3. – J. Mührmann-Lund *del.*

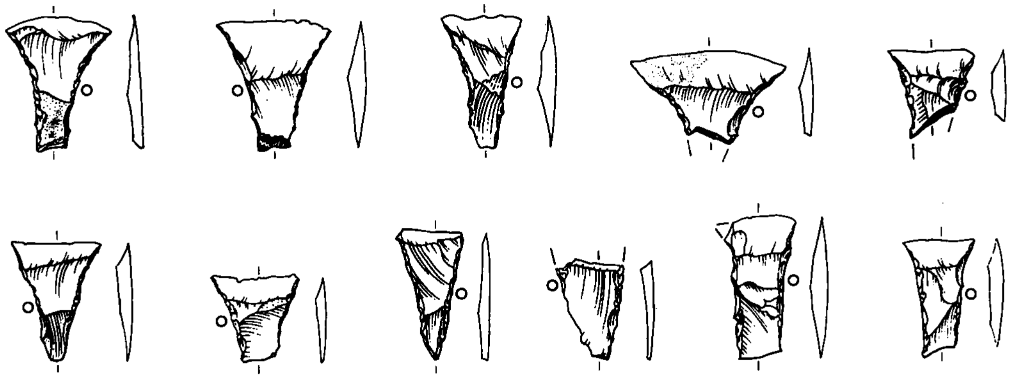
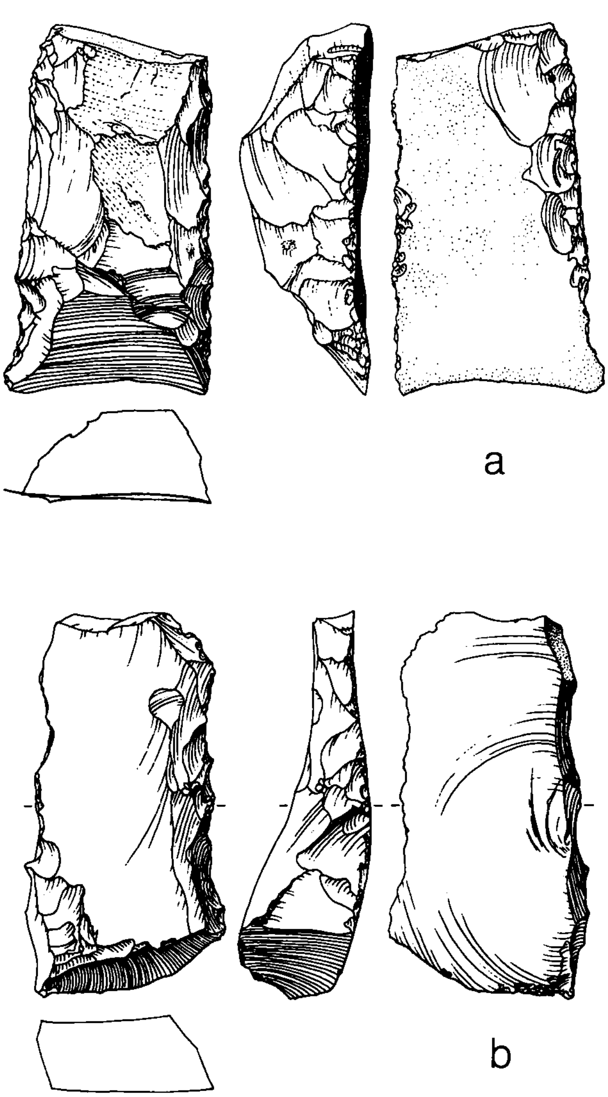


Fig. 18. Transverse arrow-heads from the Ertebølle levels. 2:3. J. Mührmann-Lund *del.*



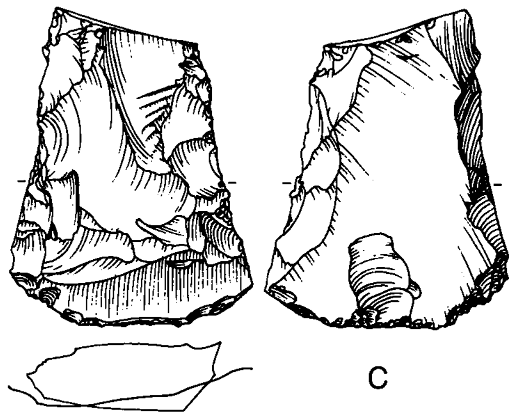


Fig. 19. Flake axes from the Ertebølle levels: a-b) Edge-trimmed. c) Flat-flaked. 2:3. – J. Mührmann-Lund *del.*

sites were inhabited or used by two groups of people with different flint tool traditions.

The Mesolithic flint inventory from Bjørnsholm displays types and type compositions characteristic of the Limfjord area and belonging to a regional group within the Ertebølle Culture in Jutland. This regional group is characterized by many tools made from regular blades made by "soft technique" used on large, flat cores with two opposing platforms (fig. 16). A number of tools are based on blades, such as scrapers, borers, burins, truncated pieces, saws, denticulated blades (fig. 17), and transverse arrow-heads (fig. 18). In addition, there are flake (fig. 19) and core axes (fig. 20, top). In the Danish Late Mesolithic, the core axe dominates in the early phases, the flake axe in the later phases. In the Bjørnsholm *køkkenmødding*, the two forms are evenly represented. In the vertical distribution of the subtypes of the flake axe,

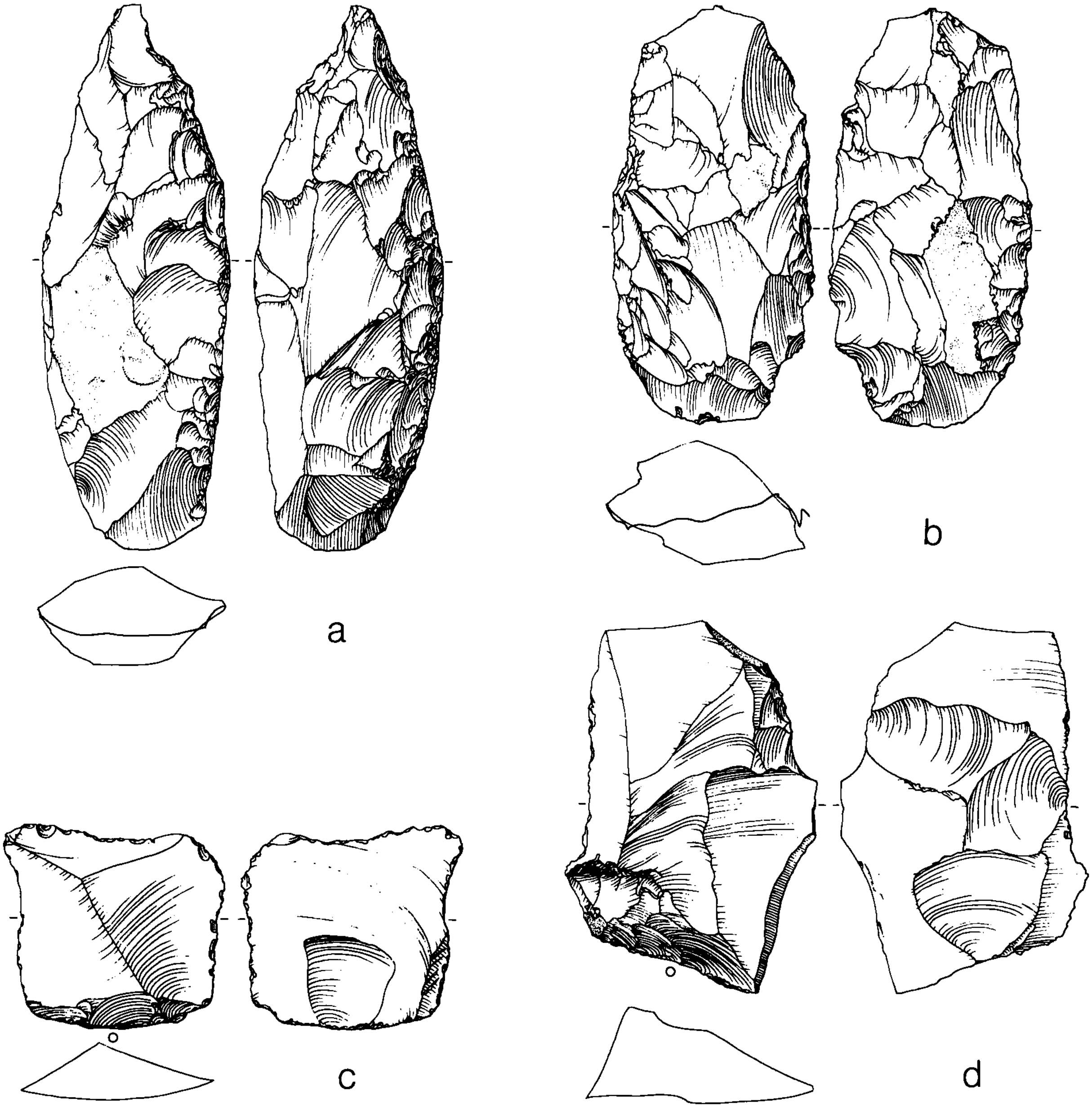


Fig. 20. Flint artefacts from the Ertebølle levels: a-b) Symmetrical core axes. c-d) Scale-worked flakes from the marine sand below the shell-mound (c) and from the black cultural layer (d). 2: 3. – J. Mührmann-Lund *del.* 2:3.

the edge-trimmed variant is very common (fig. 19a–b) in contrast to the flat-trimmed flake axe, which is numerous in Eastern Jutland and on the Danish Isles but more sparsely represented in Northern Jutland (fig. 19c). No axes of greenstone (diabase) were found.

The same types of flint tools were found in the sand layers below the shell-mound, but slight differences in technique and relative proportions can be observed. For instance, there is an increase in the number of burins and a decrease in scrapers and borers.

Among the tools made from flakes, there are several scale-worked flakes (S. H. Andersen 1979b). These flakes, which are significant for the earliest Ertebølle phase in Jutland, are found in the marine sand below and within the deepest layers of the *køkkenmødding* (fig. 20, bottom).

Tools of antler and bone belonging to the Ertebølle

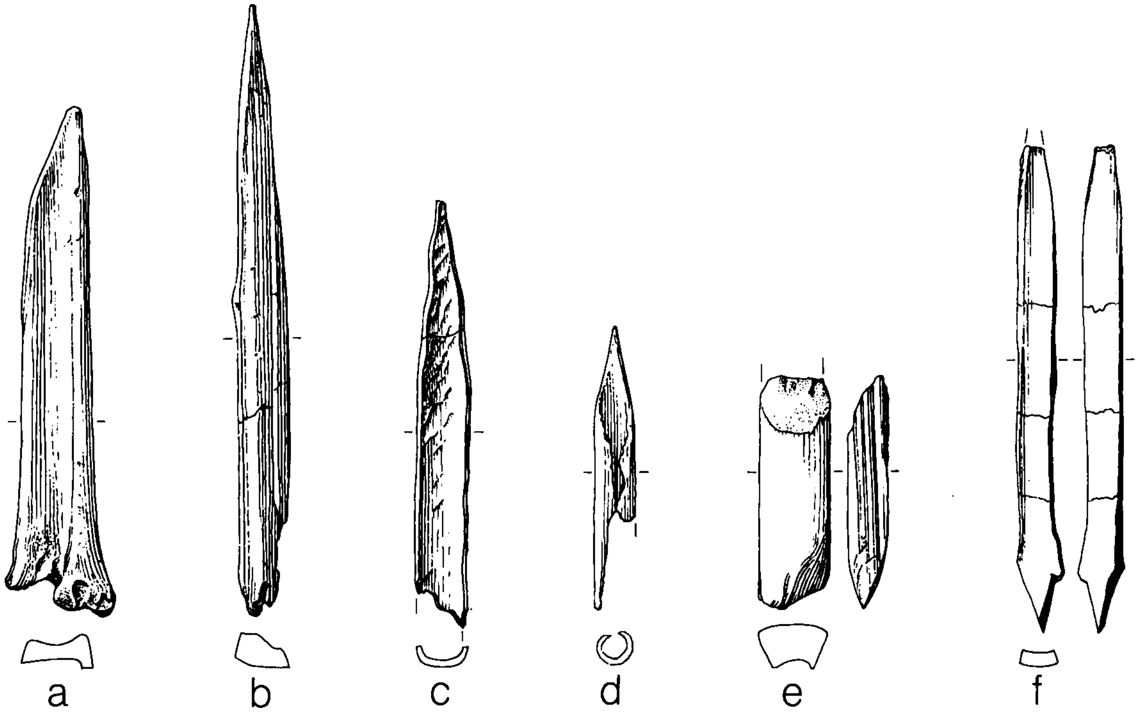


Fig. 21. Bone points from the Ertebølle levels: From roe-deer metatarsus (a), bird bone (c-d), a bone splinter (f), and with round section (b). e) Broken-off base of a bone point. 2:3. – J. Mührmann-Lund *del.*

tradition were also found. A red deer antler axe with the shaft-hole on the stem where a tine has been sawn off, a so-called T-shaped axe, was found in the top layer. The antler implements include several sawn-off tines, two pieces of red deer antler with traces of groove- and splinter technique which are obviously waste from the production of harpoons[8] (S. H. Andersen 1972:105–106), four sawn tines for pressure-flaking, and one short pick with a shaft-hole made of a tine of red deer antler (fig. 25). There are 21 simple bone points – either round-sectioned (fig. 21b) or flat, made of roe-deer metatarsus (fig. 21a). Four points are made from bones of large birds, probably swans (fig. 21c–d), a type characteristic for the Early and Middle Ertebølle Culture in Jutland. Seven small fish-hooks and 3 unfinished examples are made of bone (fig. 22). In the bottom layer of the *køkkenmødding* an ornament consisting of the front teeth of the lower jaw of a young red deer was found (fig. 23). Four beads of red deer teeth with an incised groove around the root were scattered in the shell deposit. There are also two ornaments made of wild-boar tusk (the outer side of the tusk) (fig. 26). Similar pendants are known from the early excavations at Ertebølle (Madsen *et al.* 1900, Plate VII lower row).

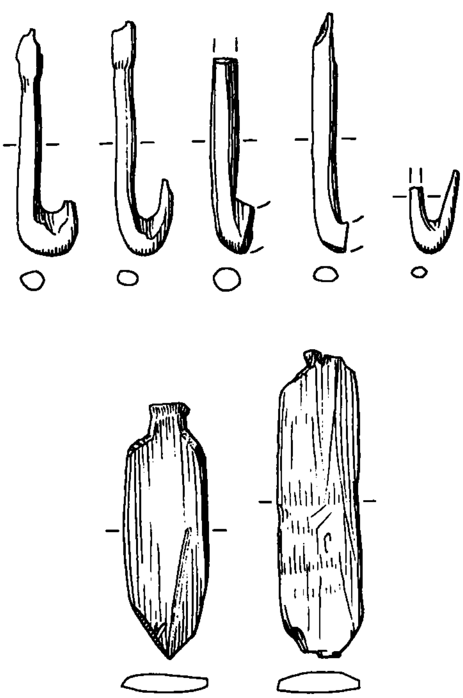


Fig. 22. Bone artefacts from the Ertebølle levels. Above: Fish-hooks of bone. Below: Flat pieces of bone, probably rough outs for fish-hooks. 1: 1. – O. Svendsen *del.*

Fig. 23. Ornament of red deer teeth. All the front teeth of the lower jaw have been cut out of the jaw – probably still attached to the tissue. 1:1. – Photo P. Dehlholm.

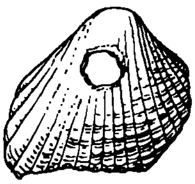


Fig. 24. Shell of *Cerastoderma* with perforation. 1:1. – J. Mührmann-Lund *del.*

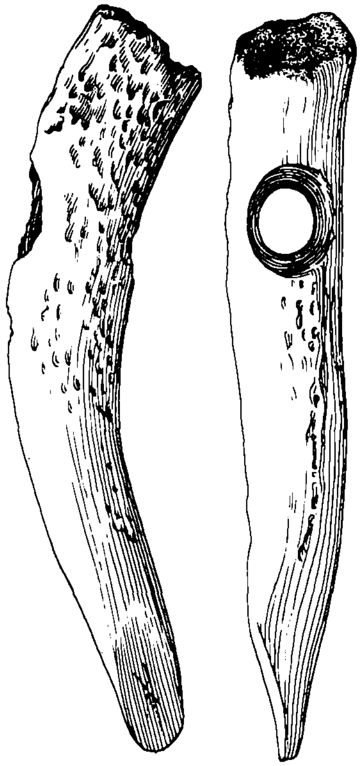


Fig. 25. Small pick with shaft-hole. 2:3. – J. Mührmann-Lund *del.*

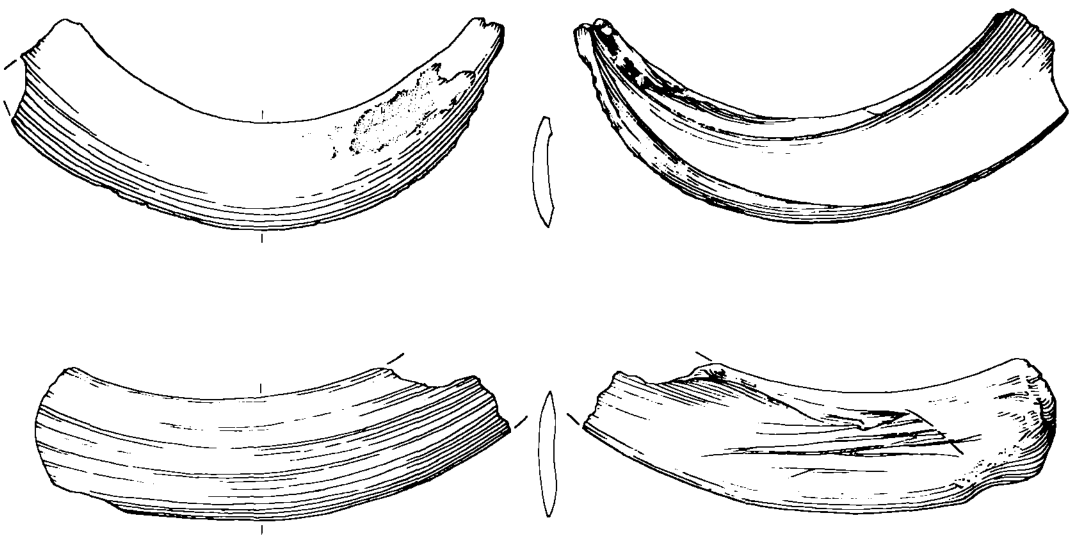


Fig. 26. Ornaments made from the outer side of wild-boar tusks. 2:3. O. Svendsen *del.*

Finally, a shell of *Cerastoderma edulis* has a perforation and was probably also an ornament (fig. 24).

Ertebølle pottery is not found in the deepest levels of the *køkkenmødding* but appears abruptly in the layers later than c. 4600 B.C. Pottery is frequently found in small concentrations around the hearths, but is very seldom present in the shell layers. The ware is 1–1.5 cm thick and is clearly thicker than pottery found at contemporaneous sites further to the south in Jutland (S. H. Andersen 1975: 56–64). The vessels are undecorated. Only sherds from simple, pointed-bottom vessels are found.

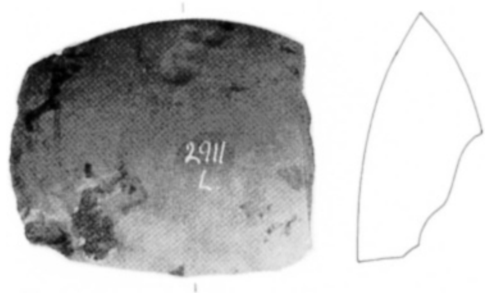


Fig. 27. Fragment of a thin-butted, polished flint axe. 2:3. Photo P. Dehlholm.

Finds from the Neolithic layers

The flint artefacts from the Early Neolithic are very few and restricted in type – mainly because of the small amount of flint in these levels, and also because of the small areas of excavation. The Neolithic flint tools are only slightly different from the Mesolithic ones. The Neolithic assemblage is characterised by both blade and flake techniques. Blades are fewer than in the deeper layers of the shell-mound, and more tools are made from flakes. As we are dealing with the same site there is no reason to suppose that this difference has anything to do with access to raw material; it must, indeed, be a change in "style". Generally there are the same types and type groups as before, but in other relative frequencies.

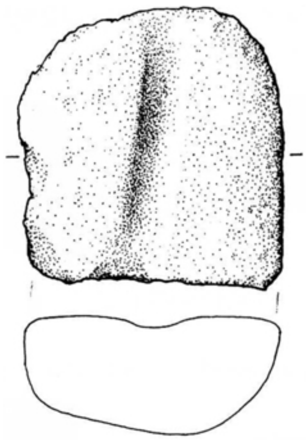


Fig. 28. Arrow-shaft straightener of sandstone. 1:1. – J. Mührmann-Lund *del.*

Only a few axe types are documented from this level. Core and greenstone axes are completely absent and only a few flake axes are found. The dominant axe type is now the polished, thin-butted axe – probably of type IV (possibly also type I) (fig. 27) (Nielsen 1977:72–74 and 77–78, 106). Transverse arrow-heads are also found, but these have slightly convex sides and a pointed butt. In addition, there are several round flake scrapers, some borers and knives, while burins and truncated pieces are few. From the Early Neolithic comes a fragment of a sandstone arrow-shaft straightener with a grooved channel (fig. 28).

Tools of bone and antler are very few in number; only some simple bone points and sawn off tines for pressure flaking are present. A simple bone point has its articular end preserved as a handle (metatarsal of a sheep) (fig. 29, left). A small oval bead of mother-of-pearl with a central perforation is also recorded from this layer (fig. 29, right).

The most abundant artefact group is pottery, normally found in large fragments – very often in the ash and stone layers. In comparison to the Ertebølle level, ceramics play a more important role in the inventory. With regard to

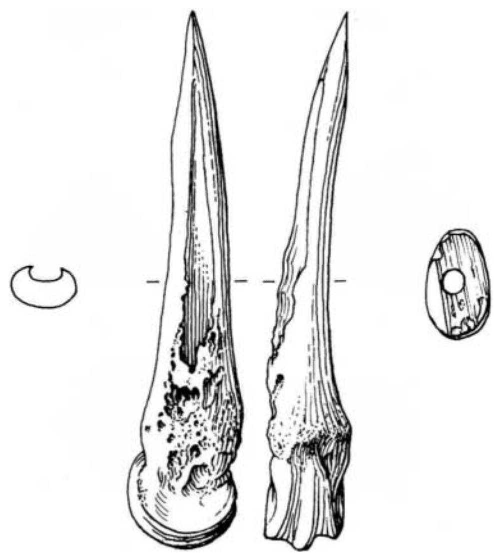


Fig. 29. Left: Simple bone point from metatarsus of sheep. Right: Bead of mother-of-pearl. 1:1. – J. Mührmann-Lund *del.*

Fig. 30. Decorated funnel beakers of Volling type. From the top of the Early Neolithic level in the *køkkenmødding*. 1:2. – Photo P. Dehlholm.

shape, technique, and ornamentation the Early Neolithic pottery is fundamentally different. Hybrids between the Ertebølle and Funnel-Beaker ceramics have not been found.

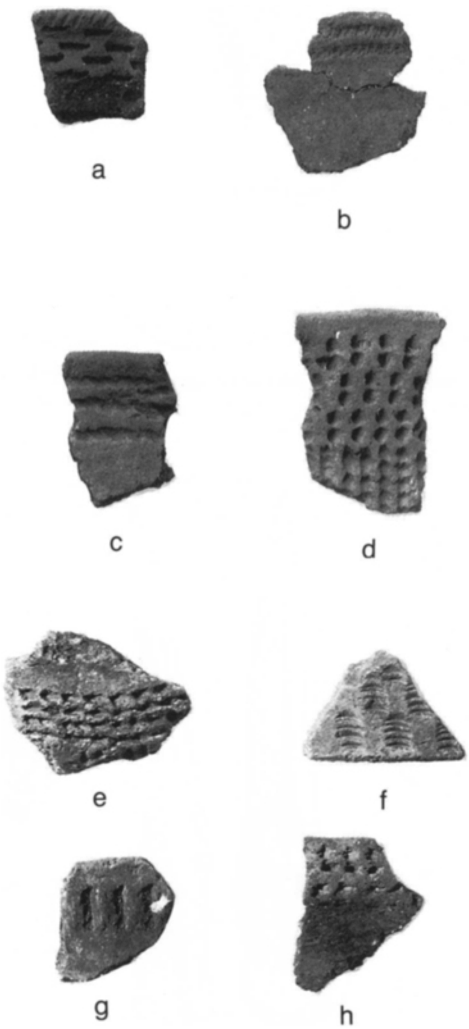


Fig. 31. Rim-sherds from the Early Neolithic level. 1:2. – Photo P. Dehlholm.

The ceramic inventory comprises simple funnel-necked beakers, lugged beakers, and large lugged jars. The dominant form is simple funnel-necked beakers, which are present in two size groups. The largest group is made up of rather small vessels with a height of c. 15–20 cm and a smaller group of larger pots c. 30–40 cm in height. The majority of the vessels display a very characteristic profile with a relative high, concave neck, separated from the convex belly by a distinct angle (fig. 30). The base is always round or rounded. The pottery is generally without ornamentation. If decoration is found, it is usually confined to just below the rim. A frequent ornamentation consists of 2–3 horizontal cord impressions on the rim (fig. 31). Some vessels also display single or double rows of horizontal stabs or short strokes (fig. 31). Within this ceramic group a small number differ from the rest in that they are of a finer and thinner ware and that the entire surface is covered with decoration in stab-and-drag technique in a chequer composition (fig. 30).

The large group of funnel beakers corresponds to the so-called B-beakers, while the finer vessels belong to the "non-megalithic C-Group" (Becker 1947). Both groups have recently been incorporated in the Volling Group (Madsen & Petersen 1984). The Bjørnsholm (and Norsminde) stratigraphy clearly demonstrates that the two types of funnel beakers are contemporaneous in northern and eastern Jutland, and that these types of pottery should be dated to 4000–3800 B.C.

Of special interest is a thin-walled and undecorated vessel of a different type with a short, concave neck and a long belly. Unfortunately, the bottom is not preserved, but from the outline of the belly it is evident that the vessel must have had a very narrow bottom, which was either rounded or pointed (fig. 32). Typologically and

Fig. 32. Funnel beaker from the deepest level of the Early Neolithic level of the *køkkenmødding*. 1:2. – Photo P. Dehlholm.

technologically it is clearly a funnel beaker and shows clear affinity to the A-group (Becker 1947), but it is also typologically related to the pointed-bottomed Ertebølle pots. The vessel is different from the rest of the Neolithic pottery at the site. It was found at the very bottom of the Early Neolithic level *below* the material belonging to the Volling Group. A radiocarbon date for oyster shells in direct association with this vessel gave a date of 3960–3830 B.C. (K-5516) which is in accordance with the stratigraphic position of the vessel. It is not possible to determine whether this funnel-beaker represents a variation within the Early Neolithic pottery assemblage, or whether it is diagnostic of a separate phase of Early Neolithic occupation in this area. However, sherds from similar funnel beakers were frequently found in the oldest Early Neolithic levels during the excavation (fig. 33).

Although the sample size is small, the pottery seems to cluster stratigraphically, so that the earliest level is mainly characterized by non-decorated vessels similar to the above mentioned, while funnel beakers, like fig. 30 – beakers of the Volling Group, belong to a *higher* level in the sequence. Undecorated pottery is also known from the Norsminde shell-midden. Unfortunately this is only dated by its stratigraphical position (S. H. Andersen 1991:34, fig. 21) at the very bottom of the Early Neolithic sequence of this site, which is a strong indication of the very early date of such vessels. The results from Bjørnsholm and Norsminde demonstrate therefore, that this type of beaker is characteristic of the very earliest Funnel Beaker Culture in Jutland.

The economy of the Mesolithic occupation

Subsistence was based on hunting, fishing, and gathering. This is well documented by the types of artefacts found associated with large numbers of animal bones and shellfish. The list of species reveals a wide range of mammals, birds, fish, and reptiles (see Bratlund 1993 and Enghoff 1993, this volume).

The only domesticated animal is the dog. A tooth of man was also recorded. It was found in the body of the shell-mound and probably came from a grave destroyed by later activities.

It is interesting that the bones in the shell-mound are generally small splinters, less than c. 10 cm in length, much smaller than the ones found in the waste dumps

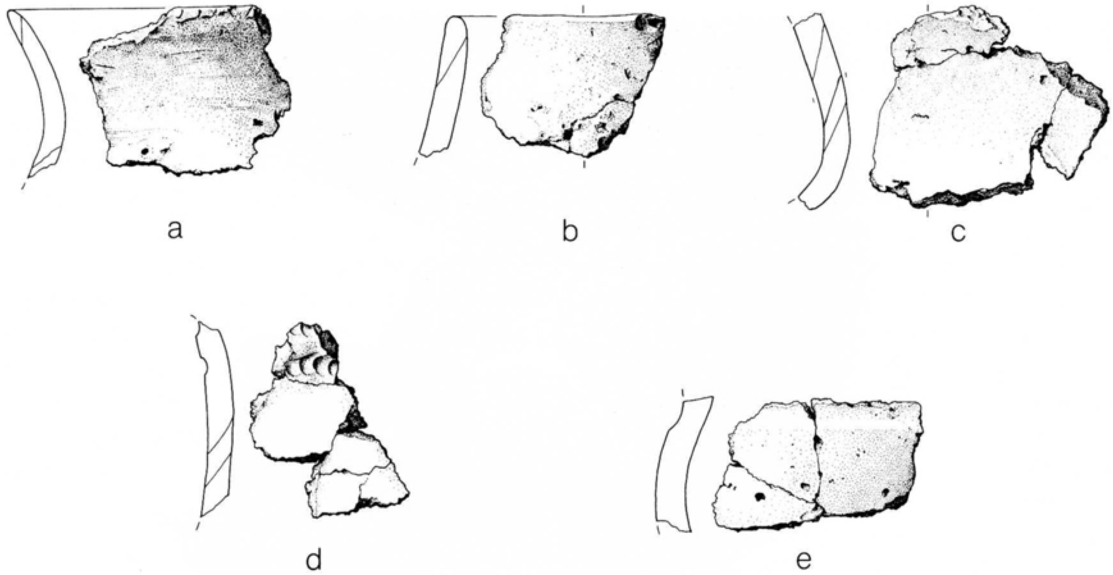


Fig. 33. Undecorated rim-sherds from the bottom of the Early Neolithic level of the *køkkenmødding* (a–b) and belly-sherds from the same level (c, e). d) Rim-sherd decorated with two lines of horisontal cords. 1:2. – J. Mührmann-Lund *del.*

(lake and sea deposits) at for example Ringkloster and Tybrind Vig, where the bones have been deposited in wet muddy layers outside the habitation area (S. H. Andersen 1975, 1985). This difference may be explained by the fact that the bones from the *køkkenmødding* have either been exposed to many different taphonomic factors such as dogs, weather, and trampling, or that the bones were intentionally crushed for making soup (Binford 1983: 149–159). The latter interpretation is supported by the fact that many of these bone splinters are found close to the hearths and very often in small concentrations (fig. 14).

The vertical distribution of animal bones follows the same patterns as described for the flint debris. There is a close correlation between the ash levels around the hearths and the higher concentrations of bone; many of these bone splinters show traces of burning, which is in contrast to the bones in other layers of the shell-mound.

The bones from mammals and birds are in most cases found individually or in small heaps, while fish bones occur in small concentrations (10–15 cm in diameter) for which we do not have any interpretation at present. They display a similar distribution pattern to the other animal bones and are also concentrated around the hearths.

In a few cases, bones of mammals, including bones from animals killed for their fur (*i.e.* pine marten, wildcat), are also found in small clusters – a well known phenomenon at other Ertebølle sites such as Ringkloster (S. H. Andersen 1975) and Tybrind Vig (S. H. Andersen 1985:57).

Among the larger animals, wild pig, red deer, and roe-deer, were the most common species. All of these were hunted without any age class restrictions. Auroch is represented by only a few bones. One scapula of a red deer displays a distinct, unhealed hunting lesion (Bratlund, this volume, p. 102).

Animals such as red fox, badger, wildcat, lynx, common otter, wolf, pine marten and western polecat were killed for their fur.

Grey seal and porpoise were hunted at sea and along the coast.

A substantial number of birds, especially swans and ducks, were captured. The majority of these birds could have been taken on or near the water, but two species indicate forest hunting: Capercaillie and the ural owl.

The fact that fishing was of great importance is confirmed by the many fish bones (found in concentrations and as single bones), the wide range of species, and the tools used for this activity (see Enghoff 1993, this volume). At Bjørnsholm the freshwater species amount to 15%, the marine species to 22%, and migratory species to 63% of the total sample. The fish bone material found at Bjørnsholm is surprising because of the many bones of eel and roach. Just like Ertebølle itself, fishing at Bjørnsholm was directed towards eel. This characteristic separates the two Limfjord sites from contemporaneous settlements such as Norsminde (S. H. Andersen 1991; Enghoff 1991) and Tybrind Vig (S. H. Andersen 1985; Trolle-Lassen 1984).

Marine species are also represented, such as mackerel, herring, and garpike. Also Cyprids like roach, tench, and rudd are frequently found, followed by cod, three-spined stickleback, and greater weaver.

Freshwater species like perch and pike add to the diversity. The explanation for this interesting aspect of subsistence is to be found in the habitat at the time of occupation. The estuary with its many river outlets within easy reach of the settlement, must have offered excellent possibilities for eel fishing.

The number of bones from eel at Bjørnsholm is far greater than normally found at Ertebølle sites. One reason for this is the high content of fat in eel which makes this fish much more attractive than most other fish species. Everything points to the fact that eel fishing was of great importance in the diet of the inhabitants, and that this type of fishing was one of the decisive factors in positioning the settlement.

Eel bones were found throughout the shell-mound layers, thereby demonstrating that this type of fishing was carried out during *both* the Mesolithic and the Neolithic occupation phases. Such great numbers of eel bones have previously only been documented at Ertebølle (Enghoff 1987). The existence of this stable resource may explain why these two sites grew to become amongst the largest of the Late Mesolithic sites.

Of special interest is the occurrence of southern fish like black seabream, European seabass, and smoothhound, indicating a warmer sea than today.

The species and size of the fish give some information as to fishing techniques. Fishing must have taken place in shallow, coastal waters with stationary equipment, *i.e.* fishtraps near the river outlets and along the coastline. This technique probably also explains the more numerous marine species at Bjørnsholm, where the large fiord with access to the Limfjord, opened up for more marine species than the lagoon at Ertebølle (Enghoff 1987:64). However, the relatively numerous small fish-hooks of bone indicate that other fishing techniques were also employed at Bjørnsholm.

Gathering is documented by the many shells of oysters, mussels, cockles, and periwinkle.

Some information on seasonality is available. The bone sample of the larger mammals points to an occupation period from late winter (January–February) to late summer (July–August), the presence of mackerel and garfish indicates summer fishing, and the eels were caught in August. The animals used for fur were most probably hunted in the winter months. This is also the case with the swans and some species of ducks.

At present, we have indicators of spring, summer, autumn, and winter activities, but it would be premature to argue that there was permanent year-round occupation.

One of our future tasks is to analyze the bone content and the seasonal indicators of the different stratigraphic units of the shell-mound, to see whether these indicators are restricted or found throughout all the units.

The economy of the Early Neolithic occupation

As would be expected with such a mixture of habitats as is the case in the Bjørnsholm area, hunting, fowling, gathering, and fishing played important roles in the economy. Bones of wild-boar, red fox, pine marten, red deer, roedeer, gannet, and whooper swan were found in the *køkkenmødding*. The domesticated animals include sheep, cattle, and pig (Bratlund 1993, this volume).

Fishing also took place and the species are largely identical with the Mesolithic ones. Eel is the most common species, followed by fish from the cod-group, mainly cod, but also mackerel, flatfish (plaice, flounder, dab), and garpike were caught. Stingray was also found in this layer (Rosenlund 1985:23–24). In contrast to the contemporaneous shell-mound at Norsminde, fishing seems to have continued into the Early Neolithic period, although the number of fishbones in these levels is noticeably lower than in the Ertebølle layers (Enghoff 1993, this volume).

Shells of cockle dominate the Early Neolithic level, but oyster, mussel, periwinkle, and whelk were also collected during this occupational phase.

The change from oysters to cockles is interesting. This may be explained in several ways. In the preliminary article on the Norsminde *køkkenmødding*, where a similar change was observed, it was presumed that it reflects a general change in the marine biotope (S. H. Andersen 1991:37), and a similar development could have taken place in the Bjørnsholm area.

The animal bones from the Early Neolithic levels also point to occupation during most parts of the year (see Bratlund 1993, this volume).

Soil samples from the mound and the fill of the two vessels 2911 AAVT and AAVW from the Early Neolithic grave were investigated for pollen (S.T. Andersen 1992). This analysis demonstrated that birch *(Betula sp.)* woodland was growing in the neighbourhood, and that the birch woodlands were exploited using swidden cultivation.

Traces of agriculture are indicated by the presence of pollen of wheat *(Triticum sp.)* and pollen likely to belong to barley *(Hordeum sp.)*. Wheat and club wheat *(Triticum compactum)* have also been identified from impressions in a potsherd from the Early Neolithic level of the *køkkenmødding* (Mathiassen 1940:41. H. Helbæk *det.*).

The available information clearly points to a very mixed economy based on farming, hunting, fishing, and gathering, but it is not possible to say anything about their relative importance. It seems that *the economy of the Early Neolithic in all essential aspects continued the Mesolithic way of living* – adding only a few domesticated animals and arable agriculture.

The settlement continuity on this location must have been based on the stable resources. In the Early Subboreal there were still sufficient resources available to make this and several other locations, such as the sites at Åle and Lundgård, favourable for habitation. The Early Neolithic settlement at Bjørnsholm was of the same size as Mosegården in eastern Jutland (Madsen & Petersen 1984:71).

A similar contemporaneous settlement is the small shell-mound at Aggersund – also with a mixed economy comprising both pastoral agriculture, hunting, fishing, and collecting. From this site bones of aurochs, domesticated ox, wild-boar, domesticated pig, roe-deer, red deer, sheep/goat, dog, swan, duck, and vertebrae of cod as well as man have been recorded (S. H. Andersen 1979a: 13–14 and note 16).

In contrast to the rapid sharp transition in aspects of material culture from the Ertebølle to the Funnel Beaker Culture it is striking here to see the gradual continuous change in economy.

Bjørnsholm and Ertebølle

The two large *køkkenmøddinger* are located on the same stretch of the Limfjord – only c. 8 km apart. Surveys of the surrounding territories demonstrate, that these two sites are not only the largest in the area, but that they are surrounded by several smaller, contemporaneous settlements. Topographically, Ertebølle is in a more exposed location in a lagoon area, close to the open waters, while Bjørnsholm is positioned on a large estuary with calmer, protected waters, but still within easy reach of open waters. The Bjørnsholm *køkkenmødding* is longer and wider than the Ertebølle, which is the thickest of the two.

The main Mesolithic occupation at the two sites falls in the same period. At both sites the earliest habitation started during the regression after the Early Atlantic transgression. We find marine sand with a mixture of shells and rebedded cultural material from the Early Ertebølle Culture. After the retreat of the sea the middens began to accumulate around 4600–4700 B.C. and then continued through the following centuries – until 4200–4100 B.C. At both settlements the intensity of shell deposits culminated around 4300 B.C.

There are many similarities with respect to stratigraphy and features between the two large shell-mounds. In all essential aspects there is a high level of congruence, and the differences are to be ascribed to the different topographic situation.

The youngest *in situ* layers at Ertebølle are dated to c. 3900 B.C., after that time only few traces of Early Neolithic habitation are documented, while there is a continued and intensive habitation at Bjørnsholm until c. 3500 B.C., and finally there are scattered remains of habitation until the Early Middle Neolithic.

The economy of the Mesolithic levels is generally identical at both sites. It was based on fishing, hunting (both forest and at sea), and shell-fish collecting. It is interesting to observe the almost complete absence of large terrestial animals such as aurochs and elk, which are found at contemporaneous Ertebølle Culture sites further to the south, *e.g.* Ringkloster (S. H. Andersen 1975:84–89 and 94).

Eel fishing in particular was extensive during the *whole* occupation period. This activity is a very characteristic aspect of these sites, which separates them from other contemporaneous settlements. The fishing techniques also seems to be of the same type at the two sites: fishing in shallow, coastal waters with fishtraps and bone hooks. At Bjørnsholm there are more marine species than at Ertebølle.

Both sites were apparently occupied throughout the whole year.

The number of structures in the shell-mounds are few, mainly hearths of burned molluscs, which are surrounded by flint and bone debris from artefact production and food preparation.

Only few traces of habitation during the Late Mesolithic were found behind the two middens.

The flint inventory is of the same order and reflects a regional, Limfjord variant of the Ertebølle Culture in Jutland. All types of flint, bone, antler, and ceramics are present and demonstrate that the same types of production and consumption – home base activities – took place at both sites.

A difference is observed in the style of the flint artefacts. The flint tools from Bjørnsholm are generally much more regular and carefully made than at Ertebølle. This feature is characteristic for the whole period of occupation and may reflect the presence of different groups with different traditions of flint making. Such a hypothesis is supported by the complete lack of Ertebølle sites in the fiord at Trend Å (fig. 2). Despite intensive surveys, no Ertebølle sites have been recorded in this fiord, which is approximately of the same size and with a similar habitat as the Bjørnsholm fiord. If we take all reservations with regard to source criticism and representativity into consideration, this lack of settlements is quite surprising. The Trend fiord is located half-way between the Bjørnsholm and Ertebølle sites, and an explanation for the absence of sites *could be* that this area was lying too close to the two other settlements, such that there were not enough resources to sustain a third system of exploitation.

CONCLUSION

The Bjørnsholm *køkkenmødding* is a stratified shell-mound with a lower Ertebølle series capped by an upper Early Neolithic section belonging to the Funnel Beaker Culture. The lower (Ertebølle) shell-mound is dated to 4700–4000 B.C. while the Early Neolithic level belongs to the period 4000–3500 B.C.

The main part of the Mesolithic occupation at Bjørnsholm is roughly contemporaneous with the Ertebølle site.

No extensive traces of occupation outside the *køkkenmødding* have been found belonging to the Ertebølle occupation phase. All finds reflect basic home base activities without any trace of specialization. The material culture of the lower midden reflects the whole range of Ertebølle flint, bone, and antler types. From the Mesolithic to the Neolithic the main types and type groups continue, but in a slightly different style, reflecting that the same types of activities took place in the two periods. Indeed, the Early Neolithic shell-mound shows indications of being a real dump – most probably being peripheral to the habitation area on higher dry ground to the west of the shell-mound area.

The explanation for the continuous habitation at Bjørnsholm is to be found in resource stability – mainly in the marine biotope. Fishing – especially of eel – was of major importance.

The economy of the Early Neolithic continues in "the Mesolithic way" and is made up of a mixture of hunting, gathering, fishing (although on a smaller scale than in the Mesolithic), farming based on the cultivation of wheat and barley, and animal husbandry probably represented by a few domesticated animals.

The presence of a habitation area and a rich grave behind the shell-mound (S. H. Andersen & E. Johansen 1992) indicates that this site must have had a high economic and social importance in the Early Neolithic. Therefore, it could not have been a short term seasonal catching site, a term which has hitherto been ascribed to the Neolithic coastal sites (Madsen 1982:203–205). The Bjørnsholm site should rather be considered as a *typical* Early Neolithic settlement with a mixed economy.

The greatest change in material culture is found in the ceramics, where a new technique, new types and decoration motifs appear. At Bjørnsholm the earliest Neolithic level is characterized by undecorated funnel beakers (related to Becker's A-pottery), which are found in a stratigraphic position below pottery belonging to the Volling Group. The lower Neolithic level at Bjørnsholm is the earliest well-dated settlement find of the Funnel Beaker Culture in Northern Jutland.

The transition from the Mesolithic to the Neolithic in this region of Denmark was a very short episode which took place in less than a century, radiocarbon dated to c. 3950 B.C.

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Acknowledgements

I wish to thank Erik Johansen, Aalborg Historiske Museum, for fine co-operation during field work at Bjørnsholm and for spending an enjoyable time together. Sincere thanks are also due to Claus Malmros, The National Museum, Natural Sciences Research Unit, Copenhagen, for inspiring discussions, much help with the figures 9–13, and for comments on the datings. Lene Frandsen, Varde Museum, is thanked for her help with the Harris-matrix, figs. 9–10. The English text was revised by David Robinson.

NOTES

1. The new excavations at Bjørnsholm are part of a joint research project by the Department of Prehistoric Archaeology, University of Aarhus, and Aalborg Historiske Museum. The scientific aim is to investigate the Late Mesolithic and Early Neolithic settlement systems and subsistence basis in the northwestern part of Himmerland. The Bjørnsholm *køkkenmødding* has Central Register no. 20 of Ranum parish, Ålborg County. The project has been sponsored by Aalborg Historiske Museum, The State Antiquary, *G.E.C. Gads Fond*, The Danish Research Council for the Humanities, *Dronning Margrethe II's Arkæologiske Fond*, and *Aarhus Universitets Forskningsfond*.
2. The excavation by the National Museum in 1931 was conducted by H. C. Broholm. Report in the archives of the National Museum, file nos. 356/30 and 361/31. An area of c. 77 m^2 was investigated.
3. The excavation by C. L. Vebæk was positioned c. 90 m from the western border of the *køkkenmødding*. Later smaller excavations have been performed west and southwest of the Bjørnsholm *køkkenmødding* by C. L. Vebæk: A Late Neolithic grave (National Museum file no. 1107/57, Central Register 26 of Ranum parish, catalogue no. A 48150) and an Early Middle Neolithic grave (National Museum file no. 1107/57, Central Register no. 25, catalogue nos. A 48151–59 og C 27501).
4. Information by Dr. Jørgen Hylleberg, Institute of Genetics and Ecology, University of Aarhus.
5. The charcoal samples were identified by Claus Malmros, The National Museum, Natural Sciences Research Unit, Copenhagen. Letter and report of 20.2.1990.
6. Report by U. Møhl of 22.5. and 28.5.1975 in the archives of the Zoological Museum, Copenhagen.
7. Report in the Museum of Natural History, University of Aarhus. Letter of 12.9.1954.
8. In the collections from the 1931 excavation in the National Museum is the base of an Ertebølle harpoon of type A (S. H. Andersen 1972: 108 and fig. 42a).

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Radiocarbon Datings from the Bjørnsholm Site, North Jutland

by KAARE LUND RASMUSSEN

Sample treatment

The conventionally dated samples were cleaned by dilute HCl prior to analysis in order to remove the outer surface. At least 10% of the sample mass was removed this way. The cleaned samples were converted to carbondioxide (CO_2) by acid treatment. The CO_2 was purified by freezing out other compounds. Subsequently the samples were dissolved in ammonium hydroxide and precipitated as carbonate. The samples were then kept in sealed flasks for at least 21 days in order to let the bulk of the radioactive ^{222}Rn decay. After that the samples were reconverted to CO_2 and purified in a CaO-oven in order to remove the remaining ^{222}Rn. Finally the samples were counted for at least 20 hours in a 2 litre 1.5 atm. conventional proportional counter equipped with a guard counter.

Stable isotope fractionation (δ^{13}C) was measured on all samples. The determined ages for the samples have been corrected for isotopic fractionation to the marine value ($\delta^{13}C = 0$ ‰ PDB) for all samples. The dates are thus directly comparable with dates for terrestrial material, i.e. no further correction is needed for reservoir effects.

The results are reported below as conventional radiocarbon ages (based on the Libby half-life) ± one standard deviation.

All samples have been calibrated into calender years using 20 years averages of the terrestrial curves in Radiocarbon (1986) with the aid of the University of Washington program. The interval of calibrated ages corresponding to ± 1 standard deviation (method A) is also reported.

Sample description of datings from Bjørnsholm

Samples were submitted by Søren H. Andersen unless otherwise stated.

K-5810 5210±95 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section, field D, co-ordinates 00/20, level 5.25 m. Expected age: Ertebølle – Early Neolithic Funnel Beaker Culture. Sample 2911 AKFK: Hg 27031. NNU A 6442.

Calibrated (Pearson *et al.*, 1986): 4030–4000 BC Cal.
Calibrated ± 1 stand. dev.: 4220–3830 BC Cal.
$\delta^{13}C$ = −0,1 ‰ PDB.

K-5817 5100±95 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section, field D, co-ordinates 00/90, level 5.15 m. Expected age: Early Neolithic Funnel Beaker Culture. Sample 2911 AKFL; Hg 27032. NNU A 6442.
Calibrated (Pearson *et al.*, 1986): 3960–3830 BC Cal.
Calibrated ± 1 stand. dev.: 4000–3790 BC Cal.
$\delta^{13}C$ = +0,3 ‰ PDB.

K-5818 5080±95 BP ^{14}C y
Shells (*Ostrea*). Oysters taken from face of section, field E, co-ordinates 00/90, level 5.25 m. Expected age: Early Neolithic Funnel Beaker Culture. Sample 2911 AKFN; Hg 27033. NNU A 6442.
Calibrated (Pearson *et al.*, 1986): 3950–3820 BC Cal.
Calibrated ± 1 stand. dev.: 3990–3780 BC Cal.
$\delta^{13}C$ +0,2 ‰ PDB.

K-5713 5320±75 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field D, co-ordinates 00/10, level +4.82 m. From the deepest part with artifacts from Middle Ertebølle Culture. Sample 2911 AENO; Hg 26933. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4230–4150 f. Kr. Cal.
Calibrated ± 1 stand. dev.: 4320–4010 f. Kr. Cal.
$\delta^{13}C$ +1,2 ‰ PDB.

K-5714 5380±70 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field D, co-ordinates 00/10, level +4.92 m. From the lower part of the midden with artifacts from Middle Ertebølle Culture. Sample 2911 AFZZ; Hg 26945. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4240 f. Kr. Cal.
Calibrated ± 1 stand. dev.: 4340–4050 f. Kr. Cal.
$\delta^{13}C$ +1,1 ‰ PDB.

K-5715 5360±100 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field D, co-ordinates 00/10, level +5.07 m. From the middle part of the midden with artifacts from Late Ertebølle Culture. Sample 2911 AFZY; Hg 26944. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4240 f. Kr. Cal.
Calibrated ± 1 stand. dev.: 4340–4040 f. Kr. Cal.
$\delta^{13}C$ +0,5 ‰ PDB.

K-5716 5450± 100 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field BH, co-ordinates 100/50, level +5.13 m. Expected age: Late Ertebølle Culture. Sample 2911 AENP; Hg 26935. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4340 f. Kr. Cal.
Calibrated ± 1 stand. dev.: 4370–4170 f. Kr. Cal.
$\delta^{13}C$ +0,7 ‰ PDB.

K-5717 5360±70 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field D, co-ordinates 00/90, level +5.17 m. From the uppermost part of the midden with artifacts of Early Neolithic Funnel Beaker Culture. Expected age: Late Ertebølle Culture – Early Funnel Beaker Culture. Sample 2911 AFZX; Hg 26943. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4240 f. Kr. Cal.
Calibrated ± 1 stand. dev.: 4340–4050 f. Kr. Cal.
$\delta^{13}C$ +1,0 ‰ PDB.

K-5718 4860±95 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field D, co-ordinates 00/70, level +5.22 m. From the uppermost part of the midden with artifacts of Early Neolithic Funnel Beaker Culture. Sample 2911 AFZW; Hg 26941. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 3680–3650 f. Kr. Cal.
Calibrated ± 1 stand. dev.: 3780–3530 f. Kr. Cal.
$\delta^{13}C$ +1,5 ‰ PDB.

K-5719 5070±95 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field E, co-ordinates 00/100, level +5.32 m. From the uppermost part of the midden with artifacts of Early Neolithic Funnel Beaker Culture. Sample 2911 AFZU; Hg 26939. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 3940–3820 f. Kr. Cal.
Calibrated ± 1 stand. dev.: 3990–3780 f. Kr. Cal.
$\delta^{13}C$ +0,9 ‰ PDB.

K-5720 4840±95 BP ^{14}C y
Shells (*Cardium, Mytilus*). Shells taken from face of section in kitchen, midden field E, co-ordinates 00/100, level +5.37 m. From the uppermost part of the midden with artifacts of Early Neolithic Funnel Beaker Culture. Sample 2911 AFZT; Hg 26938. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 3640 f. Kr. Cal.
Calibrated±1 stand. dev.: 3770–3520 f. Kr. Cal.
$\delta^{13}C$ +0,1 ‰ PDB.

K-5721 4760±90 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field E, co-ordinates 00/100, level +5.50 m. From the very top of the midden with artifacts from Early Neolithic Funnel Beaker Culture. Sample 2911 AFZS; Hg 26937. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 3620–3530 f. Kr. Cal.
Calibrated ± 1 stand. dev.: 3650–3380 f. Kr. Cal.
$\delta^{13}C$ +1,1 ‰ PDB.

K-4688 5500±95 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field AC, co-ordinates 50/50, level 6.79 m. From the top of the shell layer. Expected age: Ertebølle Culture. Sample 2911 DAA; Hg 25945. NV VIII A 6442.

Calibrated (Pearson *et al.*, 1986): 4350 BC Cal.
Calibrated ± 1 stand. dev.: 4460–4250 BC Cal.
δ^{13}C +1,4 ‰ PDB.

K-4689 5470±95 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field AB, co-ordinates 10–15/35–45, level 6.61 m at the bottom of the shell layer. Expected age: Ertebølle Culture. Sample 2911 QR; Hg 25946. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4350 BC Cal.
Calibrated ± 1 stand. dev.: 4450–4240 BC Cal.
δ^{13}C +1,5 ‰ PDB.

K-4790 5050±90 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from top of the kitchen midden, profile 2911 SPH, field K, southern profile, co-ordinates 00,10, level 274. Early Neolithic Funnel Beaker Culture. Sample 2911 SPM; Hg 26115. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 3930–3820 BC Cal.
Calibrated ±1 stand. dev.: 3980–3710 BC Cal.
δ^{13}C +1,0 ‰ PDB.

K-4791 5040±90 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from upper part of the kitchen midden, field K, southern profile, co-ordinates 00,10, level 290. Latest Ertebølle Culture – Early Funnel Beaker Culture. Sample 2911 SPN; Hg 26116. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 3910–3810 BC Cal.
Calibrated ± 1 stand. dev.: 3980–3710 BC Cal.
δ^{13}C +1,4 ‰ PDB.

K-4792 5410±90 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from the middle part of the kitchen midden, field K, southern profile, co-ordinates 00,15, level 307. Middle Ertebølle Culture. Sample 2911 SPO; Hg 26117. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4330–4250 BC Cal.
Calibrated ± 1 stand. dev.: 4350–4150 BC Cal.
δ^{13}C +0,6 ‰ PDB.

K-4793 5380±90 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from the middle part of the kitchen midden, field L, southern profile, co-ordinates 00,85, level 275. Middle Ertebølle Culture. Sample 2911 SPP; Hg 26118. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4240 BC Cal.
Calibrated ±1 stand. dev.: 4350–4050 BC Cal.
δ^{13}C +0,5 ‰ PDB.

K-4794 5560±90 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from lower part of the kitchen midden, field L, southern profile, co-ordinates 00,75, level 305. Middle Ertebølle Culture. Sample 2911 SPR; Hg 26119. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4450–4370 BC Cal.
Calibrated ± 1 stand. dev.: 4500–4350 BC Cal.
δ^{13}C +1,1 ‰ PDB.

K-4795 5310±90 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from lowermost part of kitchen midden, field L, southern profile, co-ordinates 00,85, level 335. Ertebølle Culture. Sample 2911 SPS; Hg 26120. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4220–4050 BC Cal.
Calibrated ±1 stand. dev.: 4320–4000 BC Cal.
δ^{13}C +1,3 ‰ PDB.

K-4796 4960±90 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from kitchen midden, plan 2911 LZZ, field D, co-ordinates 30,30, level 304–306. In direct contact with sherds from Early Neolithic Funnel Beaker Culture. Sample 2911 PLA; Hg 26121. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 3780–3710 BC Cal.
Calibrated ±1 stand. dev.: 3940–3690 BC Cal.
δ^{13}C +0,8 ‰ PDB.

K-4945 5440±90 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from kitchen midden, profile 2911 SPH, field L, co-ordinates 00,50, level 330–338. Middle Ertebølle Culture. Dated as control for earlier date K-4795 (see above). Sample 2911 OSX; SHg 1824. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4340 f. Kr. Kal.
Calibrated ±1 stand. dev.: 4360–4170 BC Cal.
δ^{13}C +0,8 ‰ PDB.

K-5068 5300±90 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from a kitchen midden, field R, co-ordinates 00,20, level 225–230. Transition Middle/Early Ertebølle Culture. Sample 2911 AADX; Hg 26363. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4220–4050 BC Cal.
Calibrated ±1 stand. dev.: 4240–4000 BC Cal.
δ^{13}C +1,8 ‰ PDB.

K-5069 5720±95 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from a kitchen midden, southern profile of field R, co-ordinates 00,20, level 245–250. Middle – Early Ertebølle Culture. Sample 2911 AADY; Hg 26362. NM VIII A 6442.
Calibrated (*Pearson et al.*, 1986): 4650–4580 BC Cal.
Calibrated ±1 stand. dev.: 4720–4470 BC Cal.
δ^{13}C +0,5 ‰ PDB.

K-5070 5770±70 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from kitchen midden, southern profile of field R, co-ordinates 00,20, level 255–260. Early Ertebølle Culture. Sample 2911 AADZ; Hg 26361. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4670–4620 BC Cal.
Calibrated ±1 stand.dev.: 4770–4530 BC Cal.
δ^{13}C +1,0 ‰ PDB.

K-5071 5840±95 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from kitchen midden, southern

profile of field R, co-ordinates 00,20, level 275. Early Ertebølle Culture. Sample 2911 AAEA; Hg 26360. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4770–4730 BC Cal.
Calibrated ±1 stand. dev.: 4890–4590 BC Cal.
$\delta^{13}C$ +0,1 ‰ PDB.

K-5515 4890±95 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field BJ, co-ordinates 100/35, level 5.50 m. Originates from the uppermost layer of the midden with artifacts from Early Neolithic Funnel Beaker Culture. Sample 2911 UAM; Hg 26741. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 3700 BC Cal.
Calibrated ±1 stand. dev.: 3780–3540 BC Cal.
$\delta^{13}C$ +1,0 ‰ PDB.

K-5516 5110±95 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from face of section in kitchen midden, field BH, co-ordinates 100/85, level 5.40 m. In direct contact with a large fragment of an Early Neolithic Funnel Beaker. Sample 2911 UAS, Hg 26742. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 3960–3830 BC Cal.
Calibrated ±1 stand. dev.: 4030–3790 BC Cal.
$\delta^{13}C$ −2,8 ‰ PDB.

K-5304 6090±100 BP ^{14}C y
Shells (*Ostrea ed.*). Oysters taken from kitchen midden, field U, layer 2, level 5.24–5.30 m on the highest point of a beach ridge. Early Ertebølle Culture. Submitted by C. Malmros and S.H. Andersen. Sample FHM 2911, Bjørnsholm 1988; Hg 26474. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 5050–5000 BC Cal.
Calibrated ±1 stand. dev.: 5210–4900 BC Cal.
$\delta^{13}C$ +1,3 ‰ PDB.

K-5306 5440±95 BP ^{14}C y
Shells (*Cardium, Litorina*). Shells taken from field Ø, layer 6, level 4.29–4.51 m, in marine sand layer at the foot of the kitchen midden. Expected age: Early Ertebølle Culture. Sample FHM 2911; Hg 26590. NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4340 BC Cal.
Calibrated ±1 stand. dev.: 4360–4160 BC Cal.
$\delta^{13}C$ +0,9 ‰ PDB.

K-5307 5850±95 BP ^{14}C y
Shells (*Ostrea, Cardium, Mytilus and Litorina*). Shells found in field Ø, layer 2, level 3.08–3.28 m, in the deepest marine sand layer at the foot of the kitchen midden. Layer contained flint. Sample FHM 2911; Hg 26588 NM VIII A 6442.
Calibrated (Pearson *et al.*, 1986): 4770 BC Cal.
Calibrated ±1 stand. dev.: 4890–4600 BC Cal.
$\delta^{13}C$ +4,0 ‰ PDB.

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Acknowledgements

B. Rønne and K. Skov are thanked for performing the chemical treatment and the C-14 counting. U. Rahbek, C. Malmros, M. Jacobsen, D. Robinson, A. Johnson and O.H. Eriksen are thanked for technical assistance. The Geophysical Institute and the Geological Institute, both at the University of Copenhagen are thanked for putting their mass spectrometers at our disposal.

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Journal of Danish Archaeology vol. 10. 1991, pp. 97–104.

The Bone Remains of Mammals and Birds from the Bjørnsholm Shell-Mound

A Preliminary Report

by BODIL BRATLUND

During excavations 1985–91 at the Bjørnsholm settlement site and shell-mound organised by Søren H. Andersen, University of Aarhus, and Erik Johansen, *Aalborg Historiske Museum*, an extensive material of faunal remains was recovered. The finds were by and large restricted to the calcareous environment of the shell-mound itself, whereas the adjacent areas only provided a few badly preserved bone fragments. Beside the undisturbed Ertebølle and Funnel-Beaker deposits the shell-mound comprised some Iron Age pits. These readily recognizable features contained a mixture of Iron Age bones and redeposited Stone Age material, and will not be considered further here.

In the present preliminary report the result of the faunal analysis of two samples of bone remains from undisturbed Stone Age deposits of the shell-mound is presented. The samples comprise together about half of the excavated remains of mammals, birds, and amphibia. The by far largest sample, 2234 bone and antler fragments, comes from the Late Mesolithic deposits associated with the Ertebølle Culture (ETBK). The smaller sample of 362 fragments is Early Neolithic and associated with very Early Funnel-Beaker (TRB) finds. The two samples are thus representatives of the latest respectively the earliest discernable entities in a shell-mound accumulated around the transition from the Mesolithic to the Neolithic. Radiocarbon dates for oyster shells from the Ertebølle layer range from 5050 ± 100 B.C. (K-5304) to 4050 ± 90 B.C. (K-5068), whereas the Early Neolithic occupation is dated to 3960 ± 95 B.C. (K-5516) – 3530 ± 90 B.C. (K-5721) (calibrated C-14 dates, *cf.* S. H. Andersen 1993).

BONE PRESERVATION

In general the bone remains from the midden had an excellent surface preservation, but was badly fragmented: In both samples about 90% of the recovered pieces were less the 5 cms long. Between the Mesolithic and the Neolithic sample no remarkable differences concerning preservation was seen, neither in weathering nor in the degree of fragmentation. Despite the amount of material – as counted by fragments – less than 20% of the total of each sample could be determined to species, and only a fraction proved useful for an assessment of the seasonal aspects of the shell-mound economy.

The majority of the material consisted of very small fragments 1–3 cms long, lying solitary or 2 or 3 pieces together. In a few cases in the Mesolithic layers actual bone heaps were found. These usually comprised bones from several different species and, beside a number of indeterminable splinters, they contained the few large fragments found in the shell-mound, *i.e.* fragments more than 10–12 cms long.

Compared with the size classes of bone waste from lakeside dumps from other Stone Age sites, for example Ringkloster (S. H. Andersen 1975), where fragments less than 5 cms long are rare, the shell-mound material is much more fragmentary, having been exposed to rather strong mechanical fragmentation processes. Excepting the relatively rare instances where sediment pressure or other secondary factors are responsible for the fragmentation, the well preserved pieces predominantly seem to come from fractures in fresh bone, thus indicating marrow-fracturing or other deliberate bone fragmenting activities.

How, in detail, the intentional bone fracturing was carried out, will not be described here, as much as only a minority of the bones lend themselves to a detailed reconstruction. It must, however, be pointed out, that the very fragmented state of the material not necessarily was brought about by culinary practises involving bone crushing.

Considering the depositional history of the midden the

Size	Total		*Capreolus*		*Cervus*		Unidentified Large mammals	
	n	%	n	%	n	%	n	%
1	148	6.62	1	0.79	–	–	142	8.01
2	883	39.53	26	20.47	10	10.00	788	44.44
3	558	24.98	28	22.05	10	10.00	464	26.17
4	290	12.98	18	14.17	22	22.00	207	11.68
5	128	5.73	12	9.45	17	17.00	76	4.29
6	76	3.40	12	9.45	9	9.00	42	2.37
7	49	2.19	12	9.45	9	9.00	21	1.18
8	41	1.84	5	3.94	8	8.00	12	0.68
9	12	0.54	2	1.57	1	1.00	8	0.45
10	11	0.49	2	1.57	2	2.00	5	0.28
11	12	0.54	2	1.57	3	3.00	4	0.23
12	4	0.18	1	0.79	–	–	2	0.11
13	2	0.09	–	–	2	2.00	–	–
14	6	0.27	2	1.57	2	2.00	1	0.06
15	3	0.13	–	–	1	1.00	1	0.06
16	4	0.18	1	0.79	1	1.00	–	–
17	4	0.18	2	1.57	1	1.00	–	–
18	–	–	–	–	–	–	–	–
19	–	–	–	–	–	–	–	–
≥20	3	0.13	1	0.79	2	2.00	–	–
Sum:	2234	100.00	127	99.99	100	100.00	1773	100.00

Table 1. Bjørnsholm shell-midden. Size of bone (and antler) fragments in the Late Mesolithic, ETBK, sample. Size class number = Maximum length of fragments in centimetres. (Size class 3 thus all fragments between 2,0 and 2,9 cm long, size 4 all 3,0–3,9 cm long pieces a.s.o.). N: number of fragments.
Error: A total of 16 pieces (incl. 2 capreolus and 3 cervus) were not measured.

degree of fragmentation can be accounted for in another way, under the presumption that the recovered material is only a selection of the skeletal material once present. At least for the dominant Mesolithic parts of the midden traces of hearths, artefact use, etc., designate the midden as settlement and activity area and not a mere dump for adjacent habitations (S. H. Andersen & E. Johansen 1987; S. H. Andersen 1991). It thus seems plausible, that bulky waste from the processing of game animals was removed from the midden surface in use, if not for hygienic, then at least for practical reasons. This would logically include the removal of larger bones and bone fragments from marrow-fracturing, thus resulting in a predominance in the midden of fragments which had not been regarded as cumbersome, that is those of a size similar to or smaller than the shells.

The few larger bone heaps in the Mesolithic deposits do not contradict this general interpretation. The different skeletal elements and species identified from these entities are suggestive of an accidental association of the bones rather than their being the traces of specific activities. Such accidental bone depots are consonant with crevices or depressions between shell-heaps in periods of more intense accumulation. A further argument for the rapid accumulation of shell material at least at times, and in parts of the midden area in use, is the frequent fragments or even whole bones from neonate or juvenile animals in the Mesolithic sample, not the least in the bone heaps. In the presence of dogs – remains of which have been found – such fragments must be expected to have been covered by shells almost immediately, in order to have had any chance of preservation.

FRAGMENTATION AND SPECIES REPRESENTATION

Another imminent aspect of the very fragmented state of the material is its influence on the representation of the different species of game animals. As usual in Late Mesolithic (and Early Neolithic) samples, remains of red deer (*Cervus elaphus* (L.)), roe-deer (*Capreolus capreolus* (L.)), and wild boar (*Sus scrofa* (L.)) predominate in the identified portion of fragments from the Bjørnsholm shell-mound.

Between bone samples from various sites differences in the relative frequency of these species have often been noted, and interpreted as related to different hunting practices and differences in natural resources around sites.

In the case of the Late Mesolithic and Early Neolithic materials at least, any large scale comparison based on fragment counts from different sites must take the taphonomic aspects of fragmentation and sorting of bones into consideration, – not only as a limiting factor for the amount of bone remains deposited, but also as a factor influencing the possibility for determining species specificly and consequently for the analytical retrival of any given species.

A range of methods has been devised to deal with the quantification of bone samples, notably by weighing the determined fragments, or by calculating the minimum number of individuals (MNI) of different sex and age classes necessary to account for all determined fragments (*i.e.* Grayson 1984; Reichstein 1989).

None of these methods do, however, overcome the basic problem: That a bone fragment has to be recognized as belonging to a species before any of the secondary procedures can be implemented.

The size distribution of the bone fragments in the larger Mesolithic sample from Bjørnsholm can be used to illustrate this (fig. 1 and table 1). If, for example, the number of fragments from the two anatomically related species, red deer and roe-deer, are compared, the higher fragment counts for roe-deer could be interpreted as indication of a higher frequency of roe-deer hunting.

Considering the size of the bone fragments, however, it becomes clear that the size distribution of the fragments belonging to the smaller species, roe-deer, corresponds better to that of the total sample found than the fragments from the larger species, red deer. When compared to the size distribution of unidentified fragments from larger mammals – that is the total sample minus remains of amphibia, birds, and rodents and thus that part of the material where red deer or roe-deer remains are probably hidden – this trend is supported. The bone fragments smaller than 3 cms constitute 78.62% of the unidentified mammals, 43.31% of the roe-deer but only 20.00% of the red deer remains. If fragments up to 5 cms' length are considered, the difference betweeen roe- and red deer are somewhat ameliorated, the percentages being 94.59%, 66.93%, and 59.00%, respectively.

On the average the red deer fragments are larger, thus suggesting that this species is underrepresented in the species list. This applies as well to the other large mammals, like wild boar, whereas the scarcity of the middle-sized and small carnivores most probably is fairly right. In the strongly fragmented material from Bjørnsholm large animals, species as well as individuals, are not as readily recognized, as in less fragmented samples. The validity of comparisons of the Bjørnsholm material and other contemporary finds whether from the settlement surfaces of other shell-mounds or lakeside dumps, should thus be preceded by careful analysis of possible inherent biases in each analysed sample.

The calculation of the MNI for small samples like the Bjørnsholm material has only limited value, as the recognition of individuals depends on the presence – or non-presence – of single bone fragments. Here the MNI first and foremost makes plain how very high the degree of bone loss in the shell-mound was. It can not, however, be taken at its face value as a representative age-structure of the hunted game, as no single skeletal element provided a comprehensive series through the age classes, and the MNI presented here is consequently a patchwork based on different skeletal elements. In such a case it may be predicted that young and subadult animals overweigh, as each fairly precise age-determination provides a new individual. Furthermore the strong fragmentation makes it predictable that those species whose teeth or jaw pieces are found most frequently offer the best possibilities for

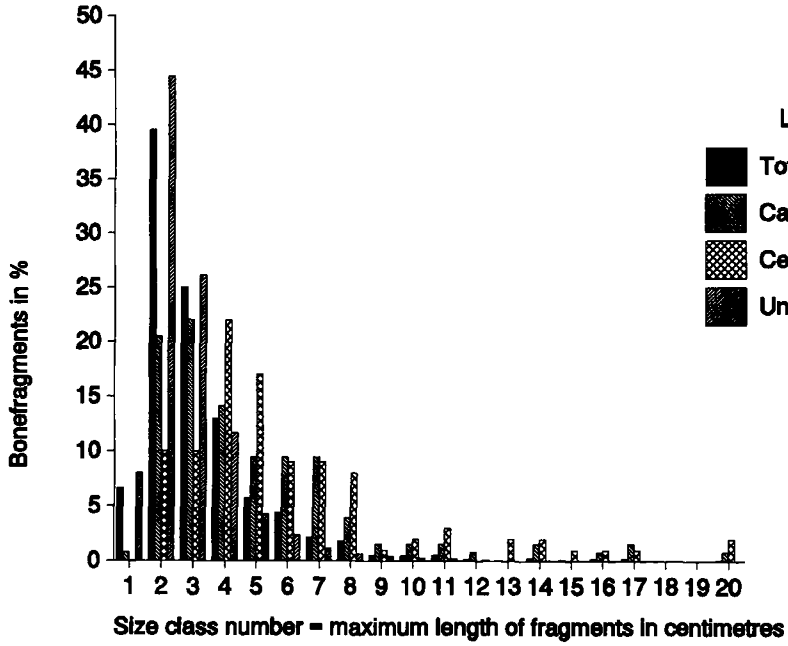

Fig. 1. Size distribution of bone fragments.

detailed age determination (here the wild boar) and thus give the highest MNI.

These problems also affect the determination of the seasons during which the shell-mound was used, and of the hunting methods. When all age groups are counted by 1 or 2 individuals, eventual quantitative preferences can hardly be detailed, and there is an imminent danger of missing periods of the year entirely. Basically the seasonal data from the shell-mound depend on two different criteria: 1) The mere presence, *i.e.* any fragment from a juvenile animal or migratory bird; 2) the quality of the fragment, *i.e.* the few pieces of jaw or antler suitable for determination. As the second criterion is rarely met amongst the strongly fragmented bone remains, the possible preference for particular periods of the year for settlement near the shell-mound will be based mainly on the presence of species.

THE LATE MESOLITHIC FAUNA

Summarizing the species list, Table 2, red deer (*Cervus elaphus* (L.)), roe-deer (*Capreolus capreolus* (L.)), and wild boar (*Sus scrofa* L.)) must be regarded as the most important game animals in the Bjørnsholm hunting territory together accounting for about three quarters of all specified fragments. From these three species adult and subadult animals as well as juveniles, and even neonates, were brought to the shell-mound.

The wild boar material comprised 83 fragments, whereof 32 came from neonate or juvenile pigs, the rest from adults or subadults. All parts of the skeleton are represented, with single teeth, small pieces of upper or lower jaw, and toe bones being most frequently encountered. The MNI counts 9, perhaps 10 different individuals: 2 neonates, 2 juveniles (one of which is 2–3 months old), 2 young subadults (one of which is 6–12 months old), 1 (perhaps 2) older subadults (at least one is 18–24 months old), and 2 adults. The wild boars could thus all have been hunted in the late spring – early summer between March and June, but some might have been hunted earlier, in the winter half of the year.

Four fragments from pig (*Sus sp.*) come from comparatively small animals and could not be determined with absolute confidence as wild boar. Three of these pieces were from juveniles and one from a young subadult. These fragments might add one young subadult, 10–16 months old, to the MNI for wild boar.

Roe-deer was identified from 129 pieces comprising two pieces of antler and bone fragments from all parts of the skeleton with pieces from skull and metapodials somewhat more common than other bones. Five bone fragments were from neonate or juvenile animals, the rest from adults or subadults. The MNI counts 7, perhaps 8 roe-deer: 1 neonate, 1 or 2 juveniles, 2 very young subadults (yearling?), two older subadult or adult females, and 1 adult male. The latter was shown by an unshed three-tined antler, thus indicating a time of death in the summer half of the year, between April and October. The neonates and juveniles could have been killed from June until July or August.

The red deer remains amount to 103 fragments including 14 pieces of antler. The antler fragments often carried traces of working, and for at least 5 pieces the determination of red deer antler has to be taken with a grain of salt. The bone fragments come from all parts of the skeleton, single teeth, toe bones, and metapodial fragments being the most often encountered. Sixteen bone fragments are from neonate and juvenile red deer calves. The MNI counts four individuals, 1 neonate, 1 juvenile, one young subadult, and one adult deer. The presence of the very young calves suggests hunting in the early summer, in June or July, whereas the antler remains are inconclusive.

Besides the three most common ungulates, wild boar, roe-deer, and red deer, the genus *Bos* was recorded, but in only two cases. One of these could by the small size of the bone be attributed to the domestic form, *Bos primigenius f. taurus* (L.). The bone fragment comes from the uppermost part of the ETBK oyster deposits, but it should rather be considered in connection with very early TRB finds in the immediate vicinity (see S.H. Andersen, this volume). The second bone fragment could not be determined further than to the genus *Bos*. As the aurochs (*Bos primigenius* (Boj.)) has been recorded in the ETBK section of the not finally evaluated part of the Bjørnsholm material, both the domesticated and the wild form of *Bos* may be considered as candidates for the moment.

Marine hunting is documented by remains of porpoise (*Phocaena phocaena* (L.)) and grey seal (*Halichoerus grypus* (Fabr.)), but both species by a few bone fragments only, and consequently with an MNI count of 1 per species. The fragments comprise pieces of humerus (grey seal) and vertebrae (porpoise), thus indicating that the marine mammals just as the land mammals were brought to the site complete and were butchered there.

Species (or higher category)		No. of fragments:	
Animals:			
Amphibians:	Amphibia:		
Toad unspec.	*Bufo sp.*	6	
Frog unspec.	*Rana sp.*	1	
Amphibians unspec.		7	
Amphibians unident.		2	
Summa,amphibians:		9	9
Birds:	Aves:		
Black-throated diver	*Gavia arctica* (L.)	2	
Rednecked grebe	*Podiceps griseigena* (Bodd.)	1	
Gannet	*Sula bassana* (L.)	3	
Whooper swan	*Cygnus cygnus* (L.)	4	
Barnacle goose	*Branta leucopsis* (Bechst.)	1	
Velvet scoter	*Melanitta fusca* (L.)	3	
Duck unident.	*Anas sp.*	6	
White-tailed eagle	*Haliaeetus albicilla* (L.)	1	
Osprey	*Pandion haliaetus* (L.)	1	
Capercaillie	*Tetrao urogallus* (L.)	2	
Curlew	*Numenius arquata* (L.)	1	
Sandpiper unspec.	*Tringa sp.*	1	
Ural Owl	*Strix uralensis* (Pall.)	1	
Thrush unspec.	*Turdus sp.*	3	
Birds ident.		30	
Birds unident.		49	
Summa, birds		79	79
Mammals:			
Insectivores:	Insectivora:		
Northern mole	*Talpa europaea* (L.)	1	1
Rodents:	Rodentia:		
Northern water-vole	*Arvicola terrestris* (L.)	5	
Vole unident.	*Microtus sp.*	1	
Yellow-necked mouse	*Apodemus flavicollis* (Melch.)	1	
Mouse unident.	*Apodemus sp.*	4	
Red squirrel	*Sciurus vulgaris* (L.)	1	
Rodents ident.		12	
Rodent unident.		7	
Summa, rodents		19	19
Carnivores:	Carnivora:		
Wolf	*Canis lupus* (L.)	3	
Dog	*Canis lupus f. familiaris* (L.)	5	
Red fox	*Vulpes vulpes* (L.)	15	
Wild-cat	*Felis silvestris* (Schreb.)	2	
Lynx	*Lynx lynx* (L.)	1	
Pine marten	*Martes martes* (L.)	2	
Western polecat	*Mustela putorius* (L.)	2	
Common otter	*Lutra lutra* (L.)	3	
Badger	*Meles meles* (L.)	6	
Grey seal	*Halichoerus grypus* (Fabr.)	2	
Artiodactyles:	Artiodactyla:		
Wild boar	*Sus scrofa* (L.)	83	
Swine unspec.	*Sus sp.*	4	
Roe-deer	*Capreolus capreolus* (L.)	129	
Red deer	*Cervus elaphus* (L.)	103*	
Cattle	*Bos primigenius f. taurus* (L.)	1	
Ox unspec.	*Bos sp.*	1	
Whales:	Cetacea:		
Porpoise	*Phocaena phocaena* (L.)	1	
Large mammals ident.		363	
Large mammals unident.		1780	
Summa, large mammals		2143	2143
Man:			
Man	*Homo sapiens sapiens*	1	1
Total number of fragments in ETBK sample:			2252

Notes:
*antler: 21, bone: 82.

Table 2. Bjørnsholm shell-midden sample. Mammals, birds, and amphibia from Late Mesolithic (ETBK) layers. N = number of bone or antler fragments identified to species or higher category.

The same applies to the carnivores, where the sparse bone remains from each species generally comprise skeletal parts, which are in better agreement with the import of whole animals to the shell-mound than would be selected parts like untrimmed furs or pelts. Again the MNI count is restricted to the minimum of 1 each of a range of species: wolf (*Canis lupus* (L.)), dog (*Canis lupus f. domesticus* (L.)), lynx (*Lynx lynx* (L.)), wild cat (*Felis silvestris* (Schr.)), polecat (*Mustela putorius* (L.)), badger (*Meles meles* (L.)), and otter (*Lutra lutra* (L.)). The red fox (*Vulpes vulpes* (L.)) was, however, counted twice, but like the above mentioned species all bones were from adults or subadults. The pine marten (*Martes martes* (L.)) was represented by a MNI of 2 individuals, one adult or older subadult and one juvenile, probably a few months old.

In general the hunting of the smaller carnivores may be seen as associated primarily with the provision of furs, and thus – with due caution – perhaps indicating autumn or winter activities. The presence of an young pine marten does, however, suggest that potential furbearing animals were also taken in the summer months. Moreover, carnivore bones from better preserved materials, for example those from Tybrind Vig, display cutmarks, which can hardly be attributed to skinning only (Trolle-Lassen 1986).

Even by modern Danish standards badgerham is considered a delicacy (Weitemeyer 1984), and that dogs and several species of rodents have been in culinary esteem at other times and places than modern Western Europe need not be discussed further here. Only, it should be pointed out that remains of carnivore carcasses do not necessarily have to be interpreted as refuse from skinning only or as traces of ultimate emergency foodreserves.

The rodents are represented by red squirrel (*Sciurus vulgaris* (L.), water-vole (*Arvicola terrestris* (L.)), and the yellow-necked mouse (*Apodemus flavicollis* (Melch.), and the insectivores by the mole (*Talpa europea* (L.)). Of these the red squirrel has most likely been hunted for its fur, whereas the remains of voles and mice, and the unspecified bones of toads and frogs as well, probably represent later intrusions.

The comparatively small number of identified bird bones comprise an extensive sample of mainly aquatic species. None of these have MNI counts of more than one individual, except the whooper swan (*Cygnus cygnus* (L.)), where at least two individuals had been brought to the shell-mound. The birds comprise seasonally indifferent (if not necessarily resident) species, which could have been hunted in the summer or in the winter, and a smaller group, whose presence in the Limfjord most probably was restricted to the winter months. The hunting of whooper swan, barnacle goose (*Branta leucopsis* (Bechst.)), gannet (*Sula bassana* (L.)), and blackthroated diver (*Gavia arctica* (L.)) may thus have taken place sometime between October and April. In addition a bone from a bird about the size of a goose, which unfortunately could not be determined to the species level, shows medullary bone deposits, thus indicating a time of death in the spring shortly before the begin of the breeding season.

Whereas the majority of the birds could have been taken on or near the water, only two point to inland hunting, namely the capercaille (*Tetrao urogallus* (L.)) and the ural owl (*Strix uralensis* (Pall.)). As a distinct forest species the latter indicates the presence of mature woodland within the Bjørnsholm foraging range – with more emphasis than the hints already given by the hunting of mammals like red squirrel, pine marten, and wild boar.

Last not least, a human molar was found. It may come from a destroyed grave and does thus, strictly speaking, not belong to the remaining faunal material.

Human modification of the bones

A scapula from an adult or older subadult red deer most probably show the traces of an unhealed hunting lesion. The lesion in question is seen as a deep, sharply cut groove running across the medial side of the collum, and containing several small indeterminable flint splinters. The doubt concerning the nature of the fracture is rooted in the likeness of the powerful blows of arrow-points to those from axes. A more or less superficial blow from for example an flake axe could possibly leave traces much like the groove found on the scapula, including the embedded splinters of flint. It is, however, hard to argue for the placement of such a single blow. Hitting in this place would most probably be done in connection with the severing of the scapula – humerus joint. As the blow is placed almost a handbreath too high to be effective, and – judging from the lack of further traces at least on the scapula – was not repeated, a hunting lesion caused by a flint-tipped arrow seems a likelier interpretation.

If so, the red deer had been shot from an almost frontal position. The ensuing lesion may not have proven immediately fatal itself, but by severing several muscles in the shoulder it would have been a severe hindrance to flight.

Cutmarks have been encountered on the identified bone fragments but both cutmarks and identified remains are too rare to warrant a description of the buthering technique used on any particular species. Traces of working and modification for artefact production were found on red deer antler fragments, wing bones from large birds (*Cygnus*) and metapodials from roe-deer.

The gross of the inidentifiable fragments are small splinters of massive bone as found in the diaphysis of longbones (or the lower jaw) of the larger (wild boar, red deer) or middle sized (roe-deer, wolf, badger, etc.) land mammals, and may indicate regular marrow fracturing in the shell-mound area. On the other hand bone pieces, which could be referred to vertebrae or ribs, are rare, even when the specified fragments are added, and may to a higher degree have been taken away or destroyed by humans or scavengers.

THE EARLY NEOLITHIC FAUNA

The very small Neolithic sample does, not surprisingly, comprise fewer species and by MNI count fewer individuals as well (table 3). All species found are documented by

Species (or higher category)		No. of fragments:	
Animals:			
Amphibians:	Amphibia:		
Toad unspec.	*Bufo unspec.*	2	
Amphibia unident.		2	
Summa, amphibia		4	4
Birds:	Aves:		
Gannet	*Sula bassana* (L.)	1	
Whooper swan	*Cygnus cygnus* (L.)	2	
Swan unspec.	*Cygnus sp.*	2	
Birds, ident.		5	
Birds, unident.		6	
Summa, birds		11	11
Rodents:	Rodentia:		
Western water vole	*Arvicola terrestris* (L.)	2	
Rodents unident.		2	
Summa, rodents		4	4
Carnivores:	Carnivora:		
Red fox	*Vulpes vulpes* (L.)	2	
Pine marten	*Martes martes* (L.)	1	
Artiodactyles:	Artiodactyla:		
Wild boar	*Sus scrofa* (L.)	3	
Swine unspec.	*Sus sp.*	2	
Roe-deer	*Capreolus capreolus* (L.)	9	
Red deer	*Cervus elaphus* (L.)	6*	
Cattle	*Bos primigenius f. taurus* (L.)	1	
Ox unspec.	*Bos sp.*	3	
Sheep	*Ovis ammon f. aries* (L.)	1	
Sheep or goat	*Ovis/Capra*	1	
Large mammals		29	
Large mammals unident.		314	
Summa, large mammals		343	343
Total number of fragments in TRB sample:			363

*antler 3, bone 3.

Table 3. Bjørnsholm shell-midden sample. Mammals, birds, and amphibians from Early Neolithic (TRB) layers.

a few bone fragments only, and consequently have the minimum MNI count of one each, adult or older subadult. For wild boar and roe-deer can be added one juvenile respectively, thus showing that the shell-mound has been used in the summer. On the other hand the presence of whooper swan and gannet suggests use in the winter half of the year, too.

With regard to the wild hunted species, wild boar, roe-deer, red deer, red fox, and pine marten, as well as the birds, there is no significant differences between this and the larger Mesolithic sample, considering the very small sample size.

The Neolithic sample does however further comprise the remains of domesticated animals, i.e. cattle, and – possibly of more consequence – of sheep (*Ovis ammon f. aries* (L.)). To these two may be added domestic pig (*Sus scrofa f. ?domestica* (L.)) from the shell-mound samples not evaluated here.

SUMMARY – AND COMMENTS ON THE FAUNAL EVIDENCE

Regarding first the seasonal evidence from the Mesolithic sample the period from late winter (January-February) to late summer (July-August) may be suggested as the shortest span of time necessary to account for all species or individuals found. This is, however, only a paraphrase for the fact that winter, spring and summer indicators have been found.

As the seasonal indications from the Neolithic sample is yet more inconclusive, only pointing to human presence in the summer as well as in the winter half of the year, the same may – or may not – be true for the TRB settlement as well.

For both samples possible use of the shell-mound in the autumn or early winter can not be ruled out. Positive evidence for that period would in practice depend on fairly undamaged antlers or wild boar jaws in the material.

The Mesolithic hunting economy presented by this preliminary sample concentrate on the three big ungulates, wild boar, red deer, and roe-deer, all of which were killed seemingly without age class restrictions. As a matter of fact juveniles are frequently encountered in well-preserved, carefully excavated Mesolithic bone samples, and were apparently hunted as was anything else. The species of marine mammals, carnivores and birds, are comparatively rare and may cautiously be interpreted in terms of occasional hunting, thus pointing to a flexible, opportunistic economy.

It can already be estimated, that the inclusion of the surveyed material would not bring about any significant change in relation to what has been stated here. First of all, the inclusion of the surveyed material will add more species of birds. To the list of mammals, only the aurochs will have to be added.

The rather extensive range of mammals in the Late

Mesolithic sample thus includes most, but not all, of the larger mammals to be expected in the comparatively complete fauna of Jutland in the Late Atlantic and the Subboreal (Aaris-Sørensen 1980). Thus the elk is not found in the Bjørnsholm sample, but it is present, as is brown bear, however rare, on other sites in the Limfjord area (*i.e.* Ertebølle (Winge 1900), and Virksund (Winge 1904)). A more conspicuous absent is the beaver. Whereas this species is found on ETBK or TRB sites in East Denmark (*i.a.* Mulbjerg and Troldebjerg), and in East Jutland (Dyrholmen), as well as Schleswig-Holstein (Degerbøl 1942; Skaarup 1973; Aaris-Sørensen 1985), it has as yet not been reported from any of the Limfjord sites.

An interesting aspect of this concerns the possibility for roughly estimating when a shell-mound sample may be regarded zoologically significant.

Using the recently excavated faunal sample from Ertebølle as a starting point (S. H. Andersen & E. Johansen 1987) a sample of 632 identified bone fragments produced almost the same species list as the wast material excavated ninety years before (Winge 1900).

As mentioned above, the Mesolithic sample of 412 identified fragments from Bjørnsholm presented here does not cover all species of birds from the site, but describes fairly well the relation between the three primary game animals and the rest. This may suggest that this kind of material, being rich in species, however very fragmented, may be roughly surveyed by means of some 500 identified bone fragments. With a percentage of identified fragments from both sites of about 20, this would be the equivalent of no more than 2500–3000 excavated pieces.

Taking these estimates into account the preliminary Neolithic sample from Bjørnsholm presented here must be considered far too small for a survey of the wild fauna around the shell-mound. It does, however, support the suspicion that the presence of the two odd fragments of domestic species may be the more significant. Not least in the case of the introduced species, the sheep, as a single bone fragment does not equal just one individual but a viable breeding population in the area.

More than showing signs of a distinct economic change, however, the Early TRB settlement in Bjørnsholm seems to have continued the Mesolithic way of life – just adding a few potentially powerful elements of their own.

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Acknowledgements

The material was put to my disposal by S. H. Andersen, Institute of Prehistoric Archaeology, Moesgård, University of Aarhus, who also advised me during the analysis. I also wish to thank sincerely H. Reichstein, Institut für Haustierkunde, Universität Kiel, who identified the rodent remains.

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Mesolithic Eel-Fishing at Bjørnsholm, Denmark, Spiced with Exotic Species

by INGE BØDKER ENGHOFF

INTRODUCTION

The Bjørnsholm settlement is situated at the Limfjord in northern Jutland, Denmark, about 8 km N of the contemporaneous *køkkenmødding* at Ertebølle (S. H. Andersen 1993, this volume, fig. 2). During the Atlantic and early Subboreal period, when the midden was formed, it lay on a c. 7 km long fiord, very close to its mouth into the Limfjord. The salinity of the Limfjord was at that time higher than today (Petersen 1987 and references therein; Petersen 1992). Three or four freshwater streams flowed into the past Bjørnsholm Fjord. However, the find of the mollusc *Bittium* in Atlantic sediments indicate high salinity in the Bjørnsholm Fjord during this period (K. S. Petersen pers. comm.). For further archeological and geological information on the settlement, see S. H. Andersen 1993 (this volume).

MATERIAL AND METHODS

The Bjørnsholm *køkkenmødding* is the largest known shell-mound in Denmark. Its extent has been about 325×10–40×max. 1.2 m. The first excavation of the *køkkenmødding* took place in the 1930'es, where only 11 fish bones (Eel, Rudd and Pike) were found (Rosenlund 1976). During 1985–1991 new excavations were made under the leadership of Søren H. Andersen (Institute of Prehistoric Archaeology, University of Aarhus) and Erik Johansen (Aalborg Historiske Museum). A 28 m long, 1 m broad ditch was excavated in the preserved remnant of the midden, as well as 3 short ditches parallel to the western (2) and eastern (1) ends of the main ditch (fig. 1). Some squares in the main ditch were, however, not or only partly excavated. The shell-mound consists mainly of Mesolithic deposits (up to 70–80 cm thick) but these have been disturbed by a few postholes from the Iron Age in the western end, and in the eastern end Early Neolithic layers (up to 30–40 cm thick) overlay the Mesolithic ones. These circumstances were considered as well during the excavation as during the analysis.

The fishbones analyzed here all derive from the new excavations. The entire material comes from the *køkkenmødding* itself, within which no traces of natural sedimentation have been observed. Part of the top of the Mesolithic layers may have been eroded by a transgression of the sea, but the underlying layers have not been disturbed.

Radiocarbon dates of the Mesolithic layers cover the period 5050±100 → 4050±90 BC. Dates for the Neolithic layers cover the period 3960±95 → 3530±90 BC (all dates calibrated, see K. L. Rasmussen in S. H. Andersen 1993, this volume).

During the excavation all recorded objects were plotted in a 3-dimensional coordinate system, and all sediment was sieved through a 2–3 mm mesh. Both wet and dry sieving were used.

Square K, which was very rich in fish bones, was excavated in 5 cm layers which were sieved in the laboratory, first through the field sieve (2–3 mm) and thereafter through a 0.6 mm mesh. The results from this square were used as a control of the method of excavation employed in the field. At the same time, the stratified sampling in square K provides a column showing the vertical

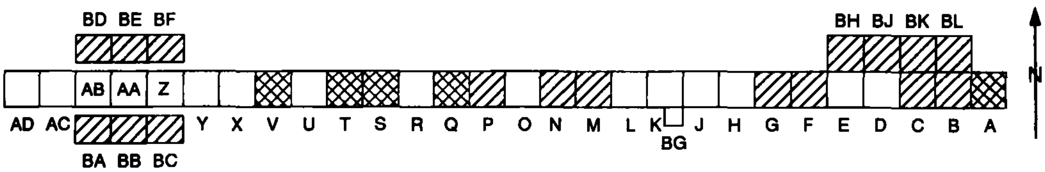

Fig. 1. Plan of the excavation at Bjørnsholm. Cross-hatched = not excavated, hatched = partly excavated squares, white = fully excavated squares.

distribution of fish bones in the midden (table 3). Some special fish bone samples were collected in square K: samples QUO, QUN, and OSU near a fireplace; sample SPT appeared in the northern profile of square K as a layer (c. 50 cm long, 10 cm thick) of fishbones. These special fish bone samples were sieved through a 0.6 mm mesh in the laboratory. See table 4.

Also square U was excavated in 5 cm layers but was only sieved through the field sieve. It does, however, provide further information on the vertical distribution of fish bones.

The fishbones generally appeared to lie in small groups in the field (Andersen 1992, fig. 5). The fishbones are overall very well preserved although neural arches and similar projections are broken. Only very few bones are burnt.

The fish bone material is kept at the Zoological Museum, University of Copenhagen.

NOTES TO IDENTIFICATION

Cyprinids: Cyprinid bones are difficult to identify, but Roach (11 bones) and Rudd (8 bones) could be recognized from the species-specific bones ossa pharyngea inferiora, processus pharyngeus ossis basioccipitalis and basioccipitale. Nine very large and characteristic vertebrae could be identified as belonging to Tench. The many small cyprinid vertebrae presumably derive from Rudd and in particular Roach.

Gadis: Of the gadid bones the following characteristic bones were identified to species: praevomer, parasphenoideum, praemaxillare, maxillare, dentale, and vertebrae 1–4. All of these bones in the material derived from Cod. In addition, otoliths were identified, these belonged to Cod and Saithe. The gadid bones are assumed to derive mainly from Cod – apart from the otoliths there is no indication of other species.

Flatfish: For difficulties in identification of flatfish bones, see Enghoff (1987, 1991). In the present material Flounder and Turbot could be identified by means of dermal denticles, the former in addition by means of 1 urohyale.

SPECIES OF FISH AND THEIR RELATIVE FREQUENCIES IN THE MATERIAL

The subfossil fish bones were identified by means of the comparative fish bone collection at the Zoological Museum, University of Copenhagen. The result is shown in table 1. The material has been divided into a Mesolithic and a Neolithic part. Bones from transition layers between the two periods, bones from mixed layers, and bones which for other reasons could not be stratigraphically placed with certainty, have been excluded.

The species list includes a total of 28 species. In the following text, these will be referred to by their English names. Scientific and Danish names are given in table 1. For each species the number of bones is given, and for the Mesolithic part of the material the relative frequency of each species is given as a percentage value. These percentages were calculated on the basis of 11490 identified bones. The Neolithic part of the material includes too few bones (252) for percentage calculations to be meaningful. The following analysis and discussion almost exclusively concern the Mesolithic phase which includes nearly the entire material.

Eel is the absolutely dominating species on the list, representing 56% of the identified bones. The cyprinids, represented by Roach, Tench, and Rudd, constitute 14%. Next in frequency follow the gadids, represented by Cod and Saithe, with 10%, Three-spined Stickleback with 7%, Greater Weaver with 6%, Mackerel with 2% and the Flatfish, represented by Flounder and Turbot, with 1%. The remaining species constitute a total of 4%.

The migratory species (see table 1) may be caught in both salt and freshwater, and the same is true of Three-spined Stickleback. These species constitute 63% of the fish bones.

The marine species (see table 1) constitute a total of 22% and the freshwater species (see table 1) 15%.

It must be mentioned that the percentual frequencies of bones of different species cannot be directly translated into percentual frequency of the species deposited in the shell-mound: Different species may have different numbers of bones per individual, and bones from different species have unequal chances of preservation (Enghoff 1987 and references therein). See also the chapter "Control of sieving efficiency".

There is, however, no doubt that as far as the present material is concerned, Eel has been by far the most important species.

Those species which are common in the material are represented by bones from all body regions, se table 2.

Most of the species on the list are common in Danish waters today, Mackerel, Garpike, and Atlantic Horse-

	Species	Mesolithic No. of bones		%		Neolithic No. of bones	
M	Eel (*Anguilla anguilla*), Ål		6460		56.22		154
F	Cyprinids (Cyprinidae), Karpefisk, total		1639		14.26		14
F	including: Roach (*Rutilus rutilus*), Skalle	111		0.97		5	
F	Tench (*Tinca tinca*), Suder	9		0.08			
F	Rudd (*Scardinius erythrophthalmus*), Rudskalle	8		0.07		1	
F	Cyprinids (Cyprinidae), Karpefisk, unspecified	1511		13.15		8	
S	Gadids (Gadidae), Torskefisk, total		1159		10.09		48
S	including: Cod (*Gadus morhua*), Torsk	253		2.20		7	
S	Saithe (*Pollachius virens*), Sej	8		0.07			
S	Gadids (Gadidae), Torskefisk, unspecified	898		7.82		41	
FS	Three-spined Stickleback (*Gasterosteus aculeatus*), Trepigget Hundestejle		754		6.56		
S	Greater Weaver (*Trachinus draco*), Alm. Fjæsing		721		6.28		1
S	Mackerel (*Scomber scombrus*), Makrel		177		1.54		12
S	Flatfish (Heterosomata), Fladfisk, total		169		1.47		9
S	including: Flounder (*Platichthys flesus*), Skrubbe	17		0.15			
S	Plaice/Flounder/Dab (*Pleuronectes platessa/Platichthys flesus/Limanda limanda*), Rødspætte/Skrubbe/Ising	147		1.28		9	
S	Turbot (*Psetta maxima*), Pighvarre	3		0.03			
S	Flatfish (Heterosomata), Fladfisk, unspecified	2		0.02			
S	Black Seabream (*Spondyliosoma cantharus*), Havrude		82 (+21 scales)		0.71		1
S	Clupeids (Clupeidae), Sildefisk, total		52		0.45		
S	including: Herring (*Clupea harengus*), Sild	40		0.35			
S	Clupeids (Clupeidae), Sildefisk, unspecified	12		0.10			
F	Perch (*Perca fluviatilis*), Aborre		51 (+ 5 scales)		0.44		
S	Eelpout (*Zoarces viviparus*), Ålekvabbe		51		0.44		1
S	Garpike (*Belone belone*), Hornfisk		41		0.36		4
S	Gurnard (*Eutrigla/Trigla*), total		26		0.23		1
S	including: Grey Gurnard (*Eutrigla gurnardus*), Grå Knurhane	11		0.10			
S	Gurnard (*E. gurnardus/Trigla lucerna*), unspecified	15		0.13		1	
F	Pike (*Esox lucius*), Gedde		26		0.23		
S	Atlantic Horse-mackerel (*Trachurus trachurus*), Hestemakrel		25		0.22		1
M	Salmonids (Salmonidae), Laksefisk, total		23		0.20		
M	including: Trout (*Salmo trutta*), Ørred	1		0.01			
	Trout/Salmon (*S. trutta/S. salar*), Ørred/Laks	20		0.17			
	Whitefish (*Coregonus* sp.), Helt/Snæbel	2		0.02			
S	European Seabass (*Dicentrarchus labrax*), Bars		11		0.10		
S	Spurdog (*Squalus acanthias*), Pighaj		10		0.09		1
S	Bullhead (*Myoxocephalus scorpius*), Alm. Ulk		8		0.07		2
S	Sand-eel (*Hyperoplus/Ammodytes* sp.), Tobis		2		0.02		
S	Gobiid (Gobiidae), Kutling		2		0.02		
S	Smoothhound (*Mustelus* sp.), Glathaj		1		0.01		2
S	Common Stingray (*Dasyatus pastinaca*), Pilrokke (K. Rosenlund det.)						1
Total			11490		100.01		252

Table 1. The species of fish in the Bjørnsholm material, numbers of bones of each species (or higher category), and for the Mesolithic part percentual occurrences. English, Latin, and Danish names of the species are given. F = freshwater species, S = saltwater species, M = migratory species. 254 fish bones which could not be uequivocally assigned to Mesolithic or Neolithic layers, are not included in the table.

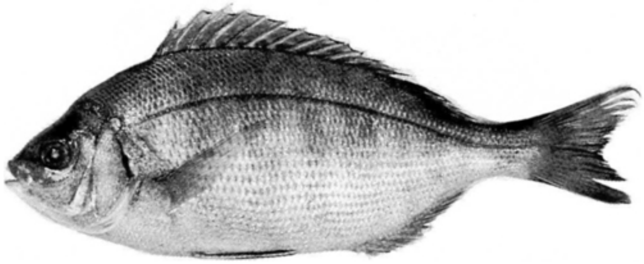

Fig. 2. *Spondyliosoma cantharus* – specimen caught near Skagen, Denmark. The fish has a characteristic deep body and a small head. The colour of back and sides usually varies in greyish blue and greyish brown hues with darker vertical bands and golden longitudinal lines; the belly is silver-grey. 1:2.

Fig. 3. Subfossil bones of *Spondyliosoma cantharus* from Bjørnsholm. Left: vertebra caudalis, top center: right articulare, bottom center: vertebra praecaudalis, right: parasphenoideum. 2:1.

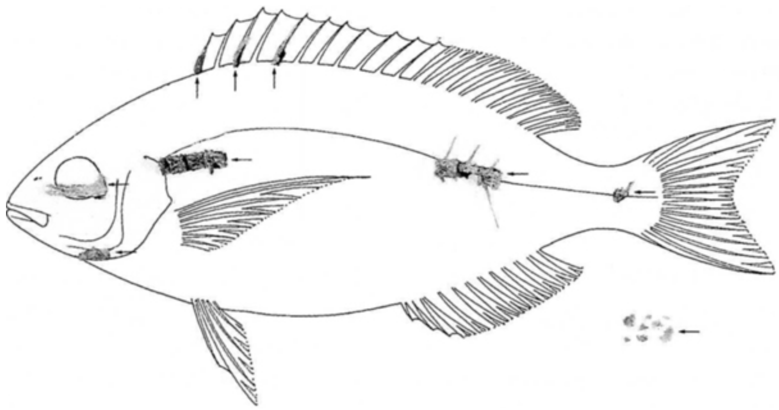

Fig. 4. Subfossil bones of *Spondyliosoma cantharus* from Bjørnsholm arranged in place on an outline drawing of the fish. A group of scales is seen in the lower right corner. The arrows indicate the bones. The bones probably all derive from a single individual.

mackerel only in the warmer half of the year, however. Four of the species, viz., Black Seabream, European Seabass, Smoothhound, and Common Stingray, are common south of England today but are more or less rare in Danish waters. The former three of these are new to the Danish subfossil fauna.

SOUTHERN FISH SPECIES IN THE BJØRNSHOLM MATERIAL

Black Seabream, *Spondyliosoma cantharus*, Da.: Havrude
This species (fig. 2) is represented by no less than 83 bones in the Bjørnsholm material, some of which are shown in fig. 3. In addition several finrays, isolated neural arches, and 21 scales were referred to Black Seabream. Black Seabream belongs to the family Sparidae, a large family with many similar-looking genera and species. The first discovered bones of this species included vertebrae only, and a safe identification was not possibly until a parasphenoideum appeared (fig. 3).

One of the finds (in square AD) probably represents a single individual, since 1 parasphenoideum, 1 keratohyale, 8 vertebrae including both the first and the last vertebra, and 8 scales were found together. This selection of bones represents the whole skeleton (fig. 4).

The 83 bones represent at least three individuals, since there are three first vertebrae and three left palatina. The first vertebrae were found 4–9 m from the palatina so the minimum number of individuals may be six rather than three. The Black Seabream bones are distributed over 20 m of the excavated ditch (squares AD to J). About half of the bones are concentrated in the western end (AD–Z); the radiocarbon dates in this area (4350±95 BC, K-4688, K-4689) are identical. It is not possible to see whether the three individuals represented by the three first vertebrae were caught at one occasion, or whether repeated catches of Black Seabream have been made.

About half of the Black Seabream bones including the three left palatina were found in square U (which was treated as a column sample during excavation). In this column, Black Seabream bones occur from top to bottom (c. 50 cm vertical extent). Radiocarbon dates in the almost neighbouring square R range from 4770–4730 BC (K-5071) to 4220–4050 BC (K-5068). Since the layers in this region of the ditch are horizontal, the same ages may be ascribed to square U (S. H. Andersen, pers. comm.).

One of the Black Seabream vertebrae derives from a Neolithic sample (in square J, where a Neolithic pit is present). Mesolithic contamination can, however, not be excluded.

All in all the horizontal and vertical distributions of bones suggest repeated catches of Black Seabream.

The subfossil Black Seabream were 30–40 long. The maximal length of the species is 60 cm. Black Seabream lives in inshore waters and its present distribution includes Atlantic coastal waters from Scandinavia to Angola, and the Mediterranean (Bauchot & Hureau 1986). It is, however, uncommon in the North Sea (Muus & Dahlstrøm 1964), although some are caught every year in Norway and almost every year in Sweden (Curry-Lindahl 1985).

European Seabass, *Dicentrarchus labrax*, Da.: Bars

The Bjørnsholm material includes 11 bones of this species (fig. 5) Most of the bones derive from fish of 30–40 cm length, a few vertebrae however from a somewhat larger specimen; thus at least two individuals are represented.

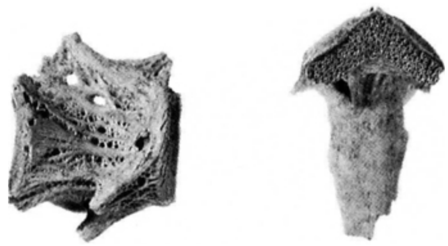

Fig. 5. Subfossil bones of *Dicentrarchus labrax* from Bjørnsholm. Left: vertebra caudalis, right: praevomer. 2:1.

Fig. 6. Subfossil vertebra of *Mustelus* sp. Notice the characteristic ridge in the bottom of the groove. 2:1.

The bones were found in squares AD to Z (3 bones) and square U (8 bones). I the U "column" European Seabass bones occur in the three lowermost samples and also somewhat higher up, all in all a vertical extent of 31 cm. As in the case of Black Seabream this indicates repeated catches.

European Seabass may reach a length of 1 m (Tortonese 1986), but individuals caught in Danish waters are normally 20–45 cm long (Muus 1970). European Seabass lives, often in schools, near the coast. During spring and summer it comes closer to the beach and may migrate into estuaries and bights (Curry-Lindahl 1985). The present distribution of European Seabass includes the North Atlantic from Norway south to Morocco and the Canary Islands, also the Mediterranean (Tortonese 1986). The species is an irregular but not particularly rare visitor in our waters where it probably occurs every year (Curry-Lindahl 1985).

Smoothhound, *Mustelus* sp., Da.: Glathaj

Three vertebrae of Smoothhound were found in the Bjørnsholm material. They are of a characteristic appearance (fig. 6) and give the impression of being more robust,

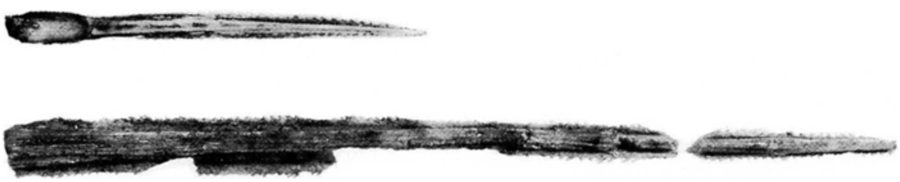

Fig. 7. Tail spine of Stingray. Bottom: subfossil spine from Bjørnsholm. Top: recent spine for comparison. 1:1.

	Eel	cyprinids	gadids	Three-spined Stickleback	Greater Weawer	Mackerel	pleuronectids	Turbot	flatish indet.	Black Seabream	Perch	Herring/clupeids	Eelpout	Garpike	Gurnard	Pike	Atlantic Horse-mackerel	salmonids	European Seabass	Bullhead	Spurdog	Smoothhound	Sand-eel	Stingray	Gobiid
Head bones																									
Parasphenoideum	48		40		4	2	1			2			1		4										
Praevomer	98		91		2		1						1						1						
Frontale	49	1		15	4		1								1										
Parietale	1																								
Supraoccipitale				7																					
Exoccipitale					2																				
Basioccipitale	33	1	19	6	2		1																		
Prooticum	15				1																				
Sphenoticum			1																						
Circumorbitalia		1			2																				
Otolithi			18									1													
Neurocranium unspecified					7		1					1			4										
Praemaxillare		2	26	4	3									6											
Maxillare	119	9	15		3		1																		
Dentale	255	12	8	4	8						2			5		4									
Articulare	98	19	12	2	2					2				1	1										
Quadratum	68	5	8	4	3		1			1							1								
Palatinum			3		7					4								1							
Ectopterygoideum																1									
Pterygoidea			6		2		5																		
Praeoperculare	1	1	1	5			3				2									1					
Interoperculare	14	1																							
Operculare	59	16	2	7	15										1										
Suboperculare	19																								
Symplecticum			3																						
Hyomandibulare	88	1	7	11	21		2									1									
Basihyale	6		2																						
Hypohyale		3			2																				
Keratohyale	214	11	3		3					2			1												
Epihyale	126	7			4																				
Urohyale	26	5	1		2		3			1															
Os pharyngeum inferius		186																							
Processus pharyngeus ossis basioccipitalis		11																							
Branchialia	32		11		2		2																		
Detached teeth[1)]		161														9									
Shoulder girdle																									
Posttemporale			19	6	22		3			1	1				2										
Supracleithrale		6	17		23		3		1																
Cleithrum	461		3	5	1		3								2										
Scapula		15								1															
Pelvic girdle																									
Basipterygium		22		46	1		1			1															
Vertebrae	4931	1137	1044	160	571	146	121		1	66	47	49	50	33	6	8	22	22	10	9	7	3	2		2

	Eel	cyprinids	gadids	Three-spined Stickleback	Greater Weawer	Mackerel	pleuronectids	Turbot	flatish indet.	Black Seabream	Perch	Herring/clupeids	Eelpout	Garpike	Gurnard	Pike	Atlantic Horse-mackerel	salmonids	European Seabass	Bullhead	Spurdog	Smoothhound	Sand-eel	Stingray	Gobiid
Others																									
Tripus		16																							
Os suspensorium		10																							
Os anale							10																		
dorsal spines				39																	1				
pelvic spines				62																					
tail spine																								1	
dorsal scutes				37																					
lateral scutes				133																					
scales etc.[2]		+					16	3		(21)	(5)						4								
unspecified bones	2		3	216	4	41				2				2	6	5									
Total	6763	1659	1280	770	723	189	179	3	2	83 + 21 scales	52 + 5 scales	51	53	47	27	28	27	23	11	10	8	3	2	1	2

Table 2. Specification of 11996 identified fish bones from Bjørnsholm. Numbers of different bones of each kind of fish are given. Regarding cyprinids, gadids, and pleuronectids, see text, page 106.
Notes: [1] Detached teeth of cyprinids derive from os pharyngeus inferius, those of Pike from oral bones. [2]+ means that scales were found but not counted (impossible). Scales of Black Seabream and Perch are not included in the total. The entry under pleuronectids refers to dermal denticles of Flounder, under Turbot also to dermal denticles, under Atlantic Horse-mackerel to the large, keeled scales of the lateral line.

i.e., more calcified, and with stouter ridges, than vertebrae from most other Danish cartilaginous fishes.

Two closely related species of *Mustelus* occur today in European waters: *M. asterias* and *M. mustelus* (Muus & Dahlstrøm 1964). Study of Recent comparative material showed no difference between vertebrae of these species which in general are very similar to each other.

The Smoothhound vertebrae were found in squares AB, J, and H and seem to derive from at least two individuals since two of the vertebrae are from sharks of about 80 cm length and one is from a somewhat larger specimen. Smoothhound may reach a length of 2 m (Curry-Lindahl 1985).

Two of the vertebrae were found in Neolithic samples (squares J and H), one of them together with a Black Seabream vertebra, see above. Again, Mesolithic contamination cannot be excluded. The horizontal distribution suggest at least two catches of Smoothhound.

Both species of Smoothhound are coastal species. Their present distribution includes the Atlantic from Morocco and Madeira northward to the British Isles, *M. asterias* even to the Shetlands, the North Sea and the Mediterranean (Branstetter 1984). They are irregular visitors in Danish, Norwegian, and Swedish waters (Curry-Lindahl 1985; J. Nielsen pers. comm.). *M. asterias* has been caught in set nets close to the Danish coast (Otterstrøm 1917).

Stingray, *Dasyatis pastinacea*, Da.: Pilrokke

Already during the beginning of the new excavations at Bjørnsholm a well-preserved tailspine of Stingray was found in the Early Neolithic layers in square G (Rosenlund 1985, 1986a). Almost the entire spine has been preserved, only the base and the very tip are missing; the break at the basis is ancient. The preserved fragment measures about 15 cm (fig. 7). All in all four subfossil finds of Stingray from Denmark are now known (Rosenlund 1985, 1986a, 1986b). On a living Stingray the spine is situated on the long, slender tail and is connected with poison glands. The spine of recent specimens may be as long as 35 cm; the fish is normally 50 cm to 1 m long, maximal length more than 2 m (Muus & Dahlstrøm 1985).

Stingray lives in from shallow to about 200 m deep water. Its recent distribution includes Atlantic coastal waters from South Africa northward to the British Isles, southern Norway, and (rarely) the western part of the Baltic, also the Mediterranean (McEachran & Capapé 1984). It is a casual visitor to Danish waters (at least 26 finds) (Curry-Lindahl 1985).

See also Enghoff (in press) concerning the southern species from Bjørnsholm.

CONTROL OF SIEVING EFFICIENCY

The column from square K which was sieved through the field sieve as well as a finer mesh in the laboratory invites some comments on the field excavation technique. Fine-sieving of all soil in the field is a practical impossibility. This does not necessarily matter as far as one realizes what is lost by the coarse mesh in the field sieve!

For each 5 cm layer which was sieved through the field sieve (2–3 mm) the material passing through the mesh was collected. One bag (c. 2 kg) of this material from each 5 cm layer was then fine-sieved (0.6 mm mesh) in order to control which bones pass through the coarse mesh. Material passing through the 0.6 mm mesh was examined but contained nothing of interest. In table 3 the bones recovered by the two sieves are shown, ordered in a sequence from top to bottom (unfortunately 2 samples are missing). The soil of each 5 cm layer was not weighed before the sieving. Therefore the columns G and F cannot be directly compared. But it remains a fact that all bones found on the fine mesh have passed through the coarse mesh – actually many more bones than shown in the table have passed through since only part of the material from each 5 cm layer was fine-sieved.

Table 3 shows which kinds of bones that are lost by the field sieve. Only some of the most frequent species are tabulated but the tendency is obvious: Some Eel bones are lost but many are also retained by the field sieve. The situation is worse regarding the small bones of cyprinids, and of the tiny Three-spined Stickleback the majority of bones are lost, if not almost all. The generally bigger gadid bones, on the contrary, are largely retained by the field sieve, to the extent that they have been preserved in the soil at all.

In summary, this shows that many small bones have been lost during field sieving on this settlement. For a general discussion of sieving efficiency, see Payne (1972).

Sample	Numbers of bones				Three-spined			
	Eel		Cyprinids		Stickleback		Gadids	
	G	F/2 kg	G	F/2 kg	G	F/2 kg	G	F/2 kg
RAX	8						1	
ORL	1	40	1	112				
ORO	5	24		4				
ORR	sample lost							
ORU	sample lost							
ORX	44	20	1			28		
OSA	8	50		6		78		
OSF	90	120	14	32	3	50		
OSP	17	24	1		1	6	2	
OSQ	250	54	71	26	2	22	2	
OSW	242	324	47	216	1	40	16	6

Table 3. The column in square K. The samples are arranged in accordance with their vertical position in the column. Samples RAX, ORL, and ORO are of mixed Mesolithic/Neolithic origin. Samples ORR and ORU have been lost. The remaining samples are purely Mesolithic. For the sake of clearness only the commonest species are tabulated. The special fish samples (QUN, QUO and OSU, see table 4) belong to levels OSQ and OSW. Each sample was sieved through a 2.5 mm mesh. About 2 kg of the material passing through the 2.5 mm mesh was sieved through a 0.6 mm mesh.
G = coarse mesh (2–3 mm).
F = fine mesh (0.6 mm). The bone numbers have been adjusted to correspond to exactly 2000 g of sediment.

Sample	Weight of sample (kg)	Numbers of bones: Eel	Cyprinids	Three-spined Stickleback	Gadids	Other species
SPT	1.90	363	352	15	11	34
QUN	1.08	157	239 +numerous scales	43	2	24
QUO	0.26	13	62 +numerous scales	35		2
OSU	0.17	425	13 +2 scales			

Table 4. Special fish samples excavated from square K. These samples were sieved through a 0.6 mm mesh, which seems sufficient for retainment of all bones of any significance.

These circumstances must be taken into account in connection with estimations of the importance of individual fish species in the material.

DISTRIBUTION OF FISH BONES THROUGH THE EXCAVATION

Fish bones have been found in all excavated squares and they are frequent all over. The western part of the midden (squares Z–AC) is especially rich in fish bones. The largest numbers were, however, found in square K in connection with a fireplace, and in the neighbouring squares J and H, which also contained a fireplace. The samples QUO and QUN from the margin of this fireplace in square K appeared in the field like compact patches of scales. In addition to the numerous cyprinid scales which were compressed into "cakes", these samples also contained many fish bones, especially from Eel, cyprinids, and Three-spined Stickleback, see table 4. Samples QUO and QUN further contained small fragments of mammal bones as well as shells of marine bivalves and a blade scraper with convex end retouch. The "fish layer" (SPT) from the northern wall of square K contained numerous fish bones (mostly from Eel and cyprinids) but also fragmented mammal bones as well as bivalve shells. Sample OSU was also described as a "fish layer", its content is of the same character as that of the above-mentioned samples. Although all these bones were found close to fireplaces none of them were burnt.

In squares A to L inclusive Early Neolithic layers overlie the Mesolithic layers. The rather few Neolithic bones derive from these fields.

Table 3 gives an impression of the vertical distribution of fish bones in square K. This square covers a small part of a Neolithic pit; therefore the three uppermost samples are of mixed origin, whereas the lower samples are purely Mesolithic. It is obvious that the Mesolithic layers, in particular the lowermost ones, are richer in fish bones. The special samples QUN, QUO, and OSU (table 4) belong to the lowermost levels and amplify this tendency. In the other "column sample", square U, the vertical distribution of bones is more uniform (or rather randomly variable).

The individual species of fish are homogeneously distributed through the excavation. The most frequent species, Eel, is found everywhere, actually in almost every sample of fish bones. Also the other frequent species are generally distributed; this is true of cyprinids, gadids, Three-spined Stickleback, Greater Weaver, and Flatfish, as well as of the summer-indicator Mackerel. The remaining species, which are represented by fewer bones, do by necessity not occcur in every square but even they seem to be randomly distributed over the entire excavated area. The distribution of the exotic, southern species in the excavation has been discussed in a special chapter – their bones are also quite dispersed.

The "columns" K and U show a uniform vertical distribution of fish *species* through the various layers.

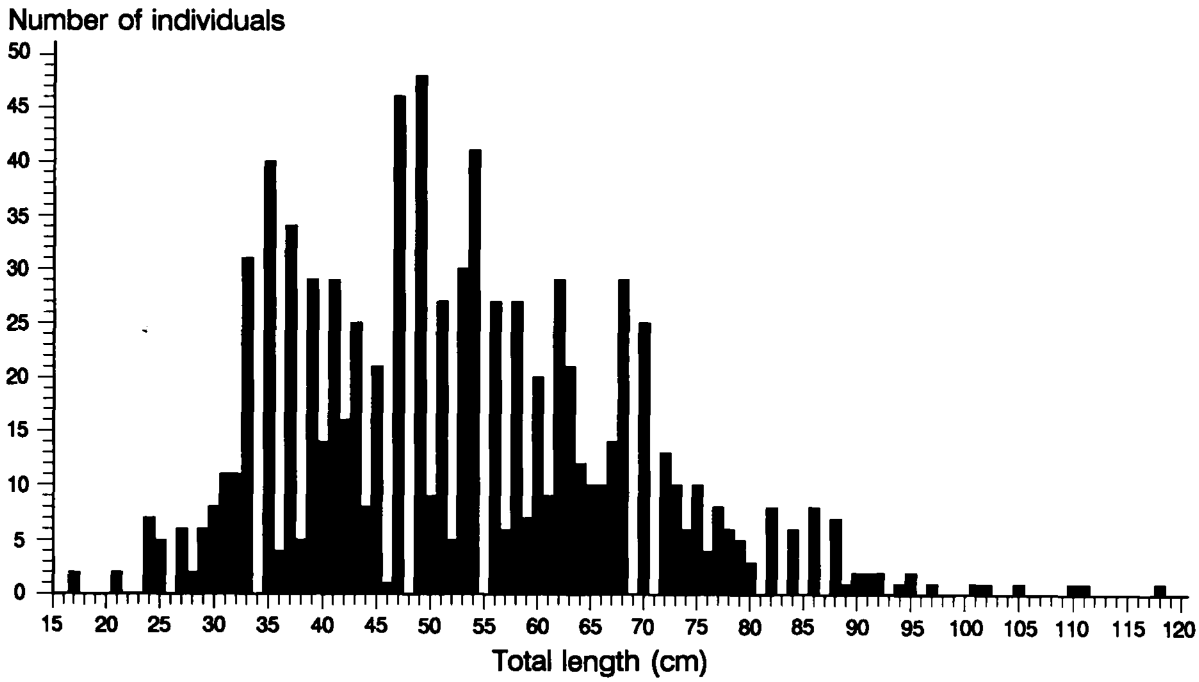

Fig. 8. Size-frequency diagram of eel (*Anguilla anguilla*) from Bjørnsholm. Total length estimated on the basis of measurements of cleithrum, keratohyale, dentale and 1. vertebra. Based on the Mesolithic part of the material only. N = 880.

Finally, it is worth noticing that freshwater species, saltwater species, and migratory species occur together in the same samples throughout the material.

SIZE OF FISH

Eel. The Bjørnsholm material includes very many Eel bones; therefore a size-frequency diagram was made. As in the analysis of the material from Ertebølle four subfossil bones were measured: cleithrum, keratohyale, dentale and 1st vertebra. The total length of the fish was estimated by means of regression equations expressing the relation between the bone measurement and the total length. See Enghoff (1987) for equations and definitions of bone measurements.

The very well-founded size-frequency diagram, which is based on Mesolithic bones exclusively, is shown in fig. 8. It appears that the Eel varied from 17 to 118 cm in total length, most specimens having measured 30–75 cm. An 118 cm Eel has been an impressive one, the present-day maximum length being recorded as 1 m (Muus & Dahlstrøm 1967).

Today all Eel longer than 50 cm are females (Muus & Dahlstrøm 1967) and this probably also applies to the Bjørnsholm material. These larger females probably included both yellow eel and silver eel. Eel shorter than 50 cm may be both males and females; such smaller females are yellow eel whereas males may have been both yellow and silver. The minimum length of male silver eel as known today is 29 cm (Petersen 1896).

Roach. The size-frequency diagram for Roach from the neighbouring settlement at Ertebølle was found to be highly interesting since a grouping of the specimens into sizeclasses was evident (Enghoff 1987). Therefore a size-frequency diagram was made for Roach from Bjørnsholm as well, although the number of Roach bones is modest.

Total length of Roach was estimated by means of regression equations expressing total length as a function of the width of 1. and 2. vertebrae. See Enghoff (1987) for equations and definitions of measurements.

The size-frequency diagram, which is based on Mesolithic bones only, is shown in fig. 9. Total length of Roach from Bjørnsholm varied from 5 to 24 cm. A diagram based on so few bones is little revealing in itself, but by comparison with the corresponding diagram from the Ertebølle settlement (Enghoff 1987, fig. 6) size-classes of about 5–6 cm, 10 cm, and 13–14 cm can be recognized on

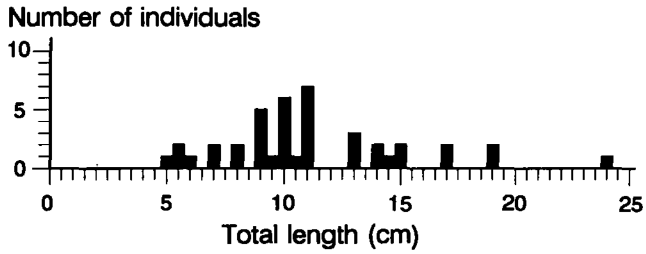

Fig. 9. Size-frequency diagram of roach (*Rutilus rutilus*) from Bjørnsholm. Total length estimated on the basis of measurements of 1. and 2. vertebrae. Based on the Mesolithic part of the material only. N = 42. Compare with the corresponding diagram for the Ertebølle-material (Enghoff 1987, fig. 6).

fig. 9, just as at Ertebølle – an indication that the same conclusions may be drawn (see also p. 116).

Other species. The gadids have been 20–50 cm long (lengths estimated from diameters of subfossil 1st – 4th vertebrae). Seven of the Tench bones derive from a very large specimen (estimated total length 60 cm); today Tench rarely exceeds 50 cm in Denmark but may reach 70 cm in eastern Europe (Muus & Dahlstrøm 1967). The *Salmo* bones on the contrary mostly derive from small specimens (just below 50 cm).

ANALYSIS OF GROWTH-RINGS IN OTOLITHS

Eleven otoliths from Cod (3) and Saithe (8) were particularly well preserved, even the surface appeared convincingly intact. A growth-ring analysis of these otoliths was made by E. Steffensen (The Danish Institute for Fisheries and Marine Research), who has years of experience with analysis of Cod otoliths. A growth-ring analysis may indicate the season at which the fish has died, as well as its age in years (Wheeler & Jones 1989).

Each analyzed otolith was snapped across its width through the nucleus, and the broken surface was ground on a wet grinding machine. The growth-rings on the plane surface could then be clearly seen through a microscope if the broken otolith was immersed in water. The growth-rings were even more conspicuous on the subfossil otoliths than on recent ones due to staining of the rings during the stay in the shell-midden.

All 11 analyzed otoliths turned out to derive from fish caught during late summer/autumn: the outermost growth zone was very broad and showed rapid growth characteristic of summer – however in nine out of 11 otoliths a faint hyaline outer edge indicates the onset of the slow wintergrowth. If the otoliths had been taken from recent fish, their death would have been assigned to the month of September. The otoliths derive from squares AC, AA, Z, P, and BC and thus represent several separate finds with some horizontal dispersion. Even though the number of analyzed otoliths is modest, this dispersion, in connection with the uniformity of the season indicated, suggests an emphasis on fishing in late summer/autumn.

The growth-ring analysis in addition showed that all the Saithes were one year old at death. Of the Cods, one had reached an age of two years, and two an age of three years.

DISCUSSION

The geographic position of the Bjørnsholm settlement (see introduction) was optimal for fishing. The species list accordingly reflects a most varied selection of species from salt as well as fresh water. The majority of bones (56%) derive from Eel. Second, third and fourth in frequency are cyprinids, gadids, and the tiny Three-spined Stickleback (table 1). The control of sieving efficiency clearly shows that many small bones have been lost during excavation, thus cyprinids and Three-spined Stickleback have been much more abundant than the sheer numbers of recovered bones suggest.

Apparently few bones of gadids have been lost during excavation. Also in terms of bone preservation the gadids are favoured, as their bones are poor in fats.

In this respect, the very fatty bones of Eel are less likely to have been preserved. Therefore the absolute dominance of Eel bones can only mean that the fishing at Bjørnsholm was no less than an Eel adventure! This conclusion is supported by the general occurrence of Eel bones in almost all fish bone samples.

Significance of Three-spined Stickleback. At first glance the importance of Three-spined Stickleback may appear strange, this species being usually not regarded as suitable for human consumption today. Its importance at Bjørnsholm is accentuated by its general distribution in the material, horizontally as well as vertically. Numerous bones of Three-spined Stickleback were also found at Ertebølle where their occurrence was, however, more local (Enghoff 1987). At Skateholm, Scania, Sweden, numerous Three-spined Stickleback bones were found, partly in graves, where their occurrence was interpreted as stomach content and food offerings (Jonsson 1986). Three-spined Stickleback may also have played an important role for the Mesolithic people at the Limfjord. The species has a high content of train oil and in historic times it has been exploited for oil extraction and as fish meal (Muus & Dahlstrøm 1967).

Exotic species. The material includes an interesting element of exotic, southern species: Black Seabream, European Seabass, Smoothhound, and Stingray. The vertical and horizontal distribution of the exotic species in the midden, in combination with the radiocarbon dates and the stratigraphical analysis, suggests repeated catches. The fact that their bones are at all represented in the material (in case of Black Seabream even rather richly represented) indicates that these species were much more common in Danish waters than they are today.

The presence of the southern species suggests a warmer climate in Denmark during the period in question than today. The presence of no less than four different species reinforces this interpretation. The higher salinity of the Limfjord has made it possible for them to reach Bjørnsholm, and as they all tend to approach the coast they have been liable to be caught in the traps of the Bjørnsholm people.

The warmer period in Denmark seems to have been quite prolonged – several of the exotic fish (Stingray, Smoothhound) possibly also a single Black Seabream) derive from Neolithic layers. This agrees with the well-known indicator of warmth, the European Pond Tortoise (*Emys orbicularis*), which is known from numerous Danish finds from both the Atlantic and the Subboreal period (Degerbøl & Krogh 1951). The European Pond Tortoise does not belong to the present Danish fauna but lives in southern and eastern Europe, its distribution being limited by summer temperature.

A further indication of a warmer climate may be the very large specimen of Tench from Bjørnsholm.

Even the most important species at Bjørnsholm, Eel, is a warmth-demanding species; today its growth in Danish waters is slow. Several specimens in the Bjørnsholm material have exceeded the maximum length for Danish Eel today (100 cm), perhaps a further indication of a warmer climate.

Characteristics of the fishing for Eel and other species. The situation of the Bjørnsholm settlement leaves no doubt that the most efficient way of fishing for Eel would have been trapping at the mouth of the freshwater streams into the Bjørnsholm Fjord. At such places, Eel tend to concentrate during their migration into the sea. If this has really been the strategy of the Bjørnsholm people, the Eel caught must have come from freshwater. The size-frequency diagram for Eel agrees with this hypothesis: Eel populations growing up in fresh water always contain a majority (80–95%) of females, and the diagram shows the presence of very many females (since all specimens >50 cm are females).

The activity of Eel is cyclic and is coupled to lunar phases (Boëtius 1967), particularly many Eel migrate during autumn interlunar periods. At these periods, silver eel leave the waters in which they have grown up, to start their spawning migration. Two independent lines of evidence suggest that the fishing at Bjørnsholm was primarily directed at this migration of Eel:

1. In the material from Ertebølle the Roach size-frequency diagram was taken as evidence for a strictly seasonal fishing directed at Eel, possibly at the late summer/autumnal migrations (Enghoff 1987). The Roach size-frequency diagram from Bjørnsholm reminds of that from Ertebølle and may be interpreted as an indication that also the Bjørnsholm people have exploited the silver eel migrations. (The Roach bones in question were found in close association with Eel bones at both settlements.)
2. All 11 analyzed otoliths (found somewhat dispersed) derive from late summer/autumn fish. The analyzed otoliths are of Cod and Saithe, but they were lying in small groups of bones together with Eel bones and must be supposed to have derived from the same meals as the Eel.

The general occurrence of seasonal fish, especially the most frequent of them, Mackerel, shows that fishing has consequently been conducted during the summer half of the year. Many other species would also have been most easy to catch during this season, *e.g.* Greater Weaver which during summer lives close to the coast but stays in deeper waters autumn and winter (Muus & Dahlstrøm 1964). The same is true of small gadids (Cod and Saithe), for which the growth-ring analysis in addition gives a more precise information on the season of capture (late summer). Even Spurdog roams in shallow water during summer (Otterstrøm 1917).

The most frequent of the summer species, Mackerel, occurs very regularly throughout the material, an indication that fishing was *not* conducted during wintertime. On the other hand, there are several winter indicators among the bird and mammal species found in the bone material, for instance the presence of bones of the Whooper Swan (*Cygnus cygnus*) (Bratlund 1993, this volume) shows that the settlement was inhabited during winter. It would thus seem that the people using the settlement during winter did not go fishing.

The fishing at Bjørnsholm shows no temporal variation, and freshwater and saltwater species have been exploited simultaneously. Many fish bones were found around fireplaces, but none were burnt. The bones presumably represent remnants from meals. There is no indication that the fish have been cut up: Both head and body bones are present, and no bones show traces of cutting. A possible interpretation would be that the bones and scales have simply been skimmed off potfuls of fish soup.

Fishing technique. As in the case of previously analyzed Mesolithic fish bone materials (Enghoff 1983, 1987, 1991), the main fishing technique at Bjørnsholm is interpreted as having consisted of stationary fish traps, possibly with leaders made of wattles, placed in shallow water. The list of species is varied and looks like a more or less uncritical sample of the species which would have been present in the local waters. Eel dominates the material, and although it may be caught on hooks or with fish spears, an Eel fishing of this order of size rather indicates trap-fishing. That the fishing, as far as the marine species is concerned, has taken place in shallow water is shown by the presence of species which spend all their life in the *Zostera* belt in shallow water, e.g., Eelpout, a species which occurs sparsely but generally distributed in the material, and Bullhead. The other species on the list spend at least part of their life in shallow water. Greater Weaver, a frequent and constant species in the samples, buries in the sand in shallow water during daytime and swims about during night (Muus & Dahlstrøm 1964) – this species clearly indicates stationary traps being set for at least one night over. Even Eel is a nocturnal species. It is true that about seven fish-hooks (2.5–3 cm long) have been found in the Mesolithic layers at Bjørnsholm (S. H. Andersen 1993, this volume), prooving that hook fishing has been conducted. Among the species on the list, it is probably first and foremost the small gadids, Eelpout and Bullhead which have been caught on hooks. Hook fishing is, however, regarded as having been a mere supplement to the main fishing by traps.

The Neolithic layers. The Bjørnsholm kitchenmidden is chiefly a Mesolithic midden but part of it is overlaid by Early Neolithic layers. The fish bone material also is mainly Mesolithic, and the above discussion refers to the

Mesolithic part exclusively. Some fish bones (albeit only about 250) have, however, been found in Neolithic layers. The low number of Neolithic fish bones does not allow calculations and elaborate speculations but does at least show that fishing appears to have continued to a certain extent into the Neolithic phase. The Neolithic fish species are largely the same as the Mesolithic ones, with some absences which may be due to the low number of bones.

In the Norsminde kitchenmidden (Andersen 1991) the contrast between Neolithic and Mesolithic layers was even more striking than at Bjørnsholm: one single fish bone was found in the former, against about 9000 fish bones in the latter (Enghoff 1991).

Comparison with the Ertebølle køkkenmødding. The settlements at Bjørnsholm and Ertebølle were contemporaneous and were separated by a mere 8 km distance. A comparison between the two is therefore self-inviting. One conspicuous difference concerns the relative proportion of freshwater and saltwater fishes: At Ertebølle 71% of the bones represented freshwater species, 12% marine species, and 17% migratory species (Enghoff 1987). The corresponding figures for Bjørnsholm are: freshwater 15%, marine 22%, migratory 63%. Both settlements agree in the dominance of Eel and cyprinids (esp. Roach). But whereas the cyprinids are number one at Ertebølle (cyprinids 67%, Eel 17%), the roles are reversed at Bjørnsholm (Eel 56%, cyprinids 14%).

There is no doubt that Eel fishing has been a major feature of life both at Ertebølle and at Bjørnsholm. But there has been one significant difference between Eel fishing at the two places. At Ertebølle, the material indicates dominance of freshwater fishing (probably conducted in nearby lakes). Cyprinids are a very characteristic secondary catch during Eel fishing in lakes. Furthermore, quite a number of Perch were caught at Ertebølle, whereas the marine catch was less significant. If the Bjørnsholm people placed their fish traps near the mouths of freshwater streams into the Bjørnsholm fiord, as suggested above, the secondary catch of cyprinids will have been much smaller, whereas the marine element will have been much more important, as is actually the case. In short, the difference between Ertebølle and Bjørnsholm may simply be due to different location of the essential Eel fishing.

Part of the difference is, however, probably due to the excavation technique. As shown by the efficiency control, many cyprinid bones may have been lost during excavation at Bjørnsholm. At Ertebølle, the technique was different and probably resulted in fewer losses of small bones. However, methodological considerations alone are probably not sufficient for explaining the profound difference.

The total lack of exotic species from Ertebølle is puzzling, regarding the importance of these species at nearby, contemporaneous Bjørnsholm. Also the lack of Mackerel at Ertebølle is difficult to explain, as this species is frequent in the Bjørnsholm material. The lack of these species may be due to the lesser importance of marine fishing at Ertebølle. The Ertebølle people have, however, caught quite a few Garpike, a marine species which is rare in the Bjørnsholm material. A further striking detail concerns the gadids: At Ertebølle, most gadids were Saithe, but at Bjørnsholm Cod clearly dominates.

CONCLUSION

The Limfjord has been renowned for its Eel fishing through historic times. A record of Eel-trap stands in Denmark about 1900 (Petersen 1901) shows that the number of traps in the Limfjord (2600) was several times higher than at any other place along the east coast of Jutland. The analysis of the fish bone materials from Bjørnsholm and Ertebølle has shown that also during the Ertebølle period in Denmark, a massive Eel fishing took place in the Limfjord, apparently mainly in late summer/autumn. Let there be no doubt that the fishing from Bjørnsholm was first and foremost directed at Eel, just as at Ertebølle. By this trait these two Limfjord settlements stand out against the other contemporaneous settlements analyzed so far; Vedbæk (Enghoff 1983, unpublished), Norsminde (Enghoff 1991), and Tybrind Vig (Trolle-Lassen 1984). Whereas the growth-ring analysis of gadid otoliths positively indicates late summer/autumn fishing, the Bjørnsholm people apparently did not go fishing in the winter, in spite of the fact that the settlement was inhabited during wintertime. A special detail of the Bjørnsholm material is constituted by the element of exotic, southern species, indicating that the fishing took place in a climate warmer than the present.

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Acknowledgements

The material was put at my disposal by S. H. Andersen (Institute of Prehistoric Archaeology, University of Aarhus), who also provided radiocarbon dates and other necessary information and advice throughout the analysis. Photographs were prepared by G. Brovad (Zoological Museum, University of Copenhagen), and diagrams by K. Rosenlund (Zool. Mus.), who also provided stimulating discussions. E. Steffensen (The Danish Institute for Fisheries and Marine Research) analyzed otoliths, and I. Boëtius (same institute) helped with interpretation of the Eel size-frequency diagram. J. Nielsen (Zool. Mus.) and Nanna Noe-Nygaard (Institute of Historical Geology and Palaeontology, University of Copenhagen) read the manuscript and provided many useful suggestions. I extend my sincere thanks to these persons. The analysis was made possible by grants from Århus Universites Forskningsfond, the Carlsberg Foundation, the Danish Natural Science Research Council.

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Late Neolithic and Bronze Age Settlements at Hemmed Church and Hemmed Plantation, East Jutland

by NIELS AXEL BOAS

INTRODUCTION

During 1987–1992 Djursland Museum investigated two settlements near Hemmed Church and Hemmed Plantation,[1] respectively, a good 150 m apart (fig. 1). The results of the first two years of excavation at Hemmed Church have been published in *JDA* vol. 8, 1989.[2] Traces of a total of 9 houses have been demonstrated at Hemmed Church and of 3 at Hemmed Plantation. Of these, 1 is a centre-post house (two-aisled) from the transition between the Single Grave Culture and the Late Neolithic, 6 are centre-post houses from the Late Neolithic A and C, and the transition Late Neolithic C to Early Bronze Age, while 3 are three-aisled houses from the Early Bronze Age. Two small outhouses are assumed to belong. Remains of at least two houses were recorded during trial excavation of adjoining areas.

In both settlements there were extensive aeolian deposits which already in the middle of the Bronze Age had led to an almost complete sealing of the ancient culture levels above the houses. Wind blow has likewise caused some stratification of the accumulated occupation levels in connection with the individual settlements at both sites. This gives a rough stratigraphic separation of early and late occupation layers within the hitherto investigated c. 1,700 sq.m. with traces of 9 houses at Hemmed Church, and c. 1,250 sq.m. with 3 houses at Hemmed Plantation. Less than half of the investigated area lies outside the actual houses. Emergency excavations are usually directed at obtaining reliable information on concrete structures.

The quantity of finds in the more or less protected culture layers is relatively large. Excavation at Hemmed Church yielded c. 45 kg pottery, 106 kg flint waste, 88 flint cores. 492 flint implements, 113 stone (i.e. other than flint) implements, 8 bronzes and 5 amber objects, besides c. ½ kg splintered burnt bone, animal teeth, charcoal and at least 10,000 charred cereal grains. Hemmed Plantation yielded c. 30 kg pottery, 107 kg flint waste, 66 flint cores, 443 flint implements, 80 stone implements, 6 pieces of amber, 1 bone awl, 1 clay bead, charcoal, and cereal grains. This large quantity of flint waste and implements has not yet been processed and analysed. The purpose of this article is solely to give an overview of the structures found at the two sites – their construction, dated finds and the radiocarbon datings carried out so far. The radiocarbon datings are discussed by K. L. Rasmussen elsewhere in this volume (Rasmussen 1993). All C^{14} dates mentioned in the following are in calendar years.

HEMMED CHURCH

The excavation at Hemmed Church (fig. 2) was carried out during the years 1987–90. The recorded occupations may be broadly divided into three phases. The late phase consists of two three-aisled houses from the middle part of the Bronze Age, each with a possible outhouse, house I + house VIII and house V + house VII, with associated collections of cooking-stones and pits in and around the houses. The intermediate phase comprises centre-post houses from the Late Neolithic/Early Bronze Age: house III, parts of house IV and house II, and a few pits. The earliest occupation phase comprises a very late Single Grave centre-post house, house VI, and a house corner, house IX, with a possibly associated collection of pits with Bell Beaker decorated sherds along the south side of the house. All houses are E-W oriented with a tendency to lie WNW-ESE in the middle phase.

The late occupation
House I

This house has been described previously (Boas 1991: 88–94). It constitutes the latest occupation ascertained so far, before extensive drift sand covered part of the area.

House I measured 30×10 m. The walls were made up of slender posts 0.2 m in diameter, set 0.2 m into the ancient topsoil c. 0.4 m apart. Along the south wall of the house were pieces of daub with wattle/stake impressions. The gable ends had slightly rounded corners.

An entrance was seen in the middle of the north wall and another one between this and the west end of the house. The entrances appear as openings a good 1.5 m wide with jamb posts inset about ½ m. In connection with two of the eight sets of roof-bearing posts set 0.9 m in the ground were cross-walls consisting of 4–5 sturdy posts. These divided the house into a large central room, a small east room, and a slightly larger western living-room. The two last-mentioned rooms each had a central fireplace, set with stones in the east room. Around the fireplaces were ovens or cooking-pits about ½ m deep with remains of cooking-stones or crumble from stones heated in the nearby fireplace. At the east end, an almost intact, 1–2 cm thick clay floor, set on levelled ground, was exposed. Remains of a clay floor were also seen at the west end. The clay floor stops c. 0.8 m from the wall, and a

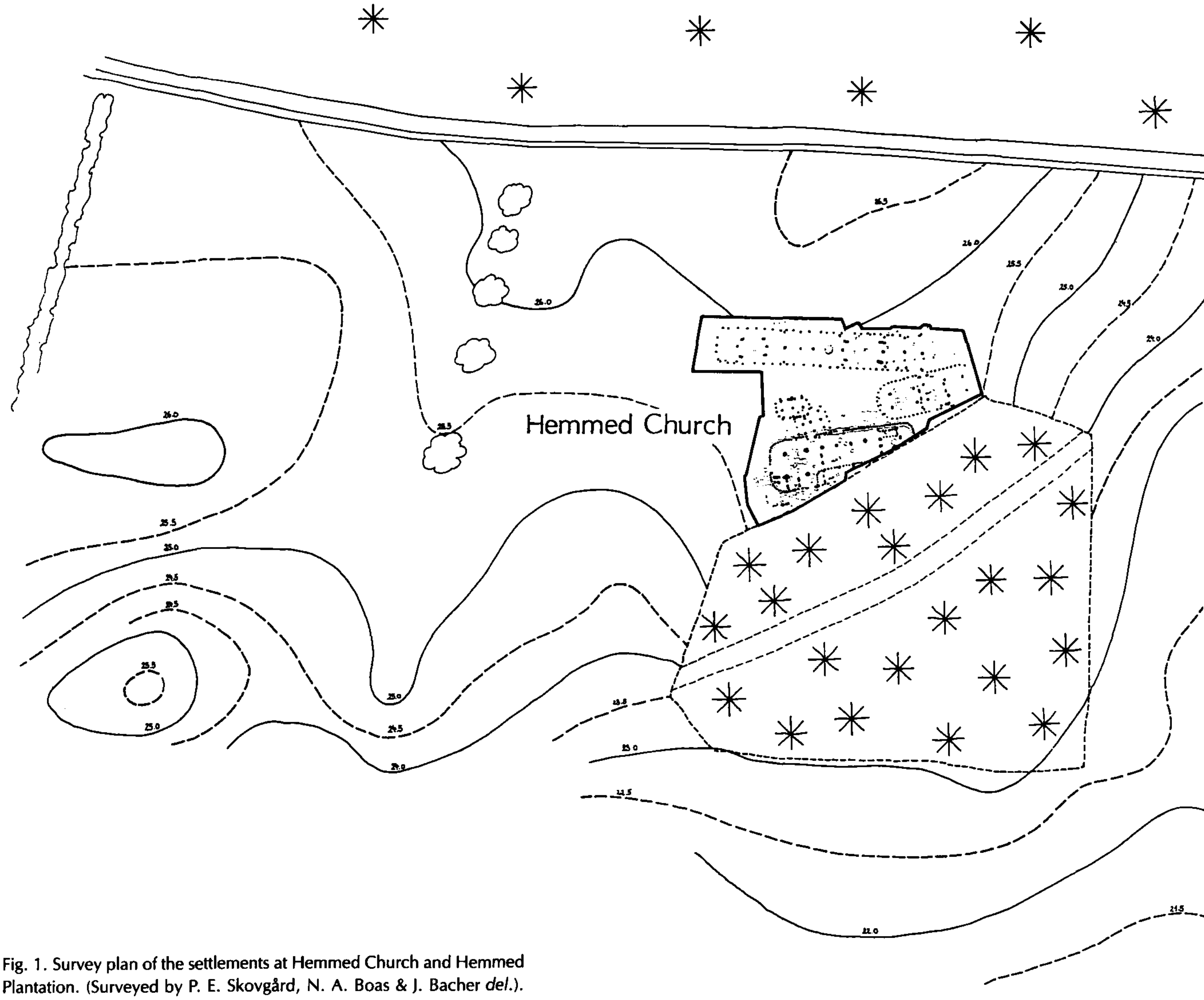


Fig. 1. Survey plan of the settlements at Hemmed Church and Hemmed Plantation. (Surveyed by P. E. Skovgård, N. A. Boas & J. Bacher *del.*).

slight change in the soil flanking the wall posts suggests the construction of a kind of sod panel or earth bench, especially along the inner side of the wall. In the middle room were four cooking-pits, and charred grains of corn in the roof posts suggest a store-room function. At various places in the house were posts from various internal structures, set into the ground.

A sample of charcoal from cooking-pit A19, which was sealed by the clay floor at the east end of house I, gave a C^{14}-dating of 990–940 BC (K-5170). Another charcoal sample from the clay floor itself at the same spot was dated to 1000 BC (K-5169).

10–20 m north of house I was an up to 0.2 m thick irregularly delimited layer of cooking-stones. It was, like the east end of house I, directly covered by yellow drift sand, and can thus be linked stratigraphically to house I. Finds of pottery, flint and bronzes, etc., are likewise in accordance with the few and scattered finds that definitely belong to house I. In addition to the tutulus found in the cooking-stone level (Boas 1991: fig. 11c), a corresponding

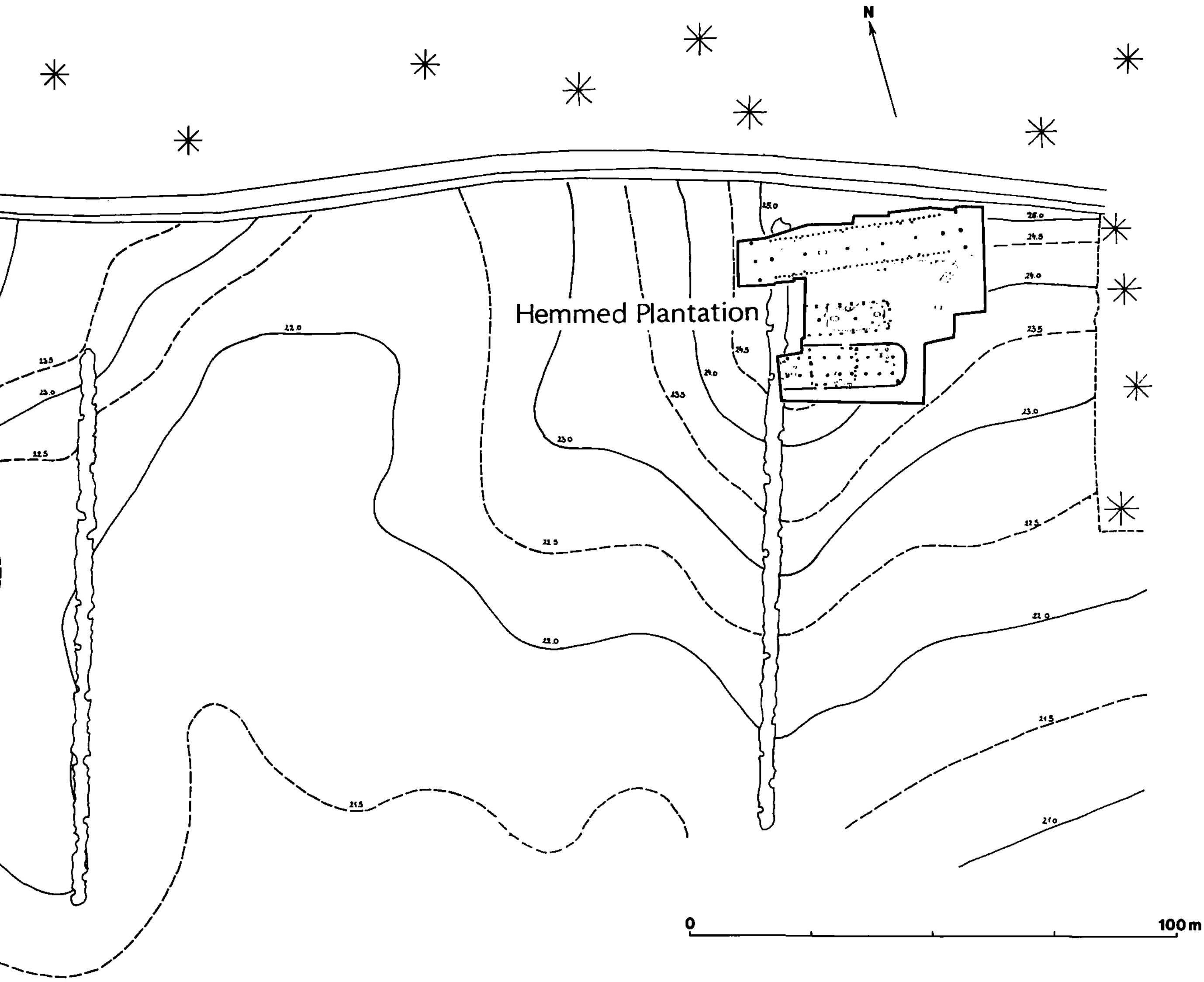


Fig. 2. Plan of the excavation at Hemmed Church. House VI from the Late Single Grave Culture is emphasized. 1:250. (N. A. Boas & J. Bacher *del.*).

Fig. 3. Hemmed Church. House V exposed. At the top, cooking-pits are seen around a fireplace. On the right is the north wall's row of square posts or post-holes without "core". The large patch in the row is a shallow depression in the middle of the entrance. (Photo: N. A. Boas).

tutulus with tall knob, a bronze awl and an "unfinished" bronze pin, apparently with hammer-marks (fig. 4), were found in the west part of the same layer. Nearby was a small stone of dense material with a smoothly polished flat surface and an annular groove.

Out-house VIII

About 6 m from the northwest corner of house I and with the same orientation was a small rectangular post-built house measuring c. 7×5 m. The supporting structure seems to be a square of 3×3 posts. Two oblique posts have been supporting the two central posts at the north and south. Just outside the three posts in north and south was a further post serving as a wall post, and four similar posts in a slight curve in the east and west gables.

Near and in the house were slight traces of clay daub and a few sherds of the same kind as in house I, and layers of cooking-stones both to the north-east and south-west. The find material in and around the house does not indicate its function. There are no certain traces of a fireplace or cooking-pits in the house.

House V

Only about 1 m from the north-east corner of house I, a three-aisled house measuring 21×8 m was investigated. It had square wall-post holes set c. 0.5 m apart and 0.1–0.2 m into the subsoil (fig. 3). The west gable was smoothly rounded, while the post-holes of the east gable, with a single exception and perhaps already in antiquity, have been ploughed away, for the gable posts, due to a fall in the terrain, must have been set in levelled ground. The five sets of roof-bearing posts were all placed 2.5–5 m apart. There were remains of partition walls, which, unlike in house I, divided the house, which covered 150 sq.m., into a smallish central room measuring 40 sq.m., an east room of c. 47 sq.m., and a western living-room of

c. 63 sq.m. Both partition walls were marked by two sets of paired posts or jamb planks, set into the ground in the middle of the house. A corresponding doorway construction was seen at the 1 m wide recessed entrances in the long wall. The north wall doorway was placed near the middle, while that in the south wall was displaced to the east, so that each doorway leads into the central room, close to a partition wall. At the western end was a diffuse reddish patch from a fireplace mid-way between the four westernmost roof posts. Around this patch there was, as in house I, a cluster of 12–15 small cooking-pits. Only one cooking-pit was seen in the central room, while no structures were found in the east room.

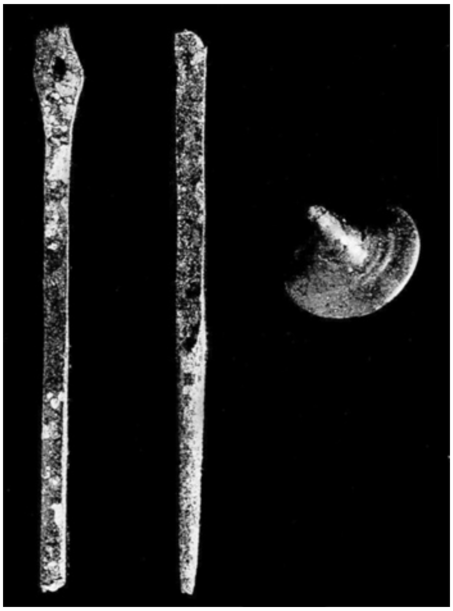


Fig. 4. Hemmed Church. Bronze pin with broken-off ends and square shaft with hammer-marks, bronze awl, and a small tutulus with raised knob. From the late settlement in the Middle Bronze Age. 1:2. (Photo: S. Harbo Andersen).

Fig. 5. Hemmed Church. Finds from cooking-pit A 203. Sherds of "slurried" pot and concave-convex pot with carination and traces of a small broken-off lug. (Photo: S. Harbo Andersen).

Outhouse VII

A small house, which based on its orientation and on stratigraphical observations can be linked to house V, was found partially under the north wall of house I, a good 10 m due west of the west gable of house V. The supporting structure was, as in house VIII, 3×3 posts c. 0.3 m in diameter and 0.8 m deep, placed practically in a square. At intervals of c. 1 m and 1 m away from the supporting structure were more slender posts. The outside dimensions of the house are thus 6.5×6 m E-W. In a few of the holes for "roof posts" was a basal packing of burnt stones and in the stone packing of the central post-hole a thigh-bone, probably of a horse. Over the house were four shallow cooking-pits, perhaps in connection with the later occupation in houses I and VIII. There were no signs of a fireplace or of cooking-pits in the house itself.

Other structures outside the houses

About 5 m NNW of the northern entrance of house V, a cooking-pit 1.7 m in diameter and 0.6 deep, A 203, was investigated and found to contain cooking-stones, charcoal and pottery (fig. 5). This pit has been C^{14}-dated to 1310 BC (K-5786). It was cut into the north side of a hole for a roof-bearing post in house III, from which a charcoal sample has been taken and C^{14}-dated to 1670 BC (K-5782). Another large pit, A 57, may be assigned on the basis of pottery to the later occupation phase. It was c. 2 m in diameter and c. 1 m deep and contained stratified drift or water-sorted sand. Stratigraphically, it was associated with house V, at the west gable of which it was placed. A north-south row of seven posts was observed c. 4 m west of pit A 203 (*cf.* Boas 1991: fig. 2). The stratigraphic association and the fill in the post-holes, a couple of which were square, link them to house V and pit A 203, and they may have had a function in connection with the latter.

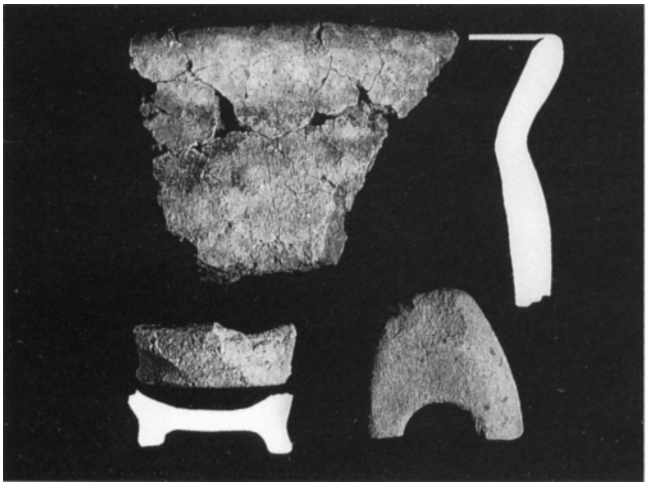


Fig. 6. Hemmed Church. Pottery and shaft-hole axe from the intermediate occupation, house III. (Photo: N. A. Boas).

Fig. 7. Hemmed Church. Wall-posts sectioned in house II's northwest corner. Intermediate occupation viewed from the north-west. (Photo: L. Wincentz Rasmussen).

The intermediate occupation

House III

The longest house at the settlement, house III, was 43 m long, with a width of 7 m throughout. It was furnished with a row of roof posts or centre-posts, six inside and one in the centre of each gable-end. The ground area of c. 300 sq.m. corresponds to that of the long-house I. The middle part of house III has been previously described (Boas 1991:95–96, fig. 13). House III appeared as a solid post-built construction with straight walls and with posts set c. 1 m apart. While the west gable was almost straight, consisting of five posts set about 1.7 m apart, a more peculiar east gable was seen. 2.5 m from the terminal wall posts were three prominent gable posts, *i.e.* two corner posts and a centre post. The corner posts were double or each paired with a retracted post – perhaps for renewal. The gable posts were, like the roof posts, set almost 1 m in the ground and the holes were about 0.5 m in diameter.

Opposite most of the roof posts were retracted wall posts which must have been connected to a cross-beam across the house to stabilize the roof-bearing construction. Inside the south wall, near the east and west ends of the house, were some extra retracted wall posts, which, combined with a slightly larger opening between the wall posts, suggest doorways. Oblong holes with traces of 2–3 closely set posts were seen between roof and wall post in the house sections near the two fireplaces measuring c. 1.8×1.5 m. The fireplaces were placed mid-way between the roof posts, which were set as much as 8 m apart. The closely set post structures must have served a special purpose in connection with activities near the hearth. A circular, flat-based and shallow pit, A 95, in the centre of the house, seems from its content of fragmented burnt stones and burnt bones to have served as a cooking-pit or oven. The pit has been C^{14}-dated to 1730–1700 BC (K-5781). From the fill in a shallow, oblong pit near the most easterly "jamb post" in the south wall, a couple of thousand cereal grains have been recovered.

Scattered in house III, and especially in its east part, were fragments of small, red-burnt clay strips for caulking the plank walls. These strips showed distinct impressions of hewn planks (Boas 1991 fig. 12). More than half of the potsherd from the excavation area may be assigned to house III, like most of the flint implements and debitage. Flint daggers of type V, a stone axe with a shaft-hole and fragments of small pedestalled beakers may with great confidence be assigned to the house and must be considered diagnostic (fig. 6).

House II

A corner of a house, house II (Boas 1991:94, fig. 2) with a wall construction very like that of house I, but with deeper-set wall posts, was seen under house I's central southern part (fig. 7). A single roof post placed in the middle was found 3 m from the west gable and about 3.5 m from the north wall. It was more than 1 m deep and thus of at least the same size as the roof posts in house III. C. 2 m east of the roof post were traces of an oval fireplace very much like those seen in house III. Unfortunately, no flint implements or pottery could be definitely associated with this house.

House IV

Near the south-west side of the excavation, a fireplace was recorded which was disturbed by later cooking-pits. Unfortunately, time and economy did not allow a final investigation of the almost 100 structures in the southwest corner of the excavation. Clarification of which posts and pits belong to the fireplace would require sectioning and excavation of every hole, in an area where observation is made difficult due to bioturbation such as animal activity and tree roots from the adjoining forest. East and north-east of the fireplace, post-holes have been recorded that are stratigraphically older than house I and II. A type IV dagger handle and some pottery of Late Neolithic C/Early Bronze Age character have been found in the culture layer around the fireplace and under house I's floor level. The house has been previously described (Boas 1991:94, fig. 13).

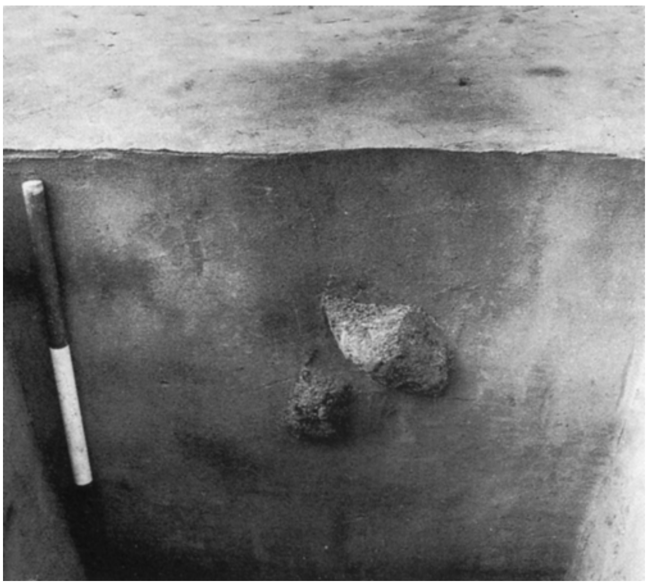


Fig. 8. Hemmed Church. North-south section through roof post in house VI. Earliest occupation. (Photo: N. A. Boas).

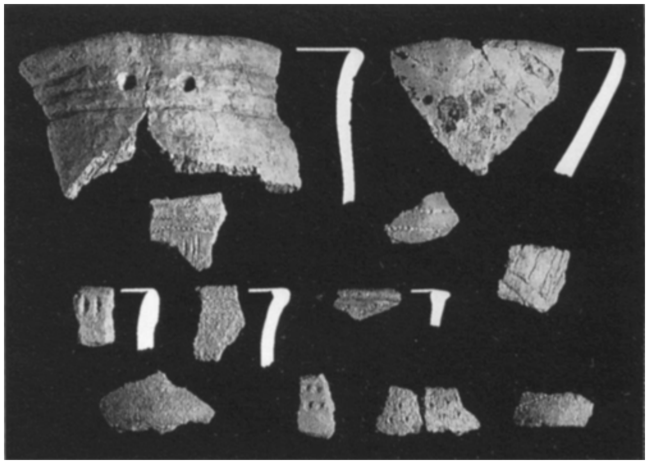


Fig. 9. Hemmed Church. Sherds from the earliest occupation. From above, sherds of flared beakers, conical bowl, and simple beakers with T-shaped rim. Ornamentation in incised groove, pin denticulation, cardium, and wedge. (Photo: S. Harbo Andersen).

Fig. 10. Hemmed Church. Flint implements from the earliest occupation. Barbed arrow-head, barbed and tanged arrow-head, leaf-shaped point with broad tang (cf. Asingh 1988, fig. 20c and e). Thick-butted axe fragment, miniature axe and under this the edge of a hollow-ground adze. Bottom left, three D-type arrow-heads. (Photo: S. Harbo Andersen).

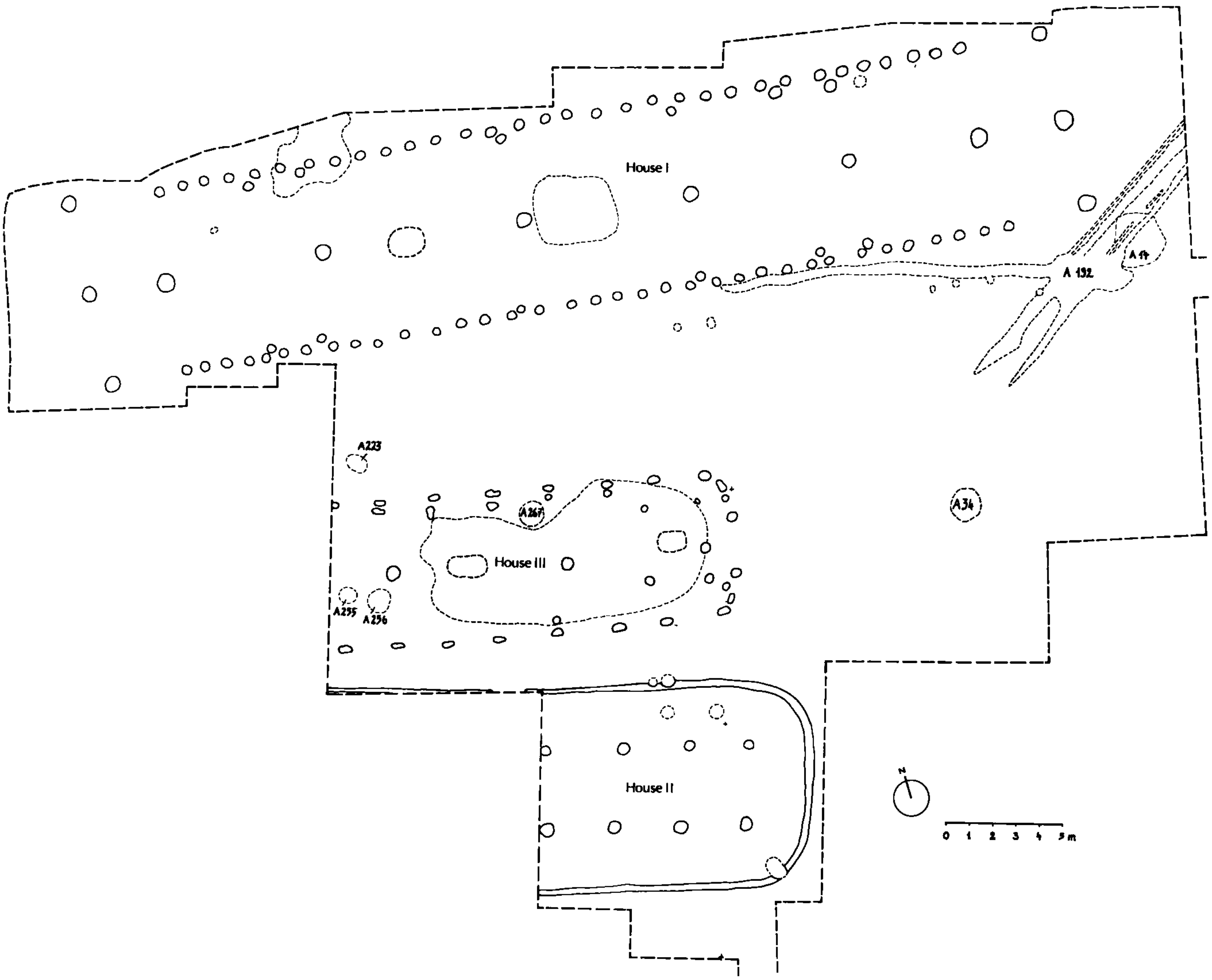
The earliest occupation
House VI

Under the east end of house III, a post-built house measuring 16×6 m was investigated. It had slender, slightly oval wall-post holes, set at intervals of 2 m. The corners were slightly rounded, formed by two closely spaced posts, which together with a centre-post make up the gable construction at each end of the house. The ridge-pole rested on a row of three internal posts 5–6 m apart. The fill in the post-holes clearly differed from the fill in the post-holes of the later structures by being more homogeneous and grey (fig. 8). It was almost impossible to differentiate between the dug hole and the actual post-mark in the individual post-hole.

Within the ground plan of the house, 4–5 pits with almost vertical sides and flat bottom were investigated. In one of these, A 275, the lower part of a pot was found, a B3 or E2 beaker, with horizontal denticulate line ornament (Glob 1945,66–67). No direct connection between house and pit can be demonstrated, however. The pits are connected chronologically via pottery finds to a large collection of corresponding pits, *i.a.* an older pit in the northwest corner of the house, and one is placed in the middle of the north wall-line of the house.

Scattered in the bottom culture layers and over most of the excavation in and around the house, and with a small concentration c. 10–15 m south-west of the house, were sherds of late Single Grave and earliest Late Neolithic (fig. 9), pieces of polished thick-butted axes and adzes,

Fig. 11. Plan of the excavation at Hemmed Plantation. 1:250. (N. A. Boas & J. Backer *del.*).



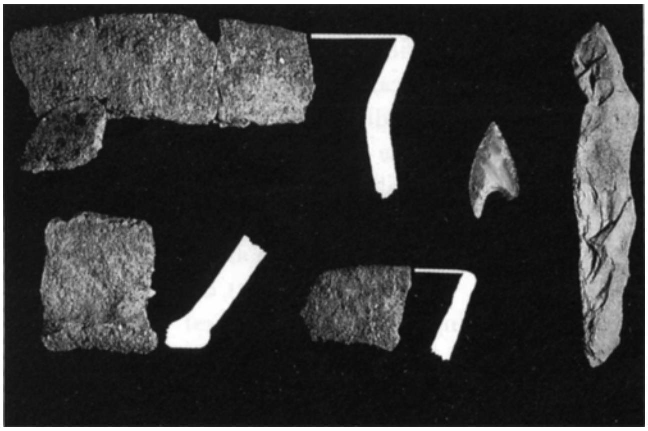


Fig. 13. Hemmed Plantation. Sherds, barbed arrow-head and sharp triangular hammer-stone of flint from the late occupation. (Photo: S. Harbo Andersen).

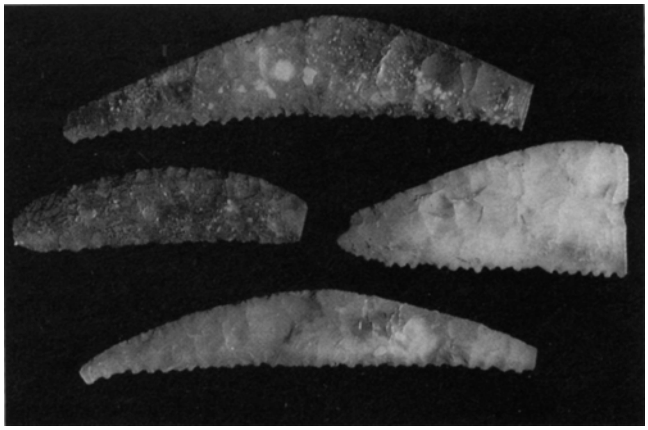


Fig. 14. Four flint sickles from house II, Hemmed Plantation. (Photo: S. Harbo Andersen).

three D-type arrowheads, a couple of broad pressure-flaked, barbed arrowheads and a single arrowhead with both barbs and tang (fig. 10).

HEMMED PLANTATION

The settlement c. 170 m east of the Hemmed Church site lie, like this, on a low elevation approximately on the 24 m contour down to the merely 2–3 m lower and now completely dried up tract of marsh called Svapkæret. Between the two settlements, an over 100 m wide and only 2 m deep flat depression stretches from the marsh to the north (fig. 1). At the edge of a newly established duck pond on the north side of Svapkæret, just opposite the depression and less than 100 m from the settlements, an almost 1 m thick layer of peat has been observed, with preserved wood, covered by a c. 0.5 m thick, yellow layer of drift sand like that covering some of the Hemmed Church structures. A similar drift sand layer covered the ancient culture layers at Hemmed Plantation. The drift formations hamper the reconstruction of the prehistoric landscape from surface observations. Extensive trial excavations or drilling is needed to permit a more certain reconstruction.

The Hemmed Plantation settlements were investigated in the years 1988–92. Three houses have been excavated, each of which corresponds approximately to the three building phases that could be distinguished at Hemmed Church.

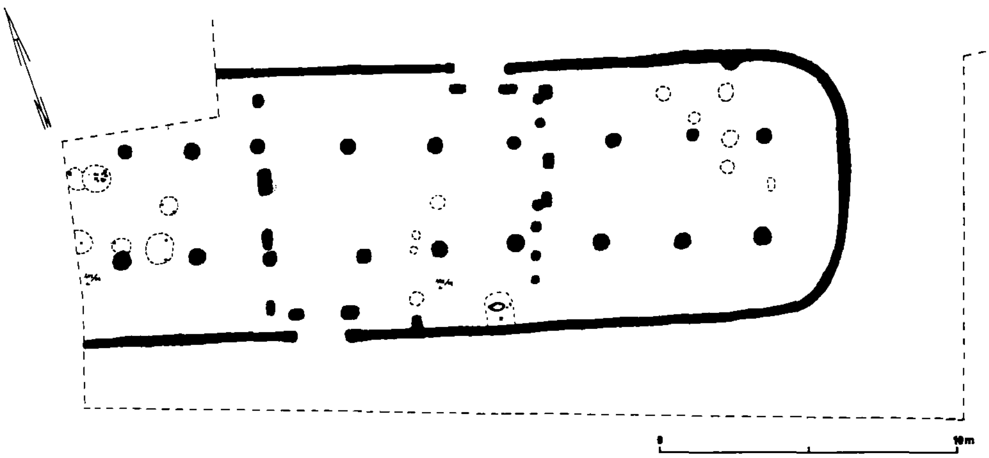


Fig. 12. Plan of house II, Hemmed Plantation. 1:250. (N. A. Boas *del.*).

Fig. 15. Hemmed Plantation. The 45 m long house I, intermediate occupation. Wall and roof posts are marked with paper plates. In the background, centre, the Hemmed Church settlement. (Photo: N. A. Boas).

The late occupation
House II

The southernmost structure, house II, is a 9 m wide three-aisled house (fig. 12). From the east gable it stretches at present 27 m to the west, and the west gable may be expected 3 m further west. The house has a 0.3 m wide and up to 0.2 m deep wall trench, which gives a ground plan with evenly rounded corners. At the base of the trench there are posts set 1.8–2.5 m apart, some of which are square-cut like those of the walls of House V, Hemmed Church. The walls are interrupted only by slightly more sturdy posts at the displaced north and south door openings. Both entrances are formed by door posts or jamb planks, recessed ½ m into the house, forming a 1.2 m wide doorway. The "outer" door opening in the wall is 1.7 m wide.

9 pairs of roof posts have been recorded, 2.5–3 m apart. They are 0.6 m deep (0.9 m in relation to the ancient surface). The posts are all placed at a distance of 2.5 m from the centre of the gable- and wall-trench. One metre to the left of each entrance are cross-partition walls, both with prominent "doorways" in the middle of the house – exactly like the recessed door openings in the outer walls of the house. Between the anticipated tenth and the ninth set of roof posts to the west is the obligatory cluster of cooking-pits – so far 6 in all. The fireplace seems, as in

Fig. 16. Hemmed Plantation. North-east doorway in house I. Note that the recessed posts of the doorway are drawn away from the door opening in the wall (to each side of the 0.6 m measuring stick). (Photo: G. H. Rasmussen).

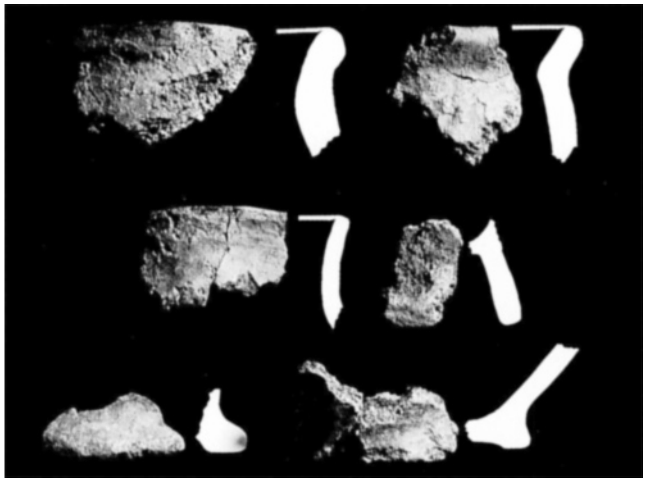


Fig. 17. Hemmed Plantation, sherds of i.a. bucket-shaped vessel and goblets. Intermediate occupation. (Photo S. Harbo Andersen).

Fig. 18. Hemmed Plantation. Flint implements from the intermediate phase, house I. Shaft scraper, hilt of type IV dagger, miniature dagger, edge of shaft-hole axe, barbed arrowheads and dagger point. (Photo S. Harbo Andersen).

house V, Hemmed Church, to have been ploughed away in the Bronze Age.

In the culture layer over the western end of the house were four oblong, lunate, pressure-flaked flint sickles and a shaft-hole axe (fig. 14). By the south wall of the house – opposite the north door – lay a saddle quern, slightly buried in the subsoil. In the upper part of the divided culture layer covering the house, sherds were found scattered. These and the sickles, can be dated to the Early Bronze Age, Period II (fig. 13).

An extensive c. 0.2 m thick layer of cooking-stones stretched from the entrance area in the north wall c. 10–12 m to the north. Nearly two tons of cooking-stones make up this "upper" occupation layer of burnt-out stones, presumably thrown out of the north door from cooking-pits in the western end of house II. C. 10 m north and north-east of the house were two cooking-pits, A 34 and A 223, each a good 1 m in diameter, with sherds of the same type as from house II and the cooking-stone layer.

The intermediate occupation
House I

The northern building is the largest with the most accurate ground-plan of all, and with centre-post construction (fig. 15). It measured 45×8 m. The walls consisted of post-holes 0.5 m deep and 0.3 m in diameter. They were placed in a perfectly straight line at intervals of 1 m in the south wall, which had 35 posts. The north wall comprised 32 posts. A slightly recessed post was regularly placed opposite each roof post or slightly displaced in relation to this, so that there was room for the cross-beam which could be morticed, tied or nailed to the roof post. A further four recessed posts may have formed door jambs (fig. 16). They were namely placed c. 2 m from one of the last reset posts at each end of the house. That four doorways are involved is supported by the fact that the "frame posts" in the outer wall stand further apart than normal. The six "inner" roof posts of the house were properly set to a depth of 1.2 m and were 0.6 m in diameter. The maximum roof-post distance of practically 9 m was seen where a fireplace measuring c. 1.7×1.4 m was placed in the middle of the west end of the house. The gables have a striking resemblance to the east gable of house III at Hemmed Church. Three posts of the same type as the roof posts form the special gable construction, which stand "apart" from the house at a distance of 3 m from the last post in the long walls.

Precisely in the middle of the fairly flat floor of the house there was a 3.5×3 m, rounded rectangular and c. 0.3 m deep depression. It contained i.a. the handle of a type IV flint dagger with flint flakes and waste and pottery of the type found in the culture layer over the house (fig. 17–18). A C^{14}-dating of charcoal, etc., from the lower part of the depression gives an age of 2120–2040 BC (K-5801).

In a c. 0.5 m deep pit inside the north house wall, just east of the northeast entrance, were jaw fragments and bones of a horse, preserved only because they were closely packed.

In the culture layer over the house an even spread of small pieces of cooking-stone, c. 300 kg altogether, was found. C. 35 kg flint flakes and 10 kg pottery were likewise evenly spread in the occupation layer. Some of the flakes and about 1 kg of the pottery are of Late Neolithic A type and can be assigned to house III to the south.

Apart from a single ambiguous piece, there are no pieces of clay joint filler of the kind found in Hemmed Church house III. A few roof and wall posts had a dense charcoal concentration in the core, where "pure" samples for radiocarbon dating could be taken. There were no signs of the house having burnt down, however.

Samples of the charcoal from four post-holes gave C^{14}-datings lying in the interval 1870–1680 BC (K-5797-5800).

The earliest occupation
House III

Between the two houses described from Hemmed Plantation, the main part of one more centre-post house was investigated. The recorded traces comprise the c. 0.4 m deep sunken east end and most of the central part, 18 m in all. The walls were made up of scattered, oval and insubstantial post-holes with homogeneous greyish fill, where a core with post remains could be discerned only with difficulty. The post-holes were c. 2 m apart and set 0.2–0.3 m

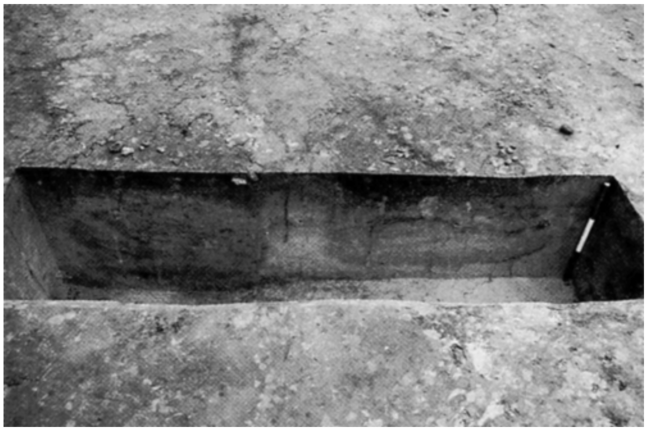


Fig. 19. Hemmed Plantation. Pits in house III. West-east section. Note the vertical sides and flat bottom. (Photo: N. A. Boas).

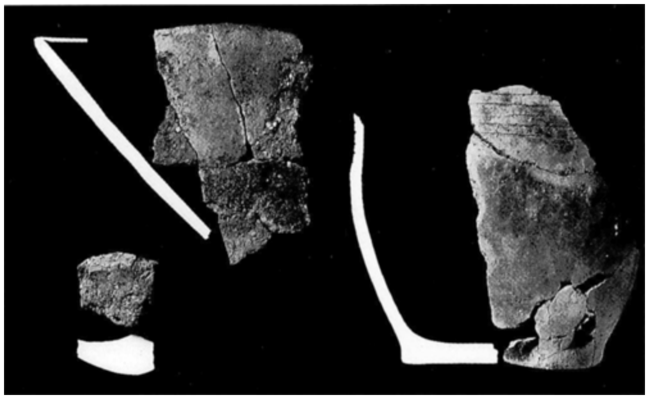


Fig. 20. Hemmed Plantation. Conical bowl, flared beaker (bell beaker) and fragment of clay spoon, earliest occupation. (Photo S. Harbo Andersen).

into the ground. At the north wall of the house was a double post setting consisting of outer wall posts 0.2–0.3 m from inner wall posts. A corresponding arrangement was seen at at least one post in the south wall. The house's east gable had slightly rounded corners with an oblong, plank-like post as the first gable post near the corner of the house. The central gable post was recessed about 1 m. It could also have served as an internal roof post in connection with the two others demonstrated down the middle of the house. Only the eastern and western roof posts were markedly deeply set, c. 0.6 m, in the subsoil and 0.4 m in diameter, while the middle post, which was in the bottom of the depression, was set shallow. The depression in the east end of the house was c. 14 m long and 4–6 m wide. Its sides were steep along the north side and in the middle of the south side, while the ends were

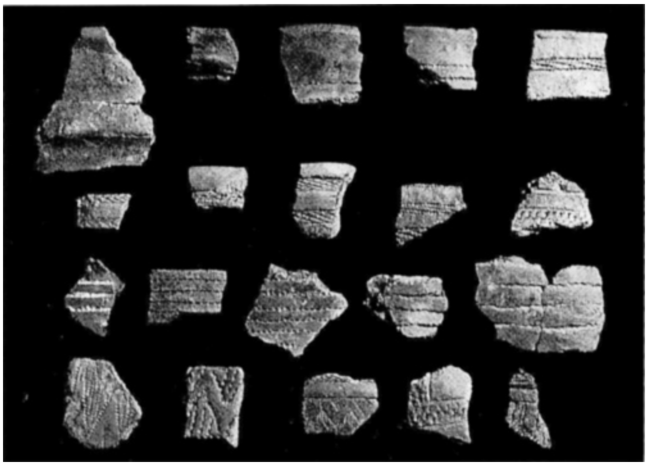


Fig. 21. Hemmed Plantation. Rim and belly bowls with cordon and Bell Beaker ornament. Note the incrustation on the first sherd in the second row from below. (Photo S. Harbo Andersen).

Fig. 22. Hemmed Plantation. Flint implements from house III, earliest occupation phase. Type I dagger fragments, barbed arrowheads, broad-edged axe and serrated blade saw. (Photo S. Harbo Andersen).

only slightly sloping. A regular shallow cooking-pit was placed in the centre of the depression's north side, and nearby lay a large burnt fragment of a quern. The pit A 267, c. 1.1 m in diameter, was almost in contact with the "inner wall line" of the north wall. It contained the settlement's largest cooking-stone, up to 5 kg, and altogether 25 kg of cooking-stones. It must be interpreted as an extremely well-preserved circular oven with incompletely burnt-out cooking-stones from the nearby fireplace. The nearest fireplace was recorded as a 1.6×1 m large, red-burnt patch in the middle of the west end of the depression, only 2 m from the oven. Traces of a corresponding fireplace were seen at the eastern end, only c. 0.6 m from the roof-post hole.

Scarcely ½ m south-west of the westernmost roof post were two circular pits lying close together, about 1 m in diameter and up to 0.7 m deep, with vertical sides, or slightly wider near the completely flat bottom (fig. 19). These pits were very similar in shape to those seen under and north-west of house VI at Hemmed Church. Typical of the pits at both sites were the few finds and their low humus content.

Just as at Hemmed Church, there were ard-marks over most of the surfaces at subsoil level. Even at the bottom of house III, distinct longitudinal ard-marks were seen. This suggests rapid conversion to arable use, after the house had been abandoned and demolished.

Everywhere in the culture layer, but most densely in the lower part, were sherds of predominantly thin-walled, often decorated (c. 450 pieces), well-fired sherd material from the Late Neolithic A (figs. 20–21). About 35 sherds have a cordon, usually 1–2 cm under the rim. There are three fragments of clay spoons (fig. 20) and five of sieve vessels. Four sherds seem to be painted with black, horizontal strokes, and two sherds have white paste or incrustation in the decoration. A collection of irregular pottery was seen in the east end of the depression in the house.

Flint waste, flint cores and implements were like the ceramics evenly distributed inside and outside the house. The scrapers were found (200 altogether) in a somewhat greater concentration in the house fill than outside, just as a thick-butted, broad-edged axe was found with fragments of several axes in the sunken part of the house (fig. 22). Broad pressure-flaked barbed arrowheads may be assigned to the house, with a couple of type I flint dagger fragments. One of these lay in the middle of the northeasterly plank-like corner post in the house (fig. 22). Three fragments of shaft-hole axes from the site are unfortunately too small to be typed.

DATING AND DISCUSSION

Frequent and sometimes very extensive sand drift in north Djursland caused by arable farming is the primary reason why the ancient settlements at Hemmed are unique in settlement-historical context.

From the Stone Age and Bronze Age it has not previously been possible in Denmark, within so small an area,

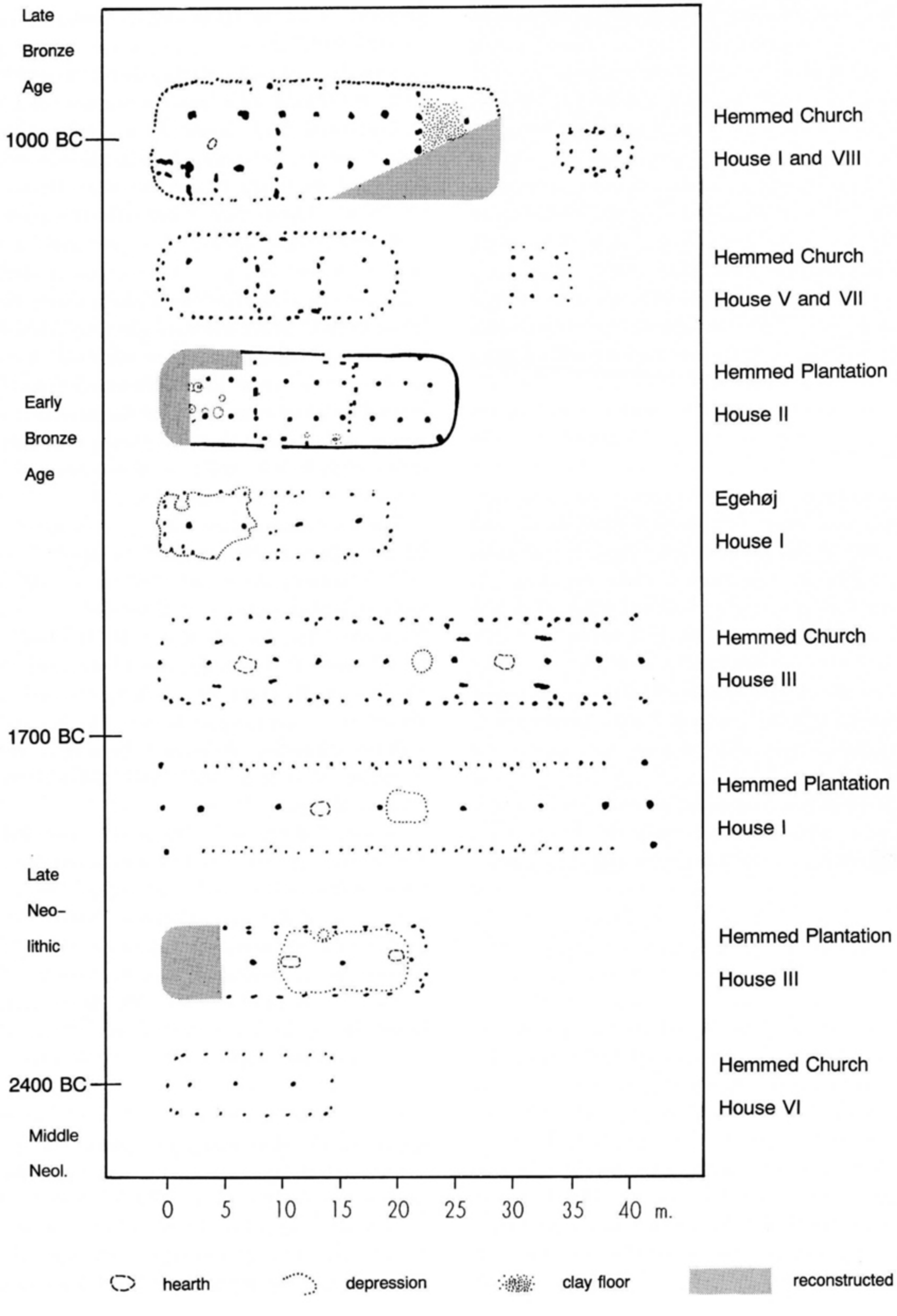


Fig. 23. Development and chronology of the Hemmed houses. (N. A. Boas & J. Bacher *del*).

to demonstrate so coherent a development in house construction, and the relevant culture layers.[3] The Hemmed settlements extend from the end of the Single Grave Culture to the middle of the Bronze Age, a total of 1,500 years (see fig. 23 and the table of C^{14}-datings in the following article by K. L. Rasmussen). Twenty years ago, the author undertook the excavation of the settlement at Egehøj, a good 1 km WNW of Hemmed Church. Here houses from an early part of the Early Bronze Age, three in all, were found for the first time (Boas 1983). They were sturdy, post-built structures with only one row of roof-bearing centre-posts. Like the almost 800 years older Myrhøj houses (Jensen 1973), they had partially sunken floors and a relatively flimsy wall construction. The Egehøj houses still stand as the latest and last link in the chain of development of the centre-post house, from the time when it appears for the first time as house VI at Hemmed Church c. 2500–2400 BC, over the most fully developed form as house I, Hemmed Plantation, until near the middle of the Early Bronze Age. It was completely replaced by the three-aisled house, the oldest example of which is house II, Hemmed Plantation and house V, Hemmed Church, indirectly dated by pit A 203, whose age has been determined as 1310 BC (K-5786). Here a new building type, the small store- or outhouse, which at Hemmed Church seems to have been built in connection with the three-aisled houses, also appears for the first time.

Just as the Hemmed investigations have now made it possible, locally and in detail, to follow the development in house construction, some details of room arrangement have also been ascertained. The culture layers in and around the houses everywhere contain fragments of cooking-stones, which clearly all derive from originally larger stones which have been split into such small pieces by repeated heating that they were unsuitable for further use. Some development can be perceived, for the amount and size of the cooking-stone pieces are slightly smaller in the centre-post houses than in the three-aisled houses. In the north side of house III, Hemmed Plantation, was a well-preserved example of an early oven. This seems to have been built on the surface or set slightly into the ground. Compare also the central pit in house III, Hemmed Church, and the heaps of cooking-stones in houses II and III at the Egehøj settlement (Boas 1983:92–93). With the first three-aisled houses, the oven is set further into the ground very near the fireplace, now as a proper cooking-pit, often c. ½ m deep, which probably made re-utilization of the small "cooking-stones" more difficult and thus led to a greater consumption of them. Pits that seem to have been used for another purpose than baking and cooking occur only inside the centre-post houses. They were seen, albeit in somewhat ambiguous context, in the bottom of the Single Grave house VI, Hemmed Church, and in the slightly later house III, Hemmed Plantation, with Bell Beaker pottery. The pits were at both places quite deep (0.5–0.7 m), with vertical or slightly sloping sides and quite flat bottom. Unfortunately their function is not known. There are normally only a few finds of flint and pottery, cooking-stones or charcoal. A couple of pits north-west of house VI at Hemmed Church contained several hundred charred cereal grains as in a presumptive storage pit in house II at the Egehøj settlement. With the three-aisled houses, the large pits seem to lie outside the houses (*e.g.* A 57, Hemmed Church).

The three-aisled houses have, as house I at Hemmed Church, presumably all had stamped clay floors and stone fireplaces in the living sections, separated by distinct partition walls, which moreover, as in house V, Hemmed Church, and house II, Hemmed Plantation, may be furnished with distinct doorways just like those in the outer walls. This three-room partition cannot be observed in the centre-post houses whether the "recessed" wall posts indicate partition walls or have merely carried tie-beams to support the "inner skeleton" of these substantial houses.

Despite 3,000 years' sealing with sand drift, many details of the structures inside and outside the houses have been obliterated by the apparently hasty and repeated cultivation of the occupation layer above the abandoned houses. This phenomenon can be observed at two further settlements in Djursland from the early part of the Late Neolithic – Svapkæret and Diverhøj (Asingh 1988) – where the house remains were in both cases sealed by graves from the middle of the Late Neolithic (Boas 1986, fig. 1–2).

It should be emphasized that the C^{14}-datings carried out at all the Hemmed sites support the archaeological datings (*cf.* Rasmussen, this volume) and the postulated development in house types. It is evident that the samples of charcoal from the post-holes must give the most precise datings, whereas the accumulated charcoal of the pits can give a higher age. Possibility of contamination from older settlement is greatest here, but the charcoal samples of the pits, with a greater variation in type of wood and most often branch pieces, should otherwise have the lowest self-age (Malmros 1991).

CONCLUSION

The very considerable find material will in the near future be carefully analysed and will, with the technical analysis of the organic find material from the houses and the area around them, without a doubt reveal new details of human behaviour through the c. 1,500 years of settlement. A few of the area's burial mounds from the Late Neolithic and Early Bronze Age have been well investigated.[4] A further 6 preserved and 3 ploughed-down tumuli can be investigated at Hemmed to further illuminate the relationship between living and dead in the Bronze Age. One of the nearby barrows on Emmelev Mark, which was investigated in 1980, contained quantities of early Late Neolithic settlement material and two different burial phases from the Early Bronze Age. The graves were placed in a barrow surrounded by two kerbs containing a total of 19 stones furnished with the Bronze Age fertility symbol, cup-marks (Boas 1980). Although the soil at Hemmed can be fertile, sand drift presumably made extraordinary measures necessary to preserve fertility.

Translated by Peter Crabb

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NOTES

1. The case numbers for Hemmed are: Hemmed Church DJM (Djurslands Museum) 2215 and Hemmed Plantation DJM 2049.
2. The investigation was an emergency excavation necessitated by imminent tree planting and was financed by the State Antiquary. It was directed by the author assisted by Lisbeth Wincentz Rasmussen, Gert Hougård Rasmussen, Karsten Kristiansen, and Ole Poulsen, with great help from the amateur archaeologists Frank Jensen and Niels O. Boas, Hemmed.
3. At Mortens Sande in Northwest Jutland, remains of drift-covered houses with culture layers, i.a. from a phase parallel to the oldest at Hemmed Church (house VI) (Liversage 1988).
4. Egehøj, KHM (Kulturhistorisk Museum, Randers) file 160/69, Galtenhøj DJM 2147, Rimsø DJM 2361, Emmelev Mark DJM 1887, Brunhøj NM (The National Museum) B 4183.

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Two more House Groups with Three-aisled Long-houses from the Early Bronze Age at Højgård, South Jutland

by PER ETHELBERG

INTRODUCTION

The investigation at Højgård started in 1984[1] and was continued in 1985. The most important result has been the demonstration of two groups of houses with large, well-built, three-aisled long-houses in the company of small houses with sunken floors.

The results were presented in this journal in 1987 (Ethelberg 1987). On the basis of the pottery found and a typological evaluation of the houses, the three-aisled long-houses were dated to the Early Bronze Age, Period II–III, while the sunken houses were dated to the transition between the Late Neolithic and the Early Bronze Age.

This archaeological dating was supported by a C^{14} dating (K-4615) from a pit above one of the typologically latest houses. This pit is dated to 1010 BC (calibrated). The typologically latest houses at this time thus had to antedate the Late Bronze Age, Period IV.

The Højgård excavation was occasioned by gravel digging, and had therefore to be carried out in stages to accommodate this. On the request of the owner and operator, the investigation was resumed in 1987, continued in 1989 and concluded in 1990. It is the results of these investigations and the scientific datings which are the subject of this article.

INVESTIGATION METHOD

The settlement traces were delimited by means of trial trenches 3 or 6 m wide and 20 or 30 m apart. Based on the results from these trenches, those areas were selected that

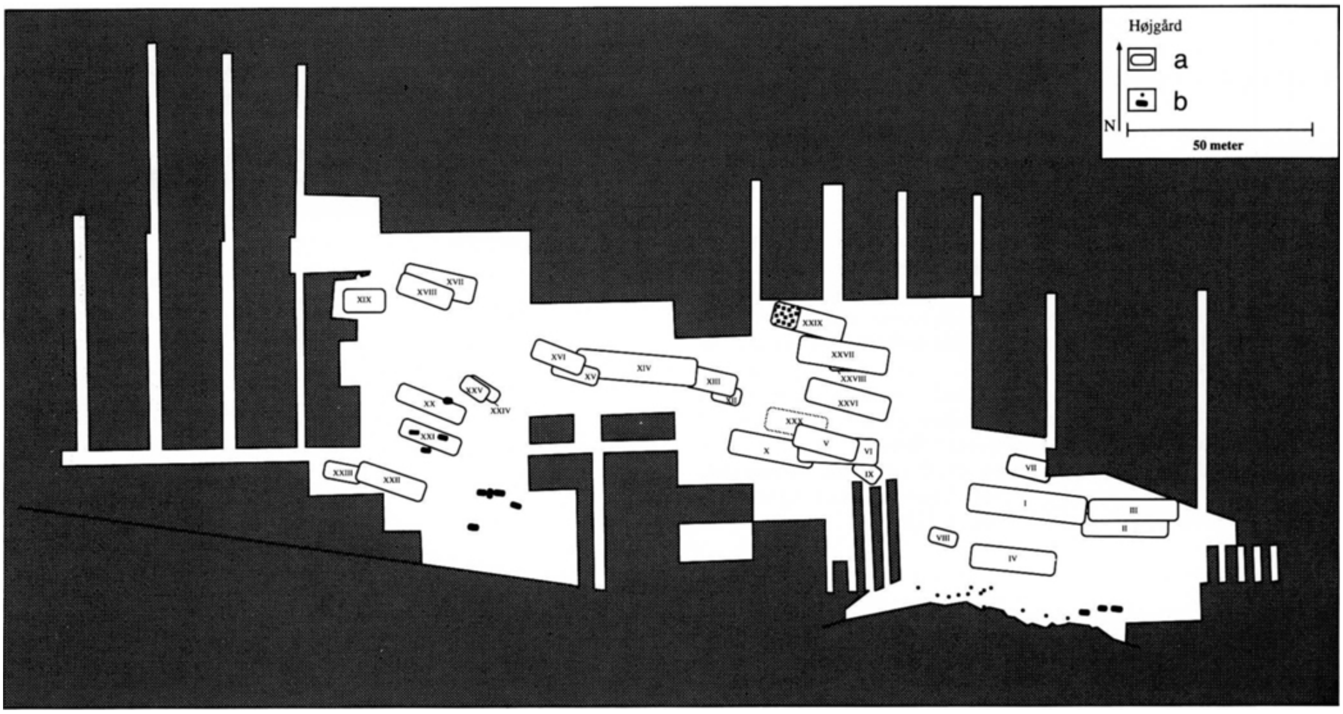

Fig. 1. Survey plan of Højgård showing the stratigraphic relation of the houses. a: Bronze Age houses. b: Iron Age graves.

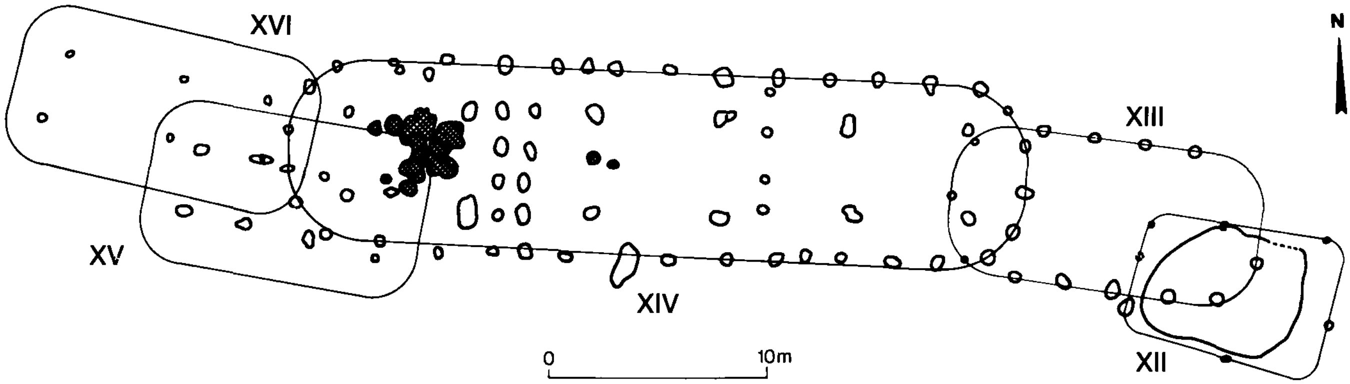

Fig. 2. The western house cluster (1987).

were to be surface-cleared. Here the topsoil was removed mechanically and the surface scraped with a mechanical shovel with a 3 m wide blade.

All structures within the surface-cleared areas were investigated in plan and section, while traces of structures in the trial trenches were usually investigated only in plan. After description, the fill remaining in the post-holes of the house constructions was sieved. All pits in the vicinity with finds were emptied after sectioning.

THE 1987 INVESTIGATION

The most important purpose of the investigation was to delimit and excavate the structures lying within the area covered by the gravel-digging permit, which meant *i.a.* that the excavation of that part of house X (Ethelberg 1987:158) that was not excavated in 1985 could now be completed.

Altogether, a continuous area of 6,050 sq.m. was surface-cleared. The remaining c. 6,550 sq.m. were covered by means of trial trenches. From 1984–87, an area of 18,050 sq.m. has been investigated. This investigation identified the western limit of the settlement. This left only the northern boundary to be defined, but this lay at this time outside the extraction area.

In addition to revealing the west end of house X, a further cluster of houses was found (fig. 2), consisting of a house with sunken floor (XII), a frame-house without traces of inner roof-bearing posts (XIII), and a large, wide, three-aisled long-house (XIV).

In addition, nine three-aisled long-houses (XV–XXIII) and two smaller, presumably also three-aisled houses (XXIV–XXV) were revealed, all with traces only of the roof posts and only occasionally a fireplace.

Two areas with four and five inhumation graves respectively were found, all of which may be dated to the beginning of the Early Roman Iron Age.

Below, only houses that can be dated to the Late Neolithic and Early Bronze Age will be described.

THE HOUSES

House XII (fig. 3): House XII has, like houses VIII and IX (Ethelberg 1987 fig. 3), a sunken floor. It appeared in plan as a large, almost rectangular depression measuring 6.70 × 5.20 m, and was oriented WNW/ESE. The house-pit, which had smoothly curved sides and floor, does not seem to have been dug in a regular manner. It is deepest in the middle – 26 cm. The depression was surrounded by at least five distinct post-holes and two ambiguous ones. One of them, in the southwest corner of the house, is considerably larger and more irregular than the others.

Just outside the west gable-end was a circular, flat-bottomed pit containing a fragmented cord-impressed A2 beaker (Glob 1945:65, fig. 29) (fig. 4). Under the pit was the base of a possible post-hole. This observation should be treated with some reservation, however, because the fill did not differ markedly from the surrounding subsoil,

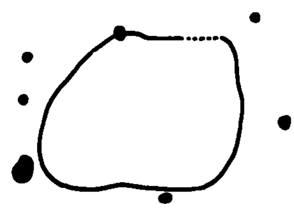

Fig. 3. House XII. 1:250.

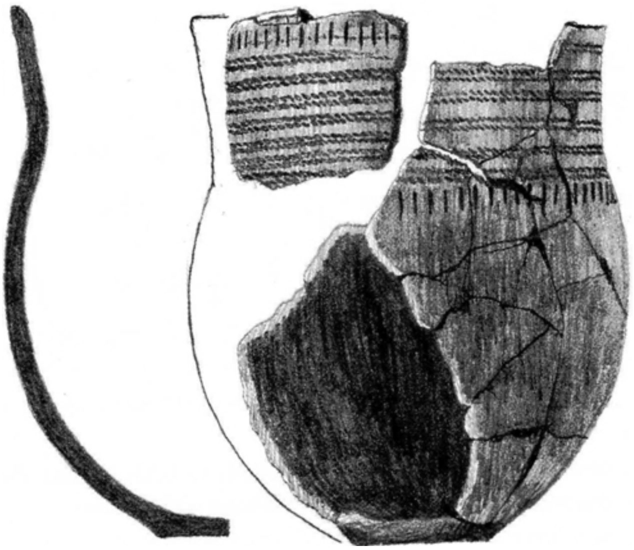

Fig. 4. A2 beaker from pit west of house XII. 1:2.

although clearly from the pit fill. If this is indeed a post-hole, it is coeval with or older than the pit. The next question is then, whether it can be linked to the house, which is important for the dating of this. Connection with the house pit cannot be proved, either. It does lie, however, in the presumptive wall line and helps to give the house an appearance resembling that of houses VIII and IX.

The house has had a rectangular to trapezoid outline measuring 8.85 × 5.7 m. There is no trace of inner roof posts or fireplace. In the centre of the house were a number of cobbles and larger stones. These were mainly associated with a post-hole, however, passing through the house pit. Two further post-holes were dug through the house pit. All belong to house XIII.

Scattered in the fill were a few potsherds of the same coarse type as found in houses VIII and IX, a few flint flakes, a blade scraper and a hammer-stone (fig. 5).

House X (fig. 6): The west end of house X was found to consist of another set of roof posts, two wall posts, two gable posts and an earth oven/cooking-stone pit.

The very clearly shaped west gable makes it doubtful whether what was perceived as the east gable in 1985 was so in fact (Ethelberg 1987 fig. 8). New scrutiny of the excavation plans from 1985 shows that the tentatively defined house XI (Ethelberg 1987 155 and fig. 3) cannot be maintained, because some of the posts that were thought to belong to house XI actually delineate the east gable of house X.

House X was 23.5 m long and 6.7 m wide. It is roughly

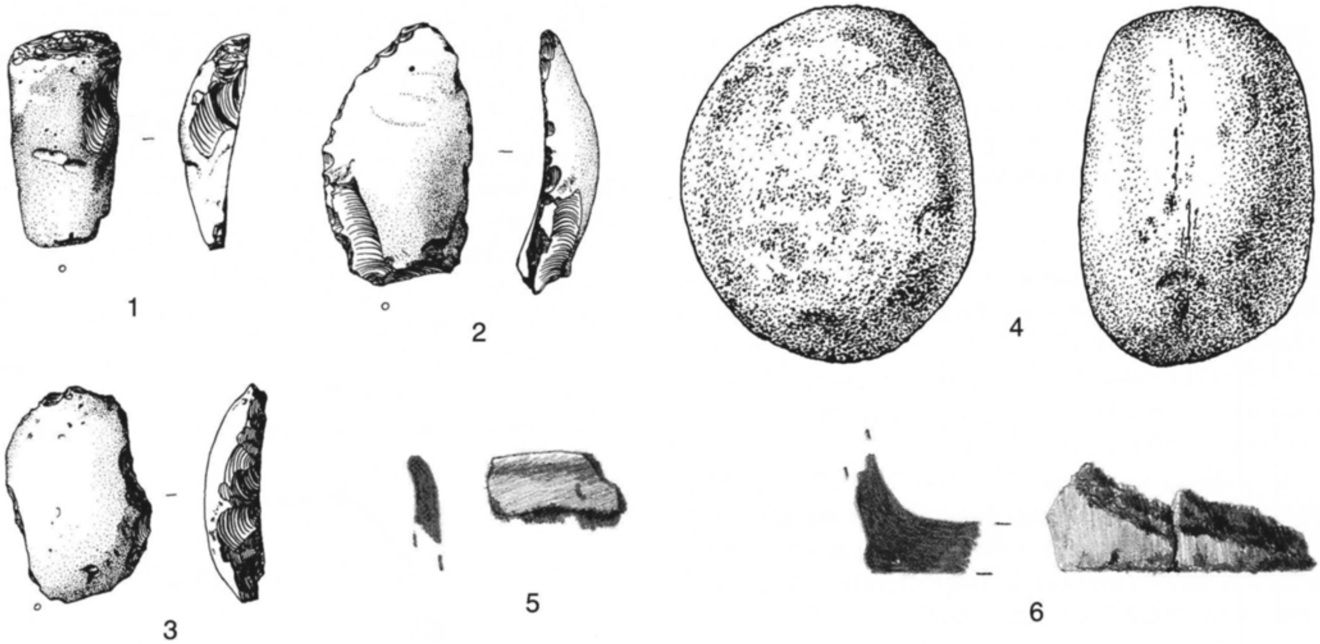

Fig. 5. Objects from house XII. Stone and flint objects 2:3, potsherds 1:2.

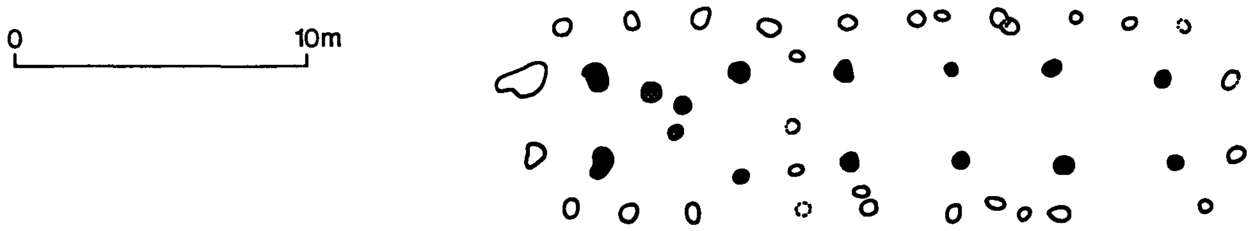

Fig. 6. House X. 1:250.

E–W oriented and three-aisled, with six sets of roof posts, which are scarcely so deeply set as the wall posts.

Between the next-last and last set of roof posts in the west end is a collection of three earth ovens/cooking-stone pits.

Between the penultimate and antepenultimate sets of roof posts – still at the west end – are three posts in a row perpendicular to the long axis of the house. In 1985, they were considered to be the west gable of house XI, but are perhaps more likely part of a partition wall dividing the house up into two rooms – a west end of c. 8.7 m and an east end of c. 14.8 m.

No entrances have been clearly ascertained, but in the south side just east of the presumptive partition wall are two post-holes slightly recessed in relation to the other posts and perhaps marking an entrance.

The gables are curved and made up of two posts which are almost in line with the set of roof posts – perhaps slightly recessed in relation to these, but not so much as is the case with house V, for example (Ethelberg 1987: fig. 7).

Finally, some of the remaining posts included in house XI may be regarded as replacement pieces. House X may thus have been in use for rather a long time, while "house XI" must be abandoned as a house construction.

House X cannot be coeval with house V and is stratigraphically older than house VI.

The revision of house X does not affect the chronological and typological conclusions presented in 1987.

House XIII (fig. 7): WNW–ESE oriented frame-house without inner or perceptible inner roof posts. The house was 13.8 cm long and 6.5 m wide. Both in the north wall and the west gable, a post-hole seems to be missing. Either they have never been there or they were not so deeply set as the other recognizable post-holes.

The side walls are straight and marked by approximately paired, opposing posts. The west gable is rounded and made up of two posts. It must be presumed that the east gable had the same construction, despite the "missing" post-hole. Neither fireplaces nor entrance have been ascertained.

Based on the stratigraphy, house XIII cannot be contemporaneous with house XIV, and it is later than house XII.

The only potsherds that can be assigned to the house derive from one of the holes dug into the house pit for house XII. Thus it cannot be determined whether they derive from house XII or house XIII.

House XIV (fig. 8): Practically WNW–ESE oriented three-aisled long-house, turned slightly more to the west than house XIII. The house has been considerably rebuilt, unless it is a matter of two phases.

At the west end, two collections of cooking-stone pits/earth ovens and two partition walls may be observed. The small number of both wall post and roof post replacements rather suggests rebuilding.

The house was 32.8 m long. The width varied from 8.0 m in the east to 8.4 m in the middle and 7.9 m at the west end. There were six sets of roof posts. The longitudinal distance between roof posts was 5–6 m and the transverse span 4–4.5 m. The distance between the roof posts and the side walls was 1.8–2.3 m.

Between the penultimate and antepenultimate set of

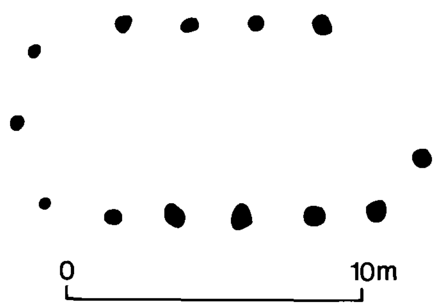

Fig. 7. House XIII. 1:250.

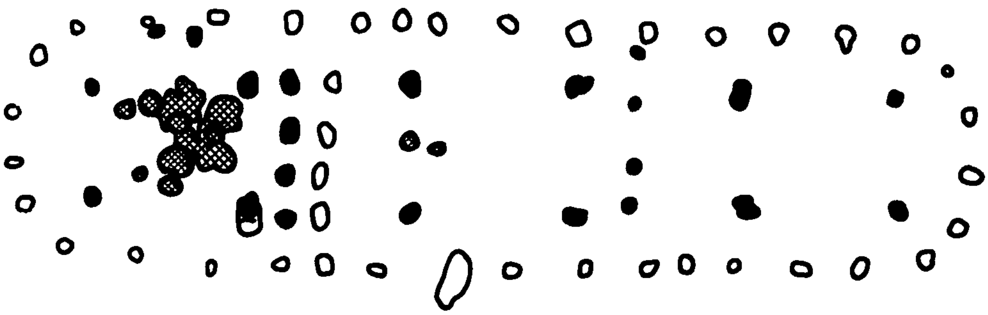

Fig. 8. House XIV phase 1 + 2. 1:250.

roof posts in the west end of the house are two partition walls c. 1.25 m apart. They cannot therefore be coeval. Although no entrance could be found in any of the partition walls, it cannot be ruled out, as with house I, that there was a central opening.

Between the penultimate and antepenultimate sets of roof posts at the east end of the house was another concentration of post-holes, some of which could derive from yet another partition. They are of considerably smaller dimensions, however, with respect both to scantlings and depth of set, than the post-holes in the partition walls of the west end. If this is a partition wall, the house was divided into three rooms of roughly equal size.

Although the house has its greatest width in the centre, this does not mean that the side walls were curved, but rather that there was a slightly irregular post-setting, especially at the west end of the house. The posts of the side walls were designed to be set in pairs opposite each other, and they were generally slightly more deeply set than the roof posts. But as the average difference is no more than 2 cm, wall posts and roof posts are considered in practice to have been equally deeply set. This suggests that also the walls played a role in roof construction. The gables were rounded and set with four posts.

In the north wall, an entrance to the west room can be demonstrated, marked with an inset wall post. There was an entrance into the central room both in the north wall and the south wall. The two entrances, diametrically opposed, are marked with an extra wall post. There may also have been an entrance in the south wall to the possible east room – likewise marked with an extra wall post.

At the west end of the house between the last and the

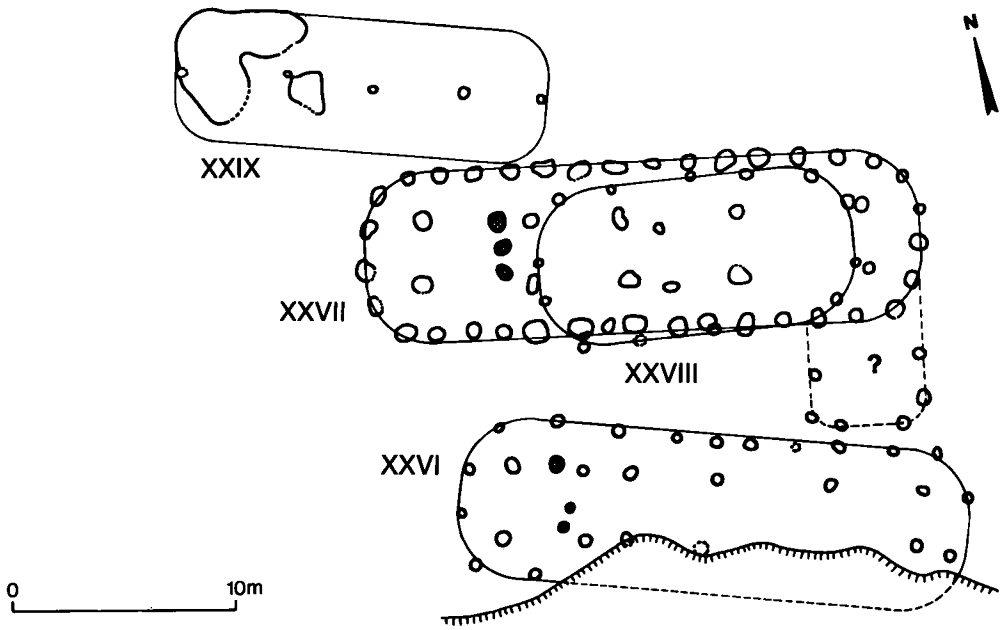

Fig. 9. The northern house cluster (1989/90).

next-last set of roof posts, a total of 11 cooking-stone pits/earth ovens were found, but they were not contemporaneous. The deepest – four in all – are the oldest, one of them being cut by two of the seven more flat-bottomed pits.

In the central room between the two roof posts and nearest the west partition wall were another two cooking-stone pits/earth ovens.

The most easterly cooking-stone pits/earth ovens in the west room, which are the deepest, must – judging by the distance – be considered coeval with the eastern partition wall, which must thus also be assigned to the construction phase. Whether the recessed entrance to the west room and the two cooking-stone pits/earth ovens in the centre room are coeval with this or later, cannot be decided, but recessed entrances seem in the light of Late Bronze Age houses to be a late feature.

If the eastern partition wall is contemporaneous with the oldest of the western partition walls, the house was constructed with three rooms of equal size, but after rebuilding, the middle room was the largest and the west room the smallest.

The fill in the post-holes yielded a few potsherds and flint flakes. These finds do not differ in any way from those made in the earlier-investigated houses.

Stratigraphically, house XIV cannot be coeval with house XIII, house XV and house XVI, but there are no vertical-stratigraphical observations.

THE 1989/90 INVESTIGATION

The investigation in 1989 sought to complete the excavation to the north-west and demonstrate the northern limit of the settlement area, while the purpose of the 1990 campaign was to examine the traces of structures encountered to the north.

In the period 1989/1990 an area of 11,600 sq.m., 3,300 sq.m. of which were surface-cleared, was investigated. During this investigation the fourth and last group of houses (fig. 9), consisting of a centre-post house with sunken west end (XXIX), a frame-house without inner roof-bearing posts (XXVIII), and two three-aisled long-houses (XXVI and XXVII) were localized and excavated. The most important result of the investigation was the demonstration of centre-post houses and of the settlement area's north boundary. The settlement can now be considered completely excavated.

THE HOUSES

House XXVI (fig. 10): House XXVI is an E–W oriented, three-aisled long-house, turned slightly to the north-west. It has been 22.45 m long and 6.55 m wide. It had six sets of roof posts. Whilst the span is relatively constant between them (3.0–3.2 m), the longitudinal distance between posts varies between 2.0 and 5.0 m.

The southern side wall lay just north of the limit of the 1985 excavation under an E–W field boundary. In connection with the continued gravel-digging, the remains of this wall have disappeared into the gravel pit without being recorded, with the exception of a single post-hole at the west end. Also a few of the southern holes for roof posts have disappeared in this way.

The diameter of wall posts and roof posts is the same, but the former are generally a shade deeper set than the latter. The depth decreases from west to east. Furthest east there are only a few centimetres of fill left. Against this, the eastern termination of the house must be treated cautiously, which is supported by the fact that the presumptive east gable is differently shaped than the well-preserved west gable.

The sides have been straight, while the gables have been rounded and set with only two posts, which at the east end are almost in line with the roof posts, while at the

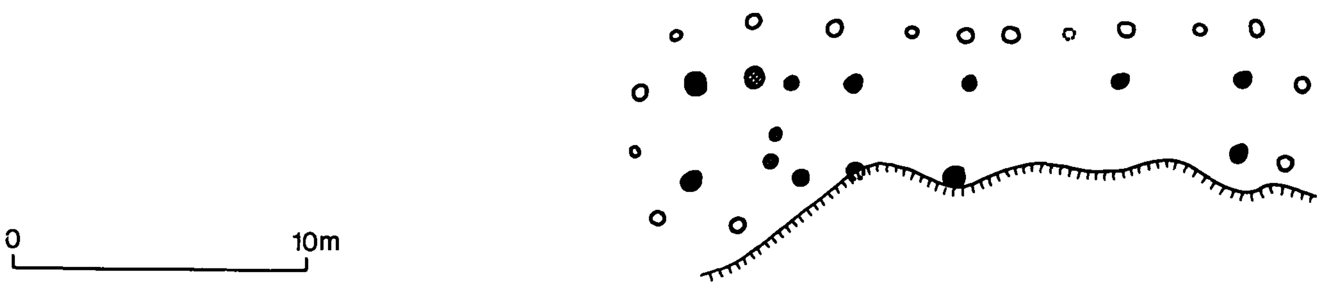

Fig. 10. Houses XXVI. 1:250.

west end they are inset. The distance between wall posts is generally 2.0–2.5 m. At a single spot in the middle of the northern side wall, the distance is only 1.5 m. Perhaps there was an entrance here.

Between the last and the next-last set of roof posts at the west end of the house is a group of cooking-stone pits.

House XXVII (fig. 11): House XXVII is an E–W oriented, three-aisled long-house, turned slightly north-west. This was 24.7 m long and 7.5 m wide.

The house had five sets of roof posts. Both the span (2.8–3.0 m) and the longitudinal interdistance (4.6–5.6 m) are very constant. The diameter of wall posts and roof posts is uniform, but unusually large. A few holes have a diameter of over 1 m. The depth of roof posts is considerably greater than that of the wall posts. Post-hole depth decreases from west to east. Furthest east, there are only a few centimetres of the fill left. The distance between wall posts is less than in house XXVI, about 1.5 m.

The side walls were straight, and the gables rounded and set with three posts. No entrances could be distinguished.

At the east gable outside the southern side wall, six post-holes form an almost square appendage (4.8×4.8 m). The diameter of the holes is considerably smaller than in the long-house, but depth and fill content are in agreement. It cannot therefore be excluded that a small outhouse is involved.

Between the last and the next-last set of roof posts at the west end of the house is a collection of cooking-stone pits.

The house is vertical-stratigraphically later than house XXVIII.

House XXVIII (fig. 11): House XXVIII is an almost E–W oriented frame-house, 14.1 m and 7.0 m wide.

Although there is a single set of post-holes within the wall frame, which could be the remains of roof posts, the house is considered to have been devoid of these, on account both of the irregular depth of these post-holes and because the house is so long that several sets of posts should be expected if they were to be considered roof-bearing and thus a house type-defining element. It cannot be ruled out that the traces referred to are rather those of a partition wall.

The gables have been rounded. The northern side wall

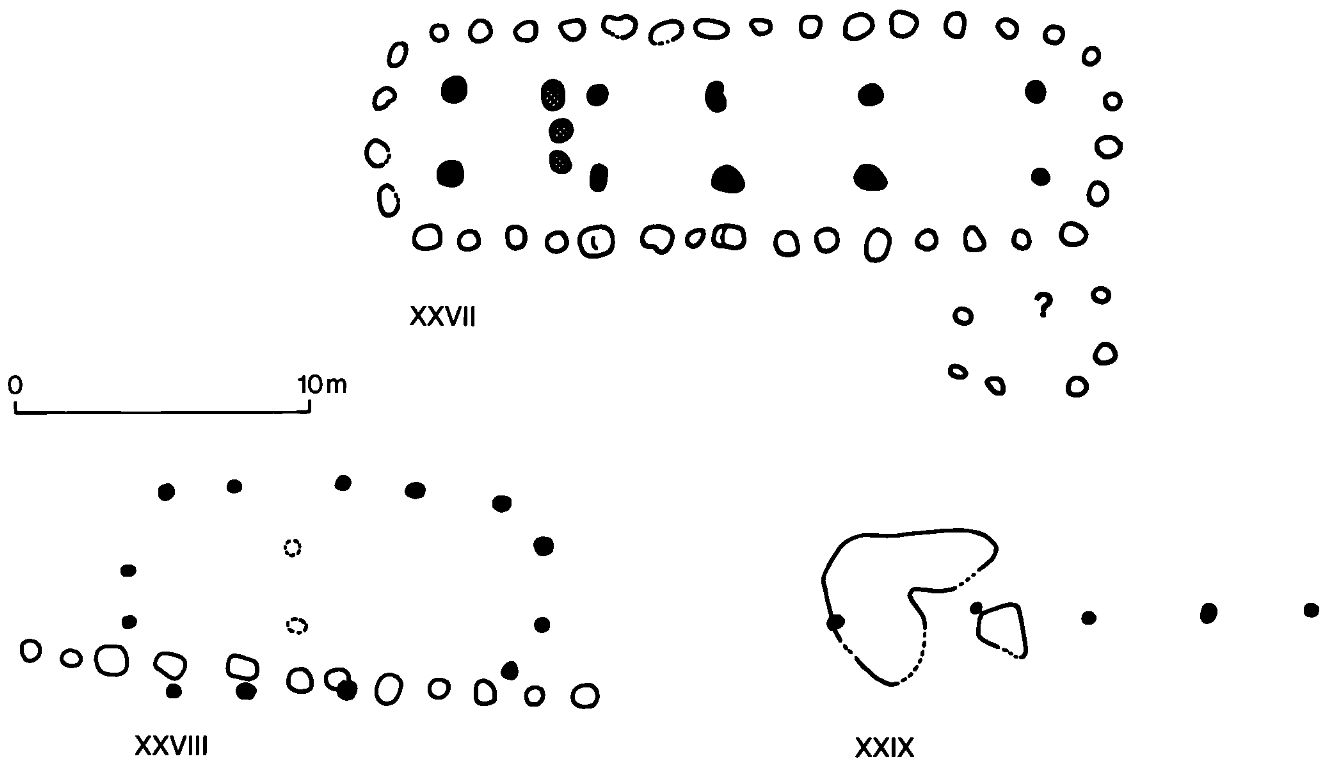

Fig. 11. Houses XVII, XXVIII and XXIX. 1:250.

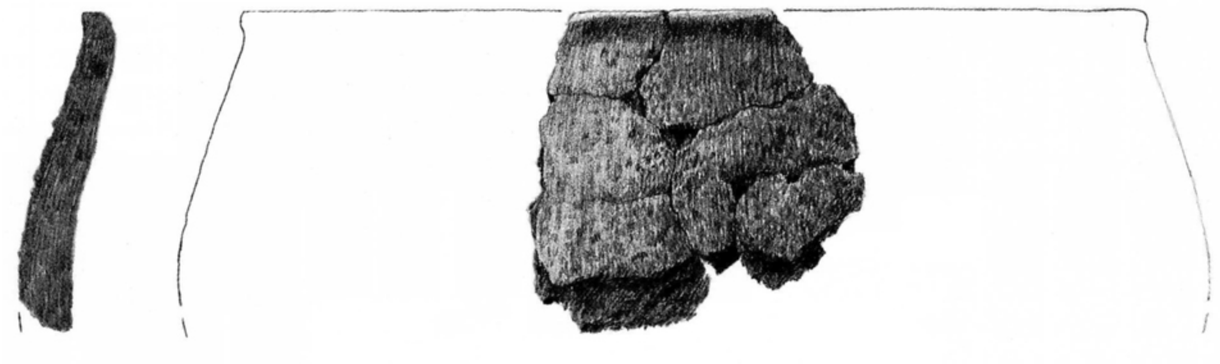

Fig. 12. Potsherd x1578 from house XXIX. 1:3.

has been slightly curved, the southern straighter. The wall posts have stood in pairs opposite each other with an interdistance of 2.5–3.5 m. No traces of either entrances or fireplaces have been demonstrated.

The house may be shown in vertical stratigraphy to be older than house XXVII.

House XXIX (fig. 11): House XXIX is an almost WNW–ESE oriented centre-post house with sunken floor – c. 6×5 m – at the west end. It must have been at least 16 m long.

No traces of the walls have been preserved, but judging from the house pit, the width was at least 5 m. In addition to the house pit, the house consists of five post-holes in the mid-line. Neither fireplaces nor any entrance could be discerned.

There are no stratigraphic observations in relation to the three-aisled houses.

ARCHAEOLOGICAL DATING OF THE NEW HOUSES

Based on the archaeological find material and the house-typological criteria laid down in 1987, the newly found houses are related to the suggested phase division, which has, however, been expanded, the settlement from the Late Neolthic and Late Bronze Age having been added. In consequence, in order to avoid confusion, it has been decided to change the phase designations.

1987	1991
	Phase A
Phase 1 =	Phase B
Phase 2 =	Phase C
Phase 3 =	Phase D
	Phase E

Phase A

There can be no doubt that house XII is associated with houses VII and IX. They are all three small, practically rectangular houses with partially sunken floors and no internal roof-bearing posts.

Scattered in the fill of the house pit in house XII is some pottery and worked flint. The pottery is of the same type as found in the previously investigated house pits, in respect of shape, temper and firing. The flint is characterized by flakes, an exception being a blade-like scraper.

A critical point is whether the pit with the A2 beaker from the early Under Grave period has any connection with house XII. This cannot be decided with certainty, the interpretation of the underlying post-hole being highly speculative. It is therefore omitted from further discussion.

In respect of shape, the houses most nearly resemble the Single Grave house from Vorbasse (Hvass 1977), while the pottery best resembles that from the large, three-aisled long-houses.

Although the sunken houses are stratigraphically older than the three-aisled long-houses, the congruence in grouping seems too remarkable to be a sheer coincidence.

House XXIX is a centre-post house with sunken west end, but without traces of wall construction. Houses of this type both with and without partially sunken floors have turned up all over the country. The dating frame work extends from the late Single Grave Culture (Hemmed Church house VI (Boas 1993, this volume)) to Early Bronze Age Period I/II (Egehøj house III (Boas 1983:101)).

The house pit was cut by a pit containing pottery deriving from a very thick-walled and coarsely tempered

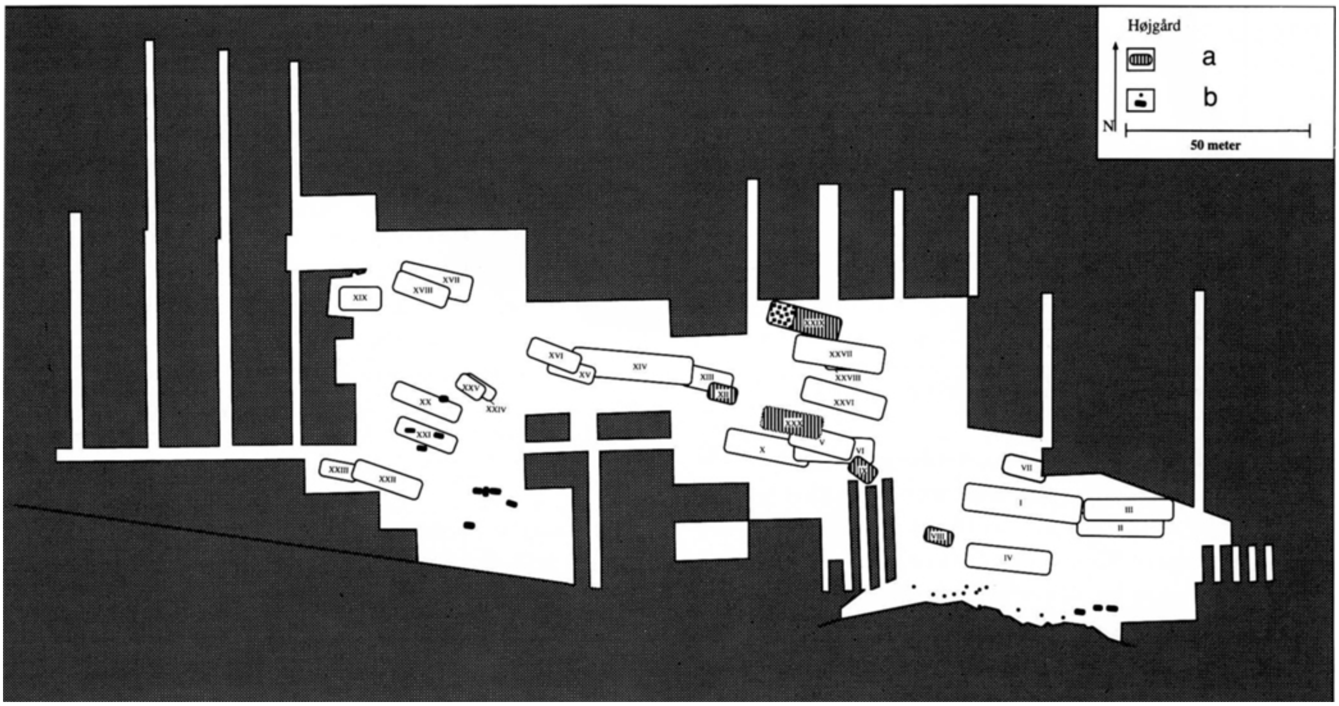

Fig. 13a. Højgård phase A. a: Late Neolithic houses. b: Iron Age graves.

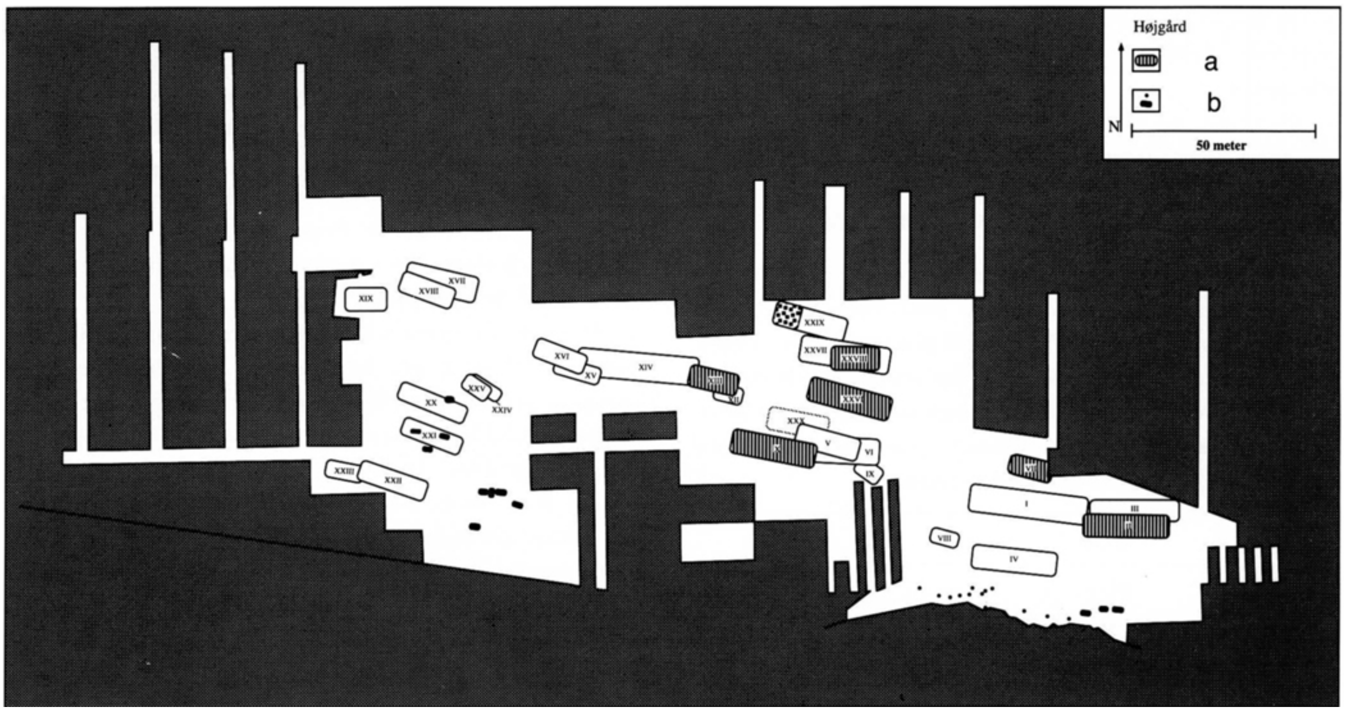

Fig. 13b. Højgård phase B. a: Houses, Early Bronze Age Period I. b: Iron Age graves.

vessel (fig. 12). The rim is rounded and slightly excurrent, while the side has been fairly straight. The transition from rim to vessel side is marked by a very indistinct shoulder. Vessel height was at least 13 cm. Considering the greatly increasing wall thickness below – 2.4 cm – the vessel can hardly have been much higher. It is burnished just below the rim but otherwise very coarsely slipped. A few other sherds, which cannot, however, be joined to the large fragmented sherd piece, suggest that the foot was offset and burnished. Although the sherd piece was found in a pit which is later than the house-pit, it is tempting to associate it with the house, for similar sherds were found in the untouched part of the house pit. The similarity to the potsherds from Egehøj (Boas 1983 fig. 7) and Røjle Mose (Jæger & Laursen 1983 fig. 17f), which may be dated to Early Bronze Age, Period I, and from Øster Nibstrup, dated to the Late Neolithic (Michaelsen 1989: fig. 8), is pronounced.

The sherd material cannot at the moment narrow down the dating beyond Late Neolithic/Early Bronze Age. But as the typologically oldest three-aisled long-houses may be dated to the transition to the Early Bronze Age, Period I, house XXIX must be dated to the Late Neolithic.

In the house cluster comprising houses V, VI, IX and X, there are five posts in a row to the north with the same orientation as house XXIX. These can derive from another centre-post house (XXX fig. 14). The holes are not linked to a depression. The area was investigated in 1985. At that time, only holes that belonged to clearly identified house constructions were sectioned. These holes have therefore been recorded only in plan.

The sunken floor at the west end of house XXIX is of approximately the same size as the house pits belonging to houses VIII, IX and XII but was not, like these, surrounded by post-holes. It is reasonable – especially on the basis of the pottery found – to regard the small sunken houses as coeval with the centre-post houses and thus part of the oldest settlement phase (fig. 13a), which should thus be dated to the Late Neolithic.

Five houses in all can be assigned to phase A, namely VIII, IX, XII, XXIX and XXX. Two different types are involved, but it cannot be ascertained whether the difference is chronological, functional, or social. Considering that the farm unit also in the subsequent period seems to consist of two different house types, there can be reason to consider the difference as primarily functional.

Phase B

Phase B (fig. 13b) comprises the typologically oldest three-aisled houses, *i.e.* those with the greatest distance between the wall posts and the smallest number of gable posts. Also characteristic is the fact that the wall posts are more deeply set than the roof posts. Besides house II, houses X and XXVI may be assigned to phase B.

Revaluation of house X has not altered the typological dating. Stratigraphically, house X is older than house V, which belongs to the typologically latest, three-aisled houses of the Early Bronze Age.

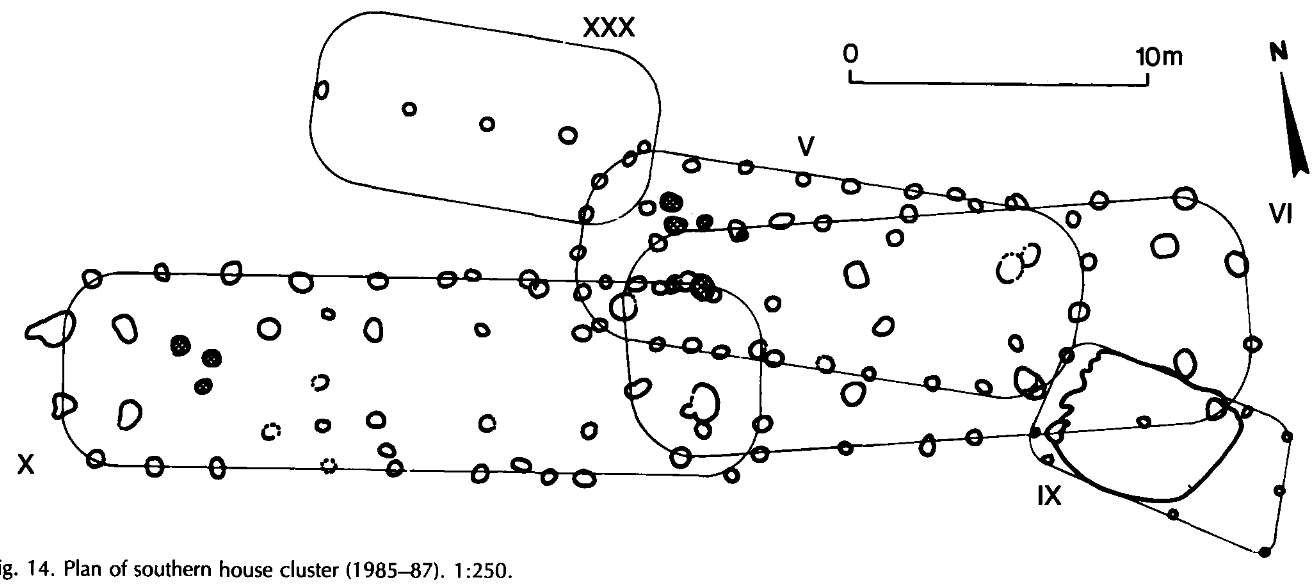

Fig. 14. Plan of southern house cluster (1985–87). 1:250.

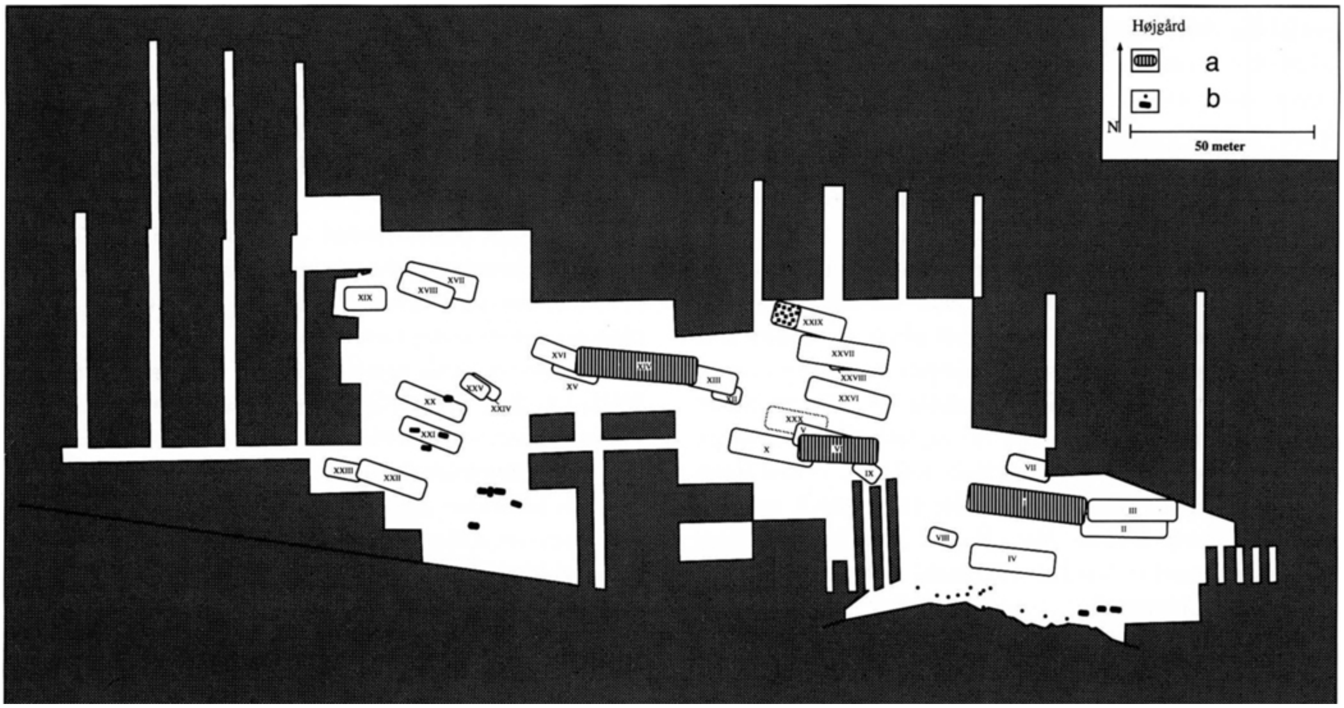

Fig. 15a. Højgård phase C. a: Houses, Early Bronze Age Period II. b: Iron Age graves.

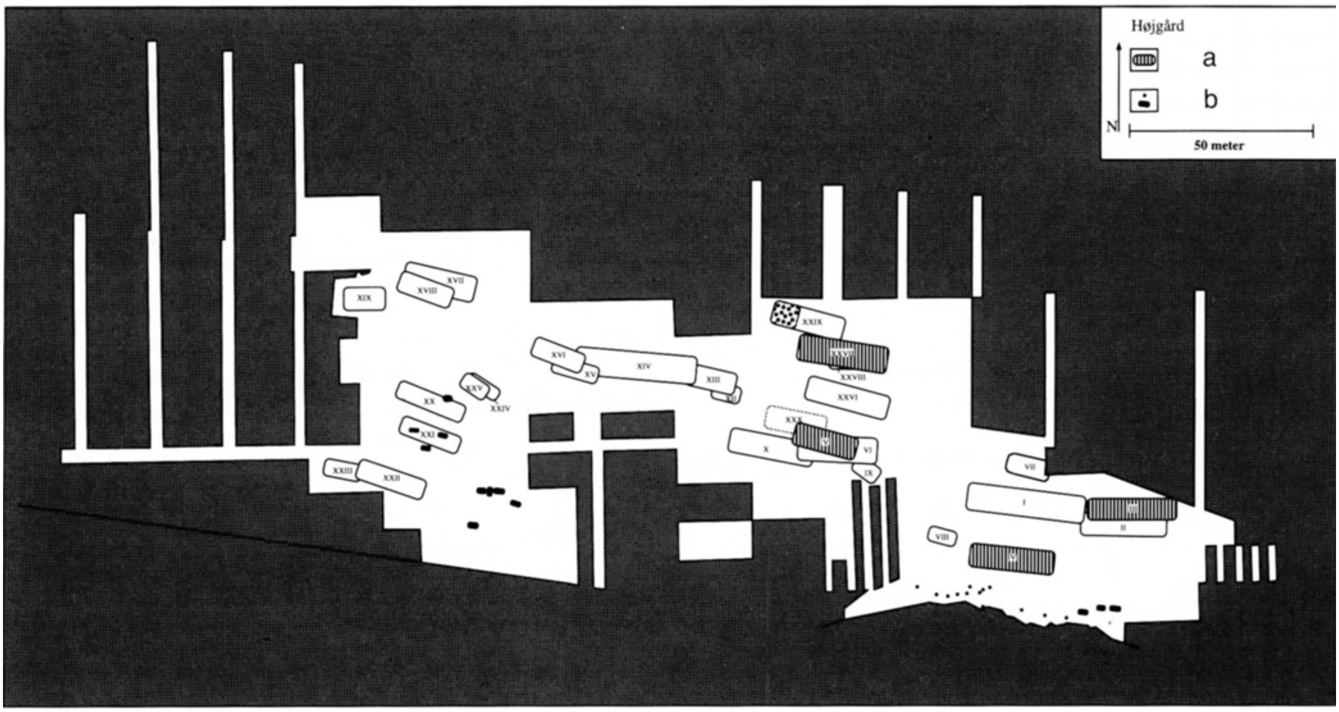

Fig. 15b. Højgård phase D. a: Houses, Early Bronze Age Period III. b: Iron Age graves.

The frame-houses belong to this phase, since they can be shown stratigraphically to be later than the small sunken houses in phase A – post-holes in house XIII are dug down through house XII – and stratigraphically older than the houses assigned to phase D – a post-hole in house XXVIII is cut by a house XXVII post-hole.

On this basis, also house VII is assigned to phase B, which thus comprises houses II, VII, X, XIII, XXVI and XXVIII. As two different types are involved, which may be assigned stratigraphically to the same phase, the difference is considered to be functional.

It is therefore reasonable to assume that the basic farm unit in this phase consisted of a large, three-aisled long-house and a small frame-house. If this is the case, it is likely that houses II and VII formed one entity, houses X and XII another, and houses XXVI and XXVIII a third. It cannot be decided whether the three farms were contemporaneous, or sequential.

The phase B sherd material cannot contribute to a narrowing of the dating beyond the Early Bronze Age. Central to the dating of this phase is therefore the find of a small house model in amber from Sejstrup (Asingh 1990: 14), which is situated a good 20 km north-west of Højgård. The ground plan of the amber house is identical to that of the frame-houses at Højgård. In particular house XXVIII shows a striking resemblance. The Sejstrup grave has to be dated to Early Bronze Age, Period I, which accords with the stratigraphical observations at Højgård and the dating of the frame-house C from Røjle Mose (Jæger & Laursen 1983:114). The Sejstrup house is at the same time important for the evaluation of whether frame-houses had internal roof-bearing posts, which due to being shallow-set have been ploughed away. This does not seem to be the case, which justifies the term frame-house.

The establishment of a Period I dating for the frame-houses thus also places the typologically oldest three-aisled house and thereby phase B in Period I.

Phase C

Characteristic of the houses belonging to phase C is their great width, practically uniform depth of wall posts and roof posts (fig. 15a). Of secondary features, *i.e.* features that are not general but are phase-specific when they occur, may be mentioned distinct partition walls at the west end, combined with lengths of about 30 m.

House XIV is on account of length and breadth, position and form of the partition wall at the west end, and in principle equally deep wall and roof posts, a pendant to houses I and VI, whereas the increased number of wall posts at the gables and the possible recessed entrance seem to be later features.

Several potsherds derive from the post-hole fill, all of the same type known from the previously published houses.

The first-mentioned features indicate coevality with houses I and VI, but house XIV also contains elements pointing ahead. This may be because it presumably functioned for longer than the other houses of this type, judging by the two partition walls and the collection of earth ovens/cooking-stone pits, which can be divided into two clusters. This means that the number of posts in the gable ends is not an unambiguous phase identifier, but one can still reckon that the greater the number, the later the house.

In this phase, there is a change in the structure of the basic farm unit from two houses – presumably with different functions – to one house, which is wider and furnished with partition walls – perhaps in order to collect the two functions under one roof (fig. 19).

No finds have turned up to narrow down the archaeological dating, which is thus still anchored in the house type: Early Bronze Age, Period II and the beginning of Period III.

Phase D

Characteristic of the houses belonging to this phase are the closely spaced wall posts and the clearly deeper set of the roof posts and lesser width than the phase C houses.

Hitherto, houses III, IV and V have been assigned to this phase. Now, house XXVII (fig. 15b) can be added. Although it approaches phase C houses in its width, the crucial features are the deeper set of the roof posts compared to the wall posts and the closeness of the wall posts.

When the houses were presented in 1987, phase D was dated stratigraphically to be later than phase C and earlier than a pit that could be C^{14}-dated to 1010 BC.

When house XXVII was investigated in 1990, three large fragmented potsherds with preserved rim (fig. 17.1–3) were found. In all three cases the sherds were from thin-walled, well-fired vessels with burnished surface. The rim is clearly thinned down. The transition between neck and top is marked by a distinct ledge and in the two cases also by oblong horizontal lugs. Vessels of

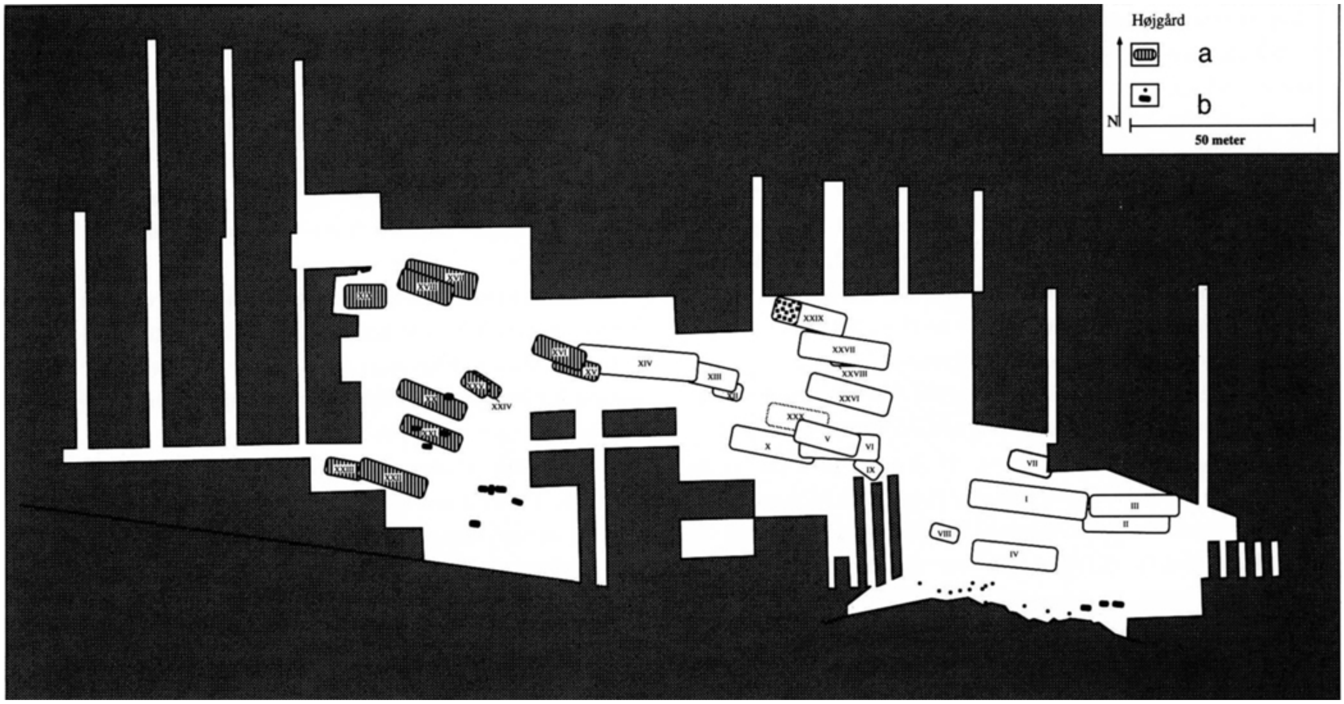

Fig. 16. Højgård phase E. a: Houses, Late Bronze Age. b: Iron Age graves.

this type have their main distribution area in the western part of South Schleswig where they are primarily found in graves dated to Early Bronze Age, Period III (Aner & Kersten 1979).

Phase E

Furthest to the west are nine three-aisled long-houses and two smaller houses which were doubtless also three-aisled (fig. 16). Only the holes from the roof posts are preserved, and a few possible fireplaces, which are never grouped together.

With the exception of house XVII, which in relation to the other houses had deeper-set roof posts with a considerably greater span between them, the other houses seem to have been constructed in pairs, successively.

The phase E houses are placed in an approximately NNE–SSW oriented group, in which houses XXIV and XXV must be outhouses to houses XX and XXI or vice-versa.

Houses XV and XVI lie east of this row of houses and are associated with the western group of houses containing, *i.a.* house XIV. The question is, however, whether this association is a real one. If it is, one would expect that at least one of the two is contemporaneous with houses III, IV, V and XXVII, but the lack of a group of cooking-stone pits/earth ovens at the west end between the last and the next-last set of roof posts and the small length and breadth argue against this.

These west-situated, slender houses are otherwise difficult to date. Stratigraphically, they cannot be coeval with the large three-aisled long-houses with partition walls. They are older than the inhumation graves from the early phase of the Early Roman Iron Age, because some of these graves have cut into the post-holes.

Only in a few of the post-holes has pottery been found, in all cases a finely tempered, relatively thin-walled, well-fired ware which cannot be more closely dated, but is presumably later than the Early Bronze Age.

In a few pits in the vicinity, pottery has been found which can be dated to the Late Bronze Age, Period IV (fig. 17.4). Here the ware is of approximately the same kind.

A dating to Pre-Roman Iron Age is hardly likely, due to the low find frequency: Pre-Roman Iron Age sites usually carry a very copious sherd material. Moreover, the entrance posts so characteristic of this period are absent. Finally, it appears that the Early Roman Iron Age houses from South Jutland (Ethelberg 1989) are grouped in the

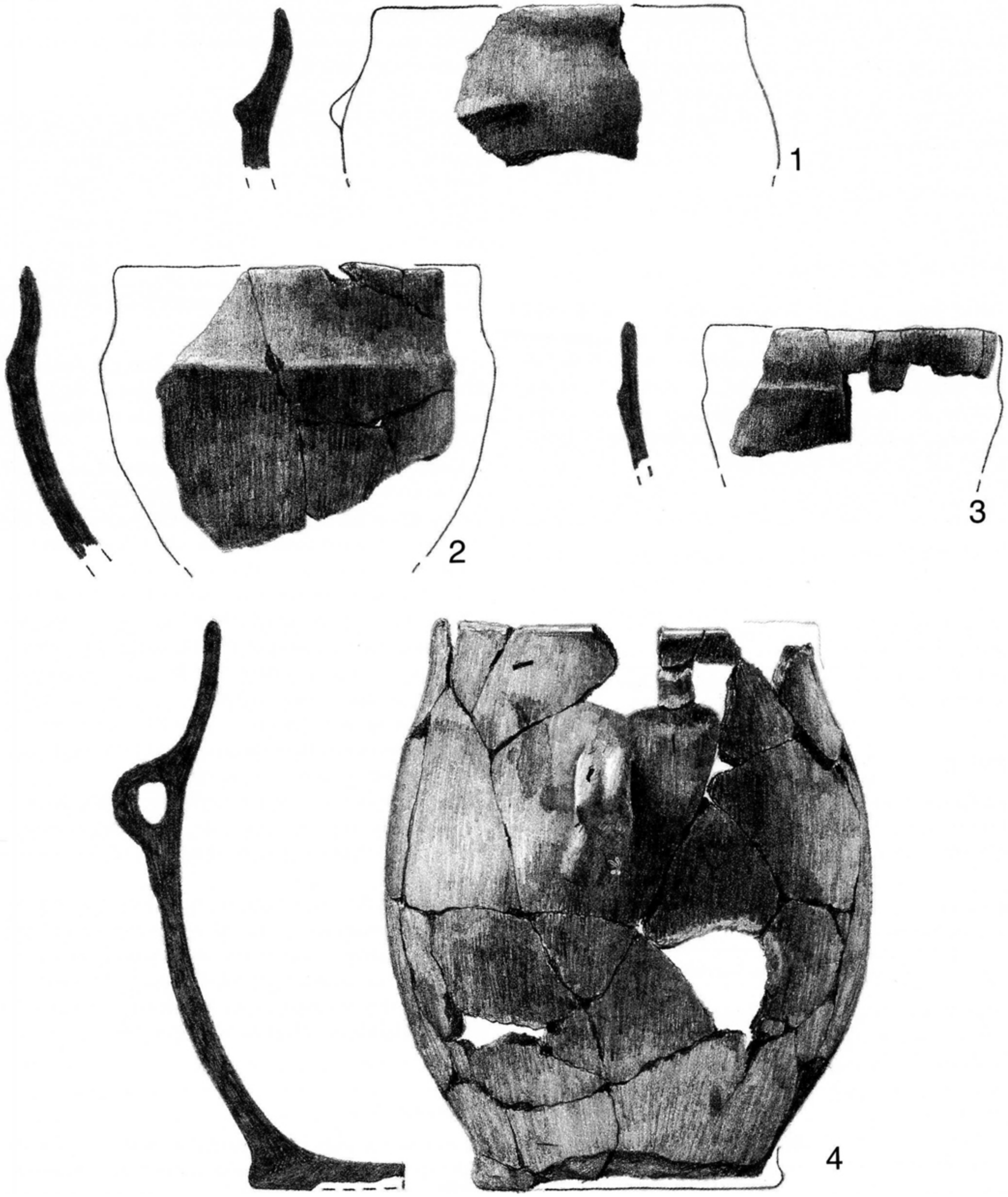

Fig. 17. 1–3: Potsherds from house XXVII. 4: Vessel x99.1 from the Late Bronze Age, found in a pit close to houses XV and XVI. 1:2.

same way, as C. J. Becker has demonstrated at Grøntoft, for example (Becker 1982).

Archaeologically, the dating cannot be narrowed down further than the end of the Early Bronze Age/Late Bronze Age. Here, a dating to the Late Bronze Age seems to be most appropriate.

Finally, it cannot be decided how many of the phase E houses were contemporaneous.

THE SCIENTIFIC DATING

The dating of the three-aisled long-houses from Højgård has been based above mainly on stratigraphic observations, house-types, a few potsherds and a single radiocarbon dating of the latest possible age (K-4615 Ethelberg 1987:161ff). In the following, the focus will be on the scientific datings and to what extent these are in agreement with the archaeological dating.

Thermoluminescence dating

V. Mejdahl took a series of thermoluminescence samples of fire-cracked stones from houses V, VI and X, which were investigated in 1985. The results are presented in table 1 (Mejdahl 1987 and 1990).

Risø TL no.	House	Pit	Sample no.	TL date ± 200 years 20C	100C
R-851102	V	822	886	830 BC	850 BC
R-851105	V	829	887	560 BC	740 BC
R-851106	V	829	887	1120 BC	400 BC
R-851108	V	832	889	1 AD	500 BC
R-851109	VI	834	890	1120 BC	1280 BC
R-851112	VI	835	891	690 BC	
R-851115	VI	836	892	1110 BC	1310 BC
R-851117	VI	836	892	980 BC	1190 BC
R-851121	X	838	894	310 AD	470 BC
R-851122	X	838	894	190 BC	360 BC

Table 1. Thermoluminescence datings from the central house cluster.

From the first results it was clear that the datings were erroneous, but by altering the fading temperature, datings could be achieved that were considerably older than the first ones. This does not alter the fact, however, that samples of stones from the same pit can give datings varying by as much as 660 years. This discrepancy can be due both to the sampling method and to the type of stone. During the investigation of house XIV in 1987, a new series of samples was taken, in which sampling was designed to eliminate errors, and more care was exercised in the selection of stones. The preliminary datings are shown in table 2 (Mejdahl 1989).

Risø TL no.	House	Pit	TL date ± 200 years
R-881103	XIV	1201	1850 BC
R-881106	XIV	1202	1310 BC
R-881108	XIV	1203	1190 BC
R-881110	XIV	1203	1290 BC
R-881111	XIV	1203	1350 BC
R-881113	XIV	1204	1280 BC

Table 2. Thermoluminescence datings from the western house cluster.

With the exception of the sample from pit 1201, the datings are nicely grouped, but in relation to the radiocarbon dates, they are still too late, also in relation to the radiocarbon samples' presumable self-age.

Finally, there is a TL-dating of potsherd no. x200, which was found at the top of the post impression in a roof-post hole belonging to house I. On the inside of this sherd were charred food remains, which have been C^{14}-dated by means of the accelerator method.

Two TL measurements were undertaken. One of these – R-871101 – yielded 1220 ± 200 BC, but must be rejected due to too great a fading of the TL signal. The other – R-871102 – yielded 1480 ± 200 BC. In comparison, accelerated radiocarbon dating – Ua 705 – yielded 3115 ± 110 bp in C^{14} years = 1410 BC, calibrated ± 1 standard deviation. Here the agreement between the two methods must be said to be acceptable.

This agreement does not immediately apply to the dating of the fire-cracked stones, the TL-dating of pottery having proved more reliable than that of fire-cracked stones.

Generally, the thermoluminescence method is still in its infancy. Development work still seems necessary. Until this has occurred, extensive culture-historical conclusions should not be drawn from TL-dating. V. Mejdahl has discussed thermoluminescence problems in relation to Højgård elsewhere (Mejdahl 1987 and 1990).

Radiocarbon dating

In connection with all excavation campaigns, charcoal samples have been taken with a view to radiocarbon dating. They were extracted with a trowel, and by wet and dry sieving. In those cases where there was insuffi-

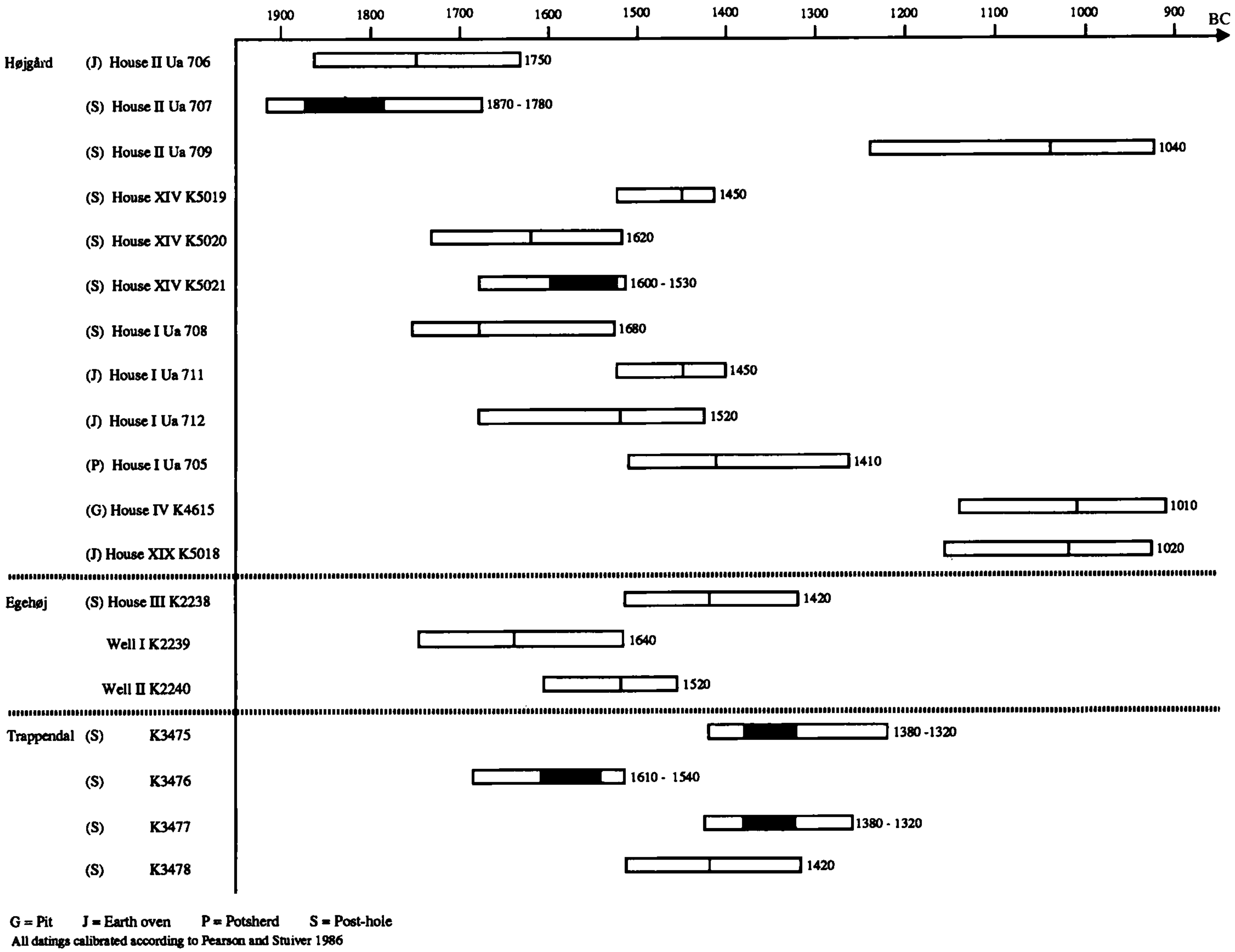

Fig. 18. Radiocarbon dates of the three-aisled long-houses at Højgård.

cient material for a conventional dating, C. Malmros of the National Museum's Environmental Department has selected the most suitable and submitted them to Uppsala for accelerator dating. A more detailed presentation of the individual datings occurs elsewhere in this volume (Rasmussen 1993). So far, results have been received only for the samples submitted up to and including 1987.

As it appears above, both conventional dating and accelerator dating are involved. The results are shown in fig. 18. The Ua-datings (Uppsala) have employed the accelerator method, the K-datings (København) are conventional. The table also includes the datings from Egehøj (Boas 1983) and Trappendal (Boysen & Andersen 1983). All datings are calibrated according to Pearson & Stuiver 1986, and may thus be directly compared with the TL-datings.

The full agreement between the two dating methods is apparent. The accelerator method has its great strength in the fact that only a fraction of a gramme of organic material is required, but it does present methodological problems that have to be taken into account during sampling. The risk that the sample to be dated has been contaminated, for instance by animal activity, is considerably greater than with conventional dating, so the date obtained can be either too late or too early. An example of this is presumably sample Ua 709, or more extreme Ua 710, which is dated to the early Viking period and has therefore been omitted from the table. Error can be counteracted by taking a series of samples, and discounting the most deviant.

Another problem is the self-age of the samples. Here too significant discrepancies can arise, if the samples are not taken from trees with a short life-span. Finally, great care should be exercised when taking samples, so they are neither mixed with extraneous material nor are contaminated with recent material.

The results of the radiocarbon datings confirm the contemporaneity of the earth ovens/cooking-stone pits and houses. There can be no doubt that these pits are an integrated part of the large, three-aisled long-houses.

The radiocarbon datings further confirm the house-typological development, but the large, broad houses with partition walls seem to be confined to Period II. Unfortunately, there is still no dating of either the centre-post houses or the typologically latest houses with their characteristic placement of earth ovens/cooking-stone pits. On the other hand, they are dated both ceramically and stratigraphically.

Finally, C^{14}-dating K-5018 of house XIX suggests that the smaller houses to the west without preserved wall traces and without the characteristic placement of the cooking-stone pits/earth ovens must be dated to the transition between the Early and Late Bronze Age. The dating is 1020 BC, calibrated ± 1 standard deviation: 1160–920 BC.

To summarize, the archaeological and scientific datings show a possible continuity of settlement from the end of the Late Neolithic to the beginning of the Late Bronze Age. There is thus a unique possibility there of studying house development through the Early Bronze Age (fig. 19).

SUMMARY OF INVESTIGATIONS 1984–90

In the period 1984–90, an area totalling 29,650 sq.m. has been excavated, 14,800 of which have been surface-cleared.

29 houses (I–XXX) (fig. 1) make up four clusters with houses from the end of the Late Neolithic to the end of the Early Bronze Age. A continuity of settlement can be demonstrated, extending from the end of the Late Neolithic to the beginning of the Early Bronze Age, and settlement furthest west presumably from the beginning of the Late Bronze Age. Within this period, the settlement can be divided into five phases (A–E):

Phase A, which comprises the centre-post houses XXIX and XXX and the sunken houses VIII, IX and XII, is the oldest and should probably be dated to the end of the Late Neolithic.

Phase B is made up of the long-houses II, X and XXVI and the frame-houses VII, XIII and XXVIII and should be dated to the transition to the Early Bronze Age, Period I.

Phase C is made up of houses I, VI and XIV and should be dated to the transition to the Early Bronze Age, Period II.

Phase D comprises houses III, IV, V and XXVII and should be dated to the Early Bronze Age, Period III, but it cannot be ruled out that it starts at the end of Period II.

Phase E is made up of houses XV–XXV and must be dated to Period III/IV, *i.e.* the transition between Early and Late Bronze Age.

This does not mean, however, that all houses that can be assigned to the same phase have necessarily existed at the same time, and considering the time involved, coevality seems hardly likely.

One can follow how the three-aisled construction technique supersedes the centre-post construction and how the weight of the roof is gradually transferred from mainly the walls to mainly the roof-bearing posts. It is in other words the development of the three-aisled house that can be followed here. This development occurs in the course of the Early Bronze Age.

The houses within each cluster do not always constitute a settlement sequence in which the same house may be followed for several phases. In the western cluster, house XIII and house XIV have hardly had the same function. In the northern cluster, house XXVI and house XXVII probably have, but in the house-typological development, the time interval is too great for one to have replaced the other.

There seems to be a striking agreement between the size of the houses and the supply of bronze, so that the largest houses – *i.e.* the Period II houses – are found when the bronze supply culminates (Kristiansen 1978:160ff). In step with the increased bronze supply, the houses seem to increase in size and to decrease again with the reduction in size in Periods III and IV.

The perception that the cooking-stone pits/earth ovens

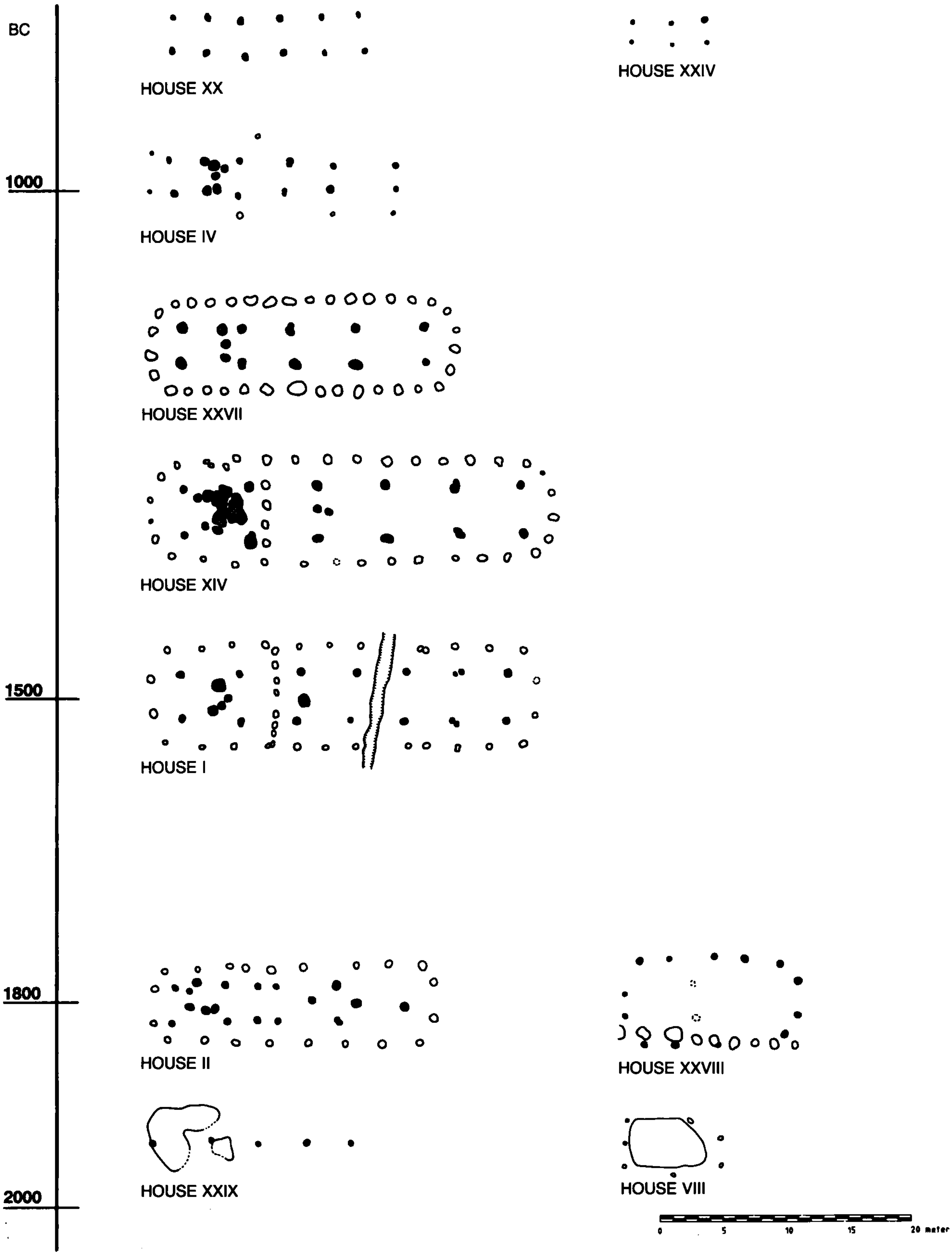

Fig. 19. The development of house-types from the end of the Late Neolithic to the beginning of the Late Bronze Age in South Jutland.

at the west end of the three-aisled long-houses are characteristic of the Early Bronze Age has been further strengthened and must be considered a defining element.

Finally, Højgård represents one of the few settlements from the Early Bronze Age which has been completely investigated.

HØJGÅRD IN CULTURE-HISTORICAL PERSPECTIVE

It is surprising that the typologically oldest three-aisled long-houses should be dated to the transition Late Neolithic/Early Bronze Age. When the possible self-age of the samples is taken into account, it is most likely that the first three-aisled long-houses at Højgård were erected at the beginning of the Early Bronze Age.

This means that houses II, X and XXVI from Højgård are the oldest known house constructions in northwest Europe in which the three-aisled construction has been used.

At this point, when the first three-aisled long-houses were built at Højgård, it is usually assumed that the country was divided into two different cultural zones – Zone I and Zone II (Lomborg 1960; Jensen 1988).

Zone I is made up largely of the Danish Islands and the northern half of Jutland. Here it is normally assumed that the Nordic Bronze Age developed in the course of Period I. In Zone II, which covers the northwest European lowland area and the southern part of Jutland, the so-called Sögel-Wohlde Culture was predominant.

The dating of the oldest three-aisled long-houses from Højgård to Period I and the location in Zone II suggest that the three-aisled long-house was perhaps developed within the Sögel-Wohlde Culture's distribution area.

At the Højgård locality, both the centre-post house and the three-aisled long-house are represented, with the centre-post houses as the oldest. Although it has not been possible using scientific methods to demonstrate continuity between the two house types, it must, judging by the position of the houses, nevertheless have been the case.

If we look at house development in Zone I, we see that the houses in the Late Neolithic have a centre-post construction and are with or without completely or partially sunken floor. This construction principle is used at least until and including Period I, *cf.* the C^{14}-dated Egehøj houses from north Djursland (Boas 1983).

The latest investigations in northern Djursland of the locality Hemmed Church seem to confirm the existence of centre-post houses some way into the Early Bronze Age (Boas 1991 and 1993, this volume).

Not until Period II do three-aisled long-houses turn up with their characteristic placement of a group of cooking-stone pits between the last and the next-last set of roof posts at the west end of the house – for example Vadgård house BN (Lomborg 1973: fig. 7) and Hemmed Church house V (Boas 1993, this volume).

For the correct understanding of Højgård, Hemmed Church is of the greatest importance, because it is a zone I locality where both house types – as at Højgård – are represented, and where the settlement must be considered continuous.

If the scientific datings of the latest centre-post houses from Djursland are correct, it looks as if the three-aisled construction principle, after being developed in Zone II at the beginning of the Early Bronze Age, Period I, perhaps expands into Zone I in the course of the Early Bronze Age, Period II.

However, one should be cautious about drawing too far-reaching conclusions about house development in the Early Bronze Age, so long as the number of houses that can be dated to the Early Bronze Age is still modest, like the number of datings. But at present it looks, as mentioned, as if the three-aisled long-house appears later in Zone I than in Zone II.

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NOTE

1. Højgård, Haderslev Museum jour.nr. 1706, sb.nr. 170 Gram sogn. The participants in the 1987 investigation were: Lene Lund, Anders Horsbøl, Carl Anker Thorsager and Per Ethelberg. The participants in 1989/90 were: Carl Anker Thorsager, Hans Peter Jørgensen. Artefact drawings: Jørgen Andersen; house plans: Hans Peter Jørgensen; survey plans: Per Ethelberg.

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Radiocarbon Dates from Late Neolithic and Early Bronze Age Settlements at Hemmed, Højgård and Trappendal, Jutland, Denmark

by KAARE LUND RASMUSSEN

INTRODUCTION

Radiocarbon dates are reported for 21 samples from excavations at Hemmed (Hemmed Church, Hemmed Plantation and Egehøj), 6 samples from the excavation at Højgård and 4 samples from the excavation at Trappendal, all dated by the Carbon-14 Laboratory in Copenhagen. In addition the results are given of the AMS-dating in Uppsala of 8 samples from Højgård.

Late Neolithic to Early Bronze Age house remains and settlements have been excavated in Hemmed parish, Randers county in Jutland, Denmark. 21 samples from three locations: Hemmed Church, Hemmed Plantation and Egehøj, have been radiocarbon dated. A paper interpreting the dates from Hemmed is printed elsewhere in this volume (Boas 1993 and 1983). Højgård, Haderslev county is a separate locality in Jutland where excavations revealed Bronze Age house remains and settlements. Conventional radiocarbon dates for 6 samples and AMS-dates for 8 samples from the excavations at Højgård are reported here. 4 samples from Trappendal, Hejls parish, Vejle county are also listed (Boysen & Andersen 1983). A paper interpreting the dates from Højgård and Trappendal is printed elsewhere in this volume (Ethelberg 1993).

SAMPLE TREATMENT

The conventionally-dated samples were, as is the usual procedure in the Copenhagen Carbon-14 Dating Laboratory, treated by the AAA chemical treatment prior to analysis. The samples were converted to carbon dioxide (CO_2) by burning in pure oxygen, precipitated as carbonate, and kept in sealed flasks for more than 21 days in order to let the bulk of the radioactive ^{222}Rn decay. Following this, the samples were reconverted to CO_2, purified in a calcium oxide oven and counted for at least 20 hours in a 2 litre 1.5 atm. conventional proportional counter equipped with a guard counter.

Stable isotope fractionation ($\delta^{13}C$) was measured on samples K-3475-78, K-3782, K-4614-15, K-5018-21, K-5168-70, K-5781-87 and K-5797-5801. The determined ages for these samples have been corrected for isotopic fractionation to the terrestrial value ($\delta^{13}C = -25‰$ PDB). Samples K-2223 and K-2238-42 were dated before it was common practice to measure stable isotopes, and therefore they were not measured for stable isotopes and thus not corrected for isotopic fractionation. The latter samples have been assigned an extra uncertainty to compensate for the lack of knowledge about their $\delta^{13}C$-values.

Samples Ua-705-12 were also not measured for stable carbon isotopes. These samples were corrected to the terrestrial value according to some average isotopic compositions for the material in question. No extra uncertainty has been assigned to these samples.

The results are reported below as conventional radiocarbon ages (based on the Libby half-life) ± one standard deviation.

All samples have been calibrated to calender years using 20 years averages of the calibration curves in Radiocarbon (1986) by means of the University of Washington program. The interval of calibrated ages corresponding to ± 1 standard deviation is also reported. The datings are summarized in Table I and II.

Wood and charcoal identifications were performed on representative portions of the samples (Malmros 1991).

SAMPLES FROM THE HEMMED EXCAVATIONS

Unless otherwise stated the samples were submitted by N. A. Boas.

Egehøj

K-2223 2400 ± 100 BP C-14 y
Charcoal, Egehøj, Randers county. Found in *hearth bac within the remains of house I. Pottery of Bronze Age type* was found in the hearth, which is secondary in relation to the house remains, which are Early Bronze Age. The hearth is linked to a clearly separate occupation in Late Bronze Age, per. V–VI. Submitted by B. Stürup. Sample bai, j.nr. 160/69; Pd 11699. NM VIII A 5677.
Calibrated (Stuiver & Pearson 1986): 410 BC Cal.
Calibrated ± 1 stand. dev.: 770–390 BC Cal.

K-2238 3160 ± 100 BP C-14 y
Charcoal, Egehøj, Randers county. Found on *settlement site* from *Early Bronze Age, Per. I.* The charcoal originates from a concentration, which is interpreted as remains of a burnt post in the southern long side in *house III.* Found in the natural c. 0.2 m below plough layer. Submitted by B. Stürup. Sample byf, j.nr. 160/69; Pd 11738. NM VIII A 5677.
Calibrated (Pearson & Stuiver 1986): 1430 BC Cal.
Calibrated ± 1 stand. dev.: 1520–1320 BC Cal.

K-2240 3240 ± 100 BP C-14 y
Charcoal, Egehøj, Randers county. From the same settlement site as K-2238, *Early Bronze Age, Per. I.* Found at a depth of c. 1 m near the bottom of *well II.* This material is considered a sealed find, as only material from *the early phase of the dwelling* was found. Submitted by B. Stürup. Sample cgg, j.nr. 160/69; Pd 11624. NM VIII A 5677.
Calibrated (Pearson & Stuiver 1986): 1520 BC Cal.
Calibrated ± 1 stand. dev.: 1640–1420 BC Cal.

K-2239 3340 ± 100 BP C-14 y
Charcoal, Egehøj, Randers county. From the same settlement site as K-2238, *Early Bronze Age, Per. I.* The sample was recovered near the bottom of *well I*, at a depth of 1.0–1.3 m. Well I constituted a sealed find with material belonging solely to the *early phase of the dwelling.* Submitted by B. Stürup. Sample cgd, j.nr. 160/69; Pd 11625. NM VIII A 5677.
Calibrated (Pearson & Stuiver 1986): 1640 BC Cal.
Calibrated ± 1 stand. dev.: 1750–1520 BC Cal.

Average of K-2238-40, Egehøj: 3250 ± 60 BP C-14 y
Calibrated (Pearson & Stuiver 1986): 1520 BC Cal.
Calibrated ± 1 stand. dev.: 1610–1450 BC Cal.

K-2241 2550 ± 100 BP C-14 y
Charcoal, Egehøj, Randers county. From the same site as K-2238. Found near the bottom of cooking pit bzå, which extended 0.3 to 0.4 m down into the moraine deposits (natural). The pit is considered to be a sealed feature linked to *a later phase of the dwelling, Bronze Age, per. V–VI.* A solid flint sickle of Late Bronze Age type was found in the pit. Submitted by B. Stürup. Sample båe, j.nr. 160/69; Pd 11737. NM VIII A 5677.
Calibrated (Pearson & Stuiver 1986): 790 BC Cal.
Calibrated ± 1 stand. dev.: 810–530 BC Cal.

Hemmed Church

K-5170 2810 ± 75 BP C-14 y
Charcoal (Quercus sp., Fraxinus sp., Corylus sp.), Hemmed Church, Randers county. From the fill of *cooking pit* A19, which was sealed by the clay floor in house I. Could possibly have been used in the house as the clay floor had been re-established after the pit went out of use. Sample DJM 2215, X681; Pd 23036. NM VIII A 6864.
Calibrated (Pearson & Stuiver 1986): 990–940 BC Cal.
Calibrated ± 1 stand. dev.: 1050–900 BC Cal.
$\delta^{13}C = -26.6‰$ PDB.

K-5169 2840 ± 75 BP C-14 y
Charcoal (Quercus sp., Tilia sp., Fraxinus sp., Betula sp., Alnus sp.), Hemmed Church, Randers county. Taken from sandy layer (layer d) around *hearth* A3. The layer constitutes the original floor level in the east end of house I. Sample DJM 2215, X689 og X573a; Pd 23037. NM VIII A 6864.
Calibrated (Pearson & Stuiver 1986): 1000 BC Cal.
Calibrated ± 1 stand. dev.: 1120–910 BC Cal.
$\delta^{13}C = -25.8‰$ PDB.

Average of K-5169-70, house I: 2830 ± 55 BP C-14 y
Calibrated (Pearson & Stuiver 1986): 1000 BC Cal.
Calibrated ± 1 stand. dev.: 1040–920 BC Cal.

K-5786 3040 ± 80 BP C-14 y
Charcoal (Betula, Populus, Corylus, Alnus and Acer), Hemmed Church, Hemmed, Randers county. Taken from the lower part of *cooking pit* A203 (cf. K-5782). Pottery (X2017) was found in the pit (c. 2 m in diam. and 0.7 m deep), which showed great resemblance to pottery from house I, which has been dated to 940–1000 BC Cal. (cf. K-5169-70). Expected age: Middle Bronze Age. Sample DJM 2215: A203, X2224; Hg 26924. NM VIII A 6864.
Calibrated (Pearson & Stuiver 1986): 1310 BC Cal.
Calibrated ± 1 stand. dev.: 1420–1220 BC Cal.
$\delta^{13}C = -26.4‰$ PDB.

K-5168 3270 ± 80 BP C-14 y
Charcoal (Quercus sp., Tilia sp., Fraxinus sp., Corylus sp.), Hemmed Church, Randers county. Taken from the two lowest layers in a c. 8 m wide *depression* under house I from the Early Bronze Age. Cooking-stones, flint and pottery, possibly from the Late Single Grave Culture were found in the layers. Sample DJM 2215, X630 og X804; Pd 23038–39. NM VIII A 6864.
Calibrated (Pearson & Stuiver 1986): 1530 BC Cal.
Calibrated ± 1 stand. dev.: 1670–1450 BC Cal.
$\delta^{13}C = -25.6‰$ PDB.

K-5783 3150 ± 80 BP C-14 y
Charcoal (Quercus sp.), Hemmed Church, Hemmed, Randers county. Taken from *post-hole in southern wall of house III.* The sample is from the postpipe in the natural. *The post-hole* was 0.3 m in diam. and 0.65 m deep. A type V–dagger and pottery were

found in layer over, and in the house. Expected age: Late Neolithic/Early Bronze Age. Sample DJM 2215: A265, X2217; Pd 23344. NM VIII A 6864.
Calibrated (Pearson & Stuiver 1986): 1430 BC Cal.
Calibrated ± 1 stand. dev.: 1520–1330 BC Cal.
$\delta^{13}C = -24.6‰$ PDB.

K-5785 3330 ± 80 BP C-14 y
Charcoal (Quercus sp.), Hemmed Church, Hemmed, Randers county. Taken from a *postpipe in south wall of house III* at a depth of c. 0.1–0.3 m. *The post-hole* was c. 0.4 m in diam. and 0.6 m deep. Expected age: Late Neolithic/Early Bronze Age. Sample DJM 2215: A279, X2255; Pd 23346. NM VIII A 6864.
Calibrated (Pearson & Stuiver 1986): 1630 BC Cal.
Calibrated ± 1 stand. dev.: 1740–1520 BC Cal.
$\delta^{13}C = -25.6‰$ PDB.

K-5782 3350 ± 80 BP C-14 y
Charcoal (Quercus sp.), Hemmed Church, Hemmed, Randers county. Taken from *core of roof-bearing post-hole in house III. The post-hole* which was 0.5 m in diam. and 0.7 m deep, was intersected by pit A203 (from Middle Bronze Age), (cf. K-5786). Expected age: Late Neolithic/Early Bronze Age. Sample DJM 2215: A259, X2178; Pd 23343. NM VIII A 6864.
Calibrated (Pearson & Stuiver 1986): 1670 BC Cal.
Calibrated ± 1 stand. dev.: 1740–1530 BC Cal.
$\delta^{13}C = -25.4‰$ PDB.

K-5784 3370 ± 80 BP C-14 y
Charcoal (Quercus sp.), Hemmed Church, Hemmed, Randers county. Taken from *post-hole in south wall of house III.* The charcoal originates from the *post* itself at a depth of 0.1–0.3 m in the c. 0.6 m deep hole. The house was covered by a 0.3 m thick layer containing abundant flint debris and pottery. Expected age: Late Neolithic/Early Bronze Age. Sample DJM 2215: A266, X2218; Pd 23345. NM VIII A 6864.
Calibrated (Pearson & Stuiver 1986): 1680 BC Cal.
Calibrated ± 1 stand. dev.: 1750–1530 BC Cal.
$\delta^{13}C = -24.6‰$ PDB.

Average of K-5782-85, house III: 3300 ± 40 BP C-14 y
Calibrated (Pearson & Stuiver 1986): 1610–1540 BC Cal.
Calibrated ± 1 stand. dev.: 1670–1520 BC Cal.

K-5781 3400 ± 100 BP C-14 y
Charcoal (Quercus, Tilia, Corylus, Alnus, Acer, bark and unindentified), Hemmed Church, Hemmed, Randers county. From central circular pit A95 (diam. 1.75 m depth 0.25 m) in house III with single central row of roof-bearing posts. The pit was used as *earth oven/cooking pit* and contained flint and pottery. In the fill there were cooking-stones besides burnt bones and a flake scraper. Expected age: Late Neolithic/Early Bronze Age. Sample DJM 2215: A95, X1538; Pd 23350. NM VIII A 6864.
Calibrated (Pearson & Stuiver 1986): 1730–1700 BC Cal.
Calibrated ± 1 stand. dev.: 1880–1540 BC Cal.
$\delta^{13}C = -26.9‰$ PDB.

K-5787 3560 ± 85 BP C-14 y
Charcoal (Quercus, Tilia, Fraxinus, Corylus, Alnus, Acer, bark and unidentified) and carbonised grain, Hemmed Church, Hemmed, Randers county. Wet-sieved from soil sample from *pit at northern wall of house III. The pit* was 0.7 m in diam. and 0.6 m deep. It contained some carbonised grain, flint and pottery of the same type as found over house III. The pit lay in a cluster of similar pits. Expected age: Late Neolithic/Early Bronze Age. Sample DJM 2215: A480, X2839; Pd 23347. NM VIII A 6864.
Calibrated (Pearson and Stuiver, 1986): 1910 BC Cal.
Calibrated ± 1 stand. dev.: 2030–1770 BC Cal.
$\delta^{13}C = -26.0‰$ PDB.

Hemmed Plantation

K-5799 3360 ± 80 BP C-14 y
Charcoal (Quercus), Hemmed Plantation, Hemmed, Randers county. Taken from *postpipe* in Late Neolithic long-house I. The sample was taken c. 0.1–0.3 m below surface of the natural in c. 0.5 m deep post-hole. Expected age: Late Neolithic C. Sample DJM 2049: A88, X945; Hg 26922. NM VIII A 7170.
Calibrated (Pearson & Stuiver 1986): 1680 BC Cal.
Calibrated ± 1 stand. dev.: 1750–1530 BC Cal.
$\delta^{13}C = -24.9‰$ PDB.

K-5798 3390 ± 85 BP C-14 y
Charcoal (Quercus), Hemmed Plantation, Hemmed, Randers county. Taken from the side and bottom of the *postpipe of a roof post.* The sample is taken at c. 0.2–0.6 m below surface of the natural in a c. 1 m deep post-hole. The post is the fourth from the west in Late Neolithic long house I. Expected age: Late Neolithic C. Sample DJM 2049: A117, X841; Hg 26920. NM VIII A 7170.
Calibrated (Pearson & Stuiver 1986): 1730–1690 BC Cal.
Calibrated ± 1 stand. dev.: 1870–1550 BC Cal.
$\delta^{13}C = -23.8‰$ PDB.

K-5800 3470 ± 85 BP C-14 y
Charcoal (Quercus), Hemmed Plantation, Hemmed, Randers county. Taken from *postpipe of wall post* in Late Neolithic long-house I. The sample was taken c. 0.3–0.5 m below surface of the natural. Expected age: Late Neolithic C. Sample DJM 2049: A78, X969; Pd 23341. NM VIII A 7170.
Calibrated (Pearson & Stuiver 1986): 1870–1770 BC Cal.
Calibrated ± 1 stand. dev.: 1900–1690 BC Cal.
$\delta^{13}C = -24.3‰$ PDB.

K-5797 3480 ± 80 BP C-14 y
Charcoal (Quercus), Hemmed Plantation, Hemmed, Randers county. Taken from *postpipe of roof post* in Late Neolithic long-house I. The sample is taken 0.2–0.7 m below surface of the natural in c. 1 m deep post-hole. Expected age: Late Neolithic C. Sample DJM 2049: A119, X970; Hg 26921. NM VIII A 7170.
Calibrated (Pearson & Stuiver 1986): 1870–1780 BC Cal.
Calibrated ± 1 stand. dev.: 1910–1700 BC Cal.
$\delta^{13}C = -24.7‰$ PDB.

Average of K-5797-5800, house I: 3420 ± 40 BP C-14 y
Calibrated (Pearson and Stuiver, 1986): 1740 BC Cal.
Calibrated ± 1 stand. dev.: 1860–1690 BC Cal.

K-5801 3680 ± 85 BP C-14 y
Charcoal (Unidentified, Quercus, Tilia, Fraxinus, Corylus including hazelnuts, Alnus, Pomoideae, Acer), Hemmed Plantation, Hemmed, Randers county. Taken from the lower c. 0.2 m of an almost 4 × 3 m wide and 0.3 m deep *central depression* at the base of longhouse I. The function of the pit is unknown. Expected age: Late Neolithic C. Sample DJM 2049: A126, X1065; Pd 23342. NM VIII A 7170.
Calibrated (Pearson & Stuiver 1986): 2120–2040 BC Cal.
Calibrated ± 1 stand. dev.: 2200–1950 BC Cal.
$\delta^{13}C = -25.3‰$ PDB.

SAMPLES FROM THE HØJGÅRD EXCAVATION

The samples have been submitted by S. W. Andersen og P. Ethelberg.

K-4614 1330 ± 65 BP C-14 y
Charcoal (Quercus sp.), Højgård, Haderselv county. From *cooking pit 214*, which is thought to belong to house III, from Early Bronze Age, period II/III. Sample 1706 × 252, sb. 170; Hg 25662. NM VIII A 6646.
Calibrated (Stuiver & Pearson 1986): AD 670 Cal.
Calibrated ± 1 stand. dev.: AD 650–760 Cal.
$\delta^{13}C = -25.3‰$ PDB.

K-4615 2850 ± 75 BP C-14 y
Charcoal (Quercus sp.), Højgård, Haderslev county. From *pit 388*, the fill of which covered a post-hole from a roof post belonging to house IV. Pottery of *Early Bronze Age* character was found in the pit. Sample 1706 × 390, sb. 170; Hg 25661. NM VIII A 6646.
Calibrated (Pearson & Stuiver 1986): 1010 BC Cal.
Calibrated ± 1 stand. dev.: 1150–920 BC Cal.
$\delta^{13}C = -24.4‰$ PDB.

K-5018 2860 ± 75 BP C-14 y
Charcoal (Quercus sp.), Højgård, Haderslev county. From *hearth*, which possibly is connected to *house XIX* from *Late Bronze Age* on account of its central position in the house. Cf. K-4615. Sample 1706, X 948, sb. 170; Hg 26309. NM VIII A 6646.
Calibrated (Pearson & Stuiver 1986): 1020 BC Cal.
Calibrated ± 1 stand. dev.: 1160–920 BC Cal.
$\delta^{13}C = -23.6‰$ PDB.

K-5019 3180 ± 75 BP C-14 y
Charcoal (Quercus sp.), Højgård, Haderslev county. From wall and roof posts in *longhouse XIV* from *Early Bronze Age*, period II/III. Sample 1706, X 967; Hg 26310. NM VIII A 6646.
Calibrated (Pearson & Stuiver 1986): 1450 BC Cal.
Calibrated ± 1 stand. dev.: 1520–1410 BC Cal.
$\delta^{13}C = -23.9‰$ PDB.

K-5020 3320 ± 75 BP C-14 y
Charcoal (Quercus sp.), Højgård, Haderslev county. From wall and roof posts in *longhouse XIV* from *Early Bronze Age*. Sample 1706, X 974; Hg 26312. NM VIII A 6646.
Calibrated (Pearson & Stuiver 1986): 1620 BC Cal.
Calibrated ± 1 stand. dev.: 1730–1520 BC Cal.
$\delta^{13}C = -25.5‰$ PDB.

K-5021 3290 ± 75 BP C-14 y
Charcoal (Quercus sp.), Højgård, Haderslev county. From wall and roof posts in *longhouse XIV* from *Early Bronze Age*. Sample 1706, X 985; Hg 26313. NM VIII 6646.
Calibrated (Pearson & Stuiver 1986): 1600–1530 BC Cal.
Calibrated ± 1 stand. dev.: 1680–1510 BC Cal.
$\delta^{13}C = -24.6‰$ PDB.

Average of K-5019, K-5020 and K-5021: 3260 ± 45 BP C-14 y
Calibrated (Pearson & Stuiver 1986): 1520 BC Cal.
Calibrated ± 1 stand. dev.: 1610–1510 BC Cal.

Samples from the Højgård excavation dated by accelerator mass spectroscopy

Accelerator mass spectroscopy has been carried out in the radiocarbon laboratory in Uppsala. The isotopic fractionation has not been measured on these samples, which are prefixed Ua. The dates have been corrected for isotopic fractionation to $\delta^{13}C = -25‰$ according to assumed values of their $\delta^{13}C$-value.

Ua-705 3115 ± 110 BP C-14 y
Burnt food remains, Højgård, Haderslev county. Burnt food remains on pottery from house I. Sample 1706 ×200.
Calibrated (Pearson & Stuiver 1986): 1410 BC Cal.
Calibrated ± 1 stand. dev.: 1520–1260 BC Cal.

Ua-706 3450 ± 100 BP C-14 y
Charcoal (Corylus), Højgård, Haderslev county. From cooking pit from house II. Sample 1706 ×324.
Calibrated (Pearson & Stuiver 1986): 1750 BC Cal.
Calibrated ± 1 stand. dev.: 1900–1670 BC Cal.

Ua-707 3475 ± 95 BP C-14 y
Charcoal (Alnus), Højgård, Haderslev county. From post-hole in house II. Sample 1706 ×331.
Calibrated (Pearson & Stuiver 1986): 1870–1780 BC Cal.
Calibrated ± 1 stand. dev.: 1930–1690 BC Cal.

Ua-708 3355 ± 100 BP C-14 y
Charcoal (Betula), Højgård, Haderslev county. From post-hole in house I. Sample 1706 ×321.
Calibrated (Pearson & Stuiver 1986): 1680 BC Cal.
Calibrated ± 1 stand. dev.: 1760–1520 BC Cal.

Ua-709 2880 ± 75 BP C-14 y
Charcoal (Alnus), Højgård, Haderslev county. From post-hole in house II. Sample 1706 ×333.

Calibrated (Pearson & Stuiver 1986): 1040 BC Cal.
Calibrated ± 1 stand. dev.: 1250–940 BC Cal.

Ua-710 1150 ± 80 BP C-14 y
Charcoal (Quercus), Højgård, Haderslev county. From post-hole in house I. Sample 1706 ×477.
Calibrated (Stuiver & Pearson 1986): 890 BC Cal.
Calibrated ± 1 stand. dev.: 780–980 BC Cal.

Ua-711 3180 ± 95 BP C-14 y
Charcoal (Corylus), Højgård, Haderslev county. From cooking pit from house I. Sample 1706 ×480.
Calibrated (Pearson & Stuiver 1986): 1450 BC Cal.
Calibrated ± 1 stand. dev.: 1530–1400 BC Cal.

Ua-712 3250 ± 110 BP C-14 y
Charcoal (Quercus), Højgård, Haderslev county. From cooking pit from house I. Sample 1706 ×485.
Calibrated (Pearson & Stuiver, 1986): 1520 BC Cal.
Calibrated ± 1 stand. dev.: 1680–1420 BC Cal.

SAMPLES FROM THE TRAPPENDAL EXCAVATION

Submitted by S. W. Andersen.

K–3475 3050 ± 80 BP C-14 y
Charcoal, Trappendal, Vejle county. From remains of *longhouse* with partition walls, under burial mound with 4 burials, the oldest a cremation grave from *Early Bronze Age*, per. III. Sample collected from several post-holes. Sample 21.863, split 1; Pd 19001. HM 704. NM VIII A 6291.
Calibrated (Pearson & Stuiver 1986): 1380–1320 BC Cal.
Calibrated ± 1 stand. dev.: 1420–1220 BC Cal.
$\delta^{13}C = -26.0‰$ PDB.

K–3476 3300 ± 80 BP C-14 y
Charcoal, Trappendal, Vejle county. From the same *longhouse* as K–3475. Collected in the same post-holes as K–3475. Sample 21.863, split 2; Pd 19002. HM 704. NM VIII A 6291.
Calibrated (Pearson & Stuiver 1986): 1610–1540 BC Cal.
Calibrated ± 1 stand. dev.: 1690–1510 BC Cal.
$\delta^{13}C = -24.7‰$ PDB.

K-3477 3060 ± 80 BP C-14 y
Charcoal, Trappendal, Vejle county. From the same *longhouse* as K–3475. Collected in post-hole 245, with diam. 22 cm and depth 42 cm. The post could have been part of a partition wall or a replacement for a roof post. Sample 21.874, split 1; Pd 19003. HM 704. NM VIII A 6291.
Calibrated (Pearson & Stuiver 1986): 1380–1320 BC Cal.
Calibrated ± 1 stand. dev.: 1420–1230 BC Cal.
$\delta^{13}C = -26.6‰$ PDB.

K-3478 3130 ± 80 BP C-14 y
Charcoal, Trappendal, Vejle county. From the same *longhouse* as K–3475. Collected in the same post-hole, 245, as K–3477. Consisted mainly of twigs up to 1.2 cm in diameter. Sample 21.874, split 2; Pd 19004. HM 704. NM VIII A 6291.
Calibrated (Pearson & Stuiver 1986): 1420 BC Cal.
Calibrated ± 1 stand. dev.: 1510–1320 BC Cal.
$\delta^{13}C = -26.3‰$ PDB.

Kaare L. Rasmussen, The C-14 Dating Laboratory, The National Museum, Ny Vestergade 11, DK-1471 Copenhagen K, Denmark / Department of Physics, University of Odense, Campusvej 55, DK-5230 Odense M, Denmark.

Acknowledgements

B. Rønne and K. Skov are thanked for performing the chemical treatment and the C-14 counting. C. Malmros, M. Jacobsen, A. Johnson and O. H. Eriksen are thanked for technical assistance. The Geophysical Institute and the Geological Institute, both at the University of Copenhagen, are thanked for putting their mass spectrometers at our disposal. N. A. Boas, B. Stürup, S. W. Andersen, and P. Ethelberg are thanked for permission to publish the sample descriptions.

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K-no.	Locality	House	House type	C-14 age	Calibrated	Calibrated ± 1 std.
				C-14 years BP	BC Cal.	BC Cal.
K-2223	Egehøj Oven bac			2400±100	410	770–390
K-2241	Egehøj Cooking pit bzå			2550±100	790	810–530
K-5170	Hemmed Church Cooking pit A19	I	three – aisled	2810± 75	990–940	1050–900
K-5169	Hemmed Church Hearth A3	I	three – aisled	2840± 75	1000	1120–910
K-5786	Hemmed Church Pit A203	I	three – aisled	3040± 80	1310	1420–1220
K-2238	Egehøj Post in South wall byf	III	two – aisled	3160±100	1430	1520–1320
K-2240	Egehøj Well II cgg	I–III	two – aisled	3240±100	1520	1640–1420
K-2239	Egehøj Well I cgd	I–III	two – aisled	3340±100	1640	1750–1520
K-5168	Hemmed Church Depression A32	III	two – aisled	3270± 80	1530	1670–1450
K-5783	Hemmed Church Post in South wall A265	III	two – aisled	3150± 80	1430	1520–1330
K-5785	Hemmed Church Post in South wall A279	III	two – aisled	3330± 80	1630	1740–1520
K-5782	Hemmed Church Roof post A259	III	two – aisled	3350± 80	1670	1740–1530
K-5784	Hemmed Church Post in South wall A266	III	two – aisled	3370± 80	1680	1750–1530
K-5781	Hemmed Church, A95 Central depression	III	two – aisled	3400±100	1730–1700	1880–1540
K-5799	Hemmed Plantation Wall post A88	I	two – aisled	3360± 80	1680	1750–1530
K-5798	Hemmed Plantation Wall post A117	I	two – aisled	3390± 85	1730–1690	1870–1550
K-5800	Hemmed Plantation Wall post A78	I	two – aisled	3470± 85	1870–1770	1900–1690
K-5797	Hemmed Plantation Roof post A119	I	two – aisled	3480± 80	1870–1780	1910–1700
K-5787	Hemmed Church, A480 Pit at North wall	III	two – aisled	3560± 85	1910	2030–1770
K-3782	Hemmed Bog oak			3660± 90	2040	2190–1920
K-5801	Hemmed Plantation A126 Central depression	I	two – aisled	3680± 85	2120–2040	2200–1950

Table I. Summary of radiocarbon dates from Egehøj, Hemmed Church and Hemmed Plantation.

K-no.	Locality	House no.	C-14 age	Calibrated	Calibrated ± 1 std.
			C-14 years BP	BC Cal.	BC Cal.
K-4614	Højgård Cooking pit 214	III	1330± 65	AD 670	AD 650–760
K-4615	Højgård Pit 388	IV	2850± 75	1010	1150–920
K-5018	Højgård Hearth 170	XIX	2860± 75	1020	1160–920
K-5019	Højgård Post-hole 967	XIV	3180± 75	1450	1520–1410
K-5020	Højgård Post-hole 974	XIV	3320± 75	1620	1730–1520
K5021	Højgård Post-hole 985	XIV	3290± 75	1600–1530	1680–1510
Ua-705	Højgård Food remains	I	3115±110	1410	1520–1260
Ua-706	Højgård Cooking pit	II	3450±100	1750	1900–1670
Ua-707	Højgård Post-hole	II	3475± 95	1870–1780	1930–1690
Ua-708	Højgård Post-hole	I	3355±100	1680	1760–1520
Ua-709	Højgård Post-hole	II	2880± 75	1040	1250–940
Ua-710	Højgård Post-hole	I	1150± 80	890	780–980
Ua-711	Højgård Cooking pit	I	3180± 95	1450	1530–1400
Ua-712	Højgård Cooking pit	I	3250±110	1520	1680–1420
K-3475	Trappendal longhouse		3050± 80	1380–1320	1420–1220
K-3476	Trappendal longhouse		3300± 80	1610–1540	1690–1510
K-3477	Trappendal longhouse		3060± 80	1380–1320	1420–1230
K-3478	Trappendal longhouse		3130± 80	1420	1510–1320

Table II. Summary of radiocarbon dates from Højgård and Trappendal.

Journal of Danish Archaeology vol. 10. 1991, pp. 163–185.

Lejre Beyond Legend – The Archaeological Evidence

by TOM CHRISTENSEN

LEJRE IN MYTH, LEGEND, AND HISTORY

Lejre is a small village at the bottom of Roskilde Fjord (fig. 4). The name which derives from the gothic or Old Danish Hleiqrar (meaning "the place with the tents or the huts") (Jørgensen 1981), has played a central part in Danish history writing for almost a millennium. This was the place where the first Danish dynasty, the Scyldings, had its royal seat according to the legends. Until the 19th century the discussion about the importance of Lejre in antiquity was based on the written sources. Thanks to the Old Norse sagas and Medieval Danish chronicles especially, the tradition of the greatness of Lejre has come down to the present.

Among many works the *Gesta Danorum* (The Deeds of the Danes) by Saxo Grammaticus is the best known (Olrik 1979; Olrik & Ræder 1931; Davidson 1979, 1980). The first part relates about the legendary age. To fill out this large span of years Saxo constructed a long sequence of kings called the Scyldings named after Skjold, the founder of the dynasty, who as the son of Woden was sent to the land of the Danes on a ship. Skjold and his descendants lived at the royal residence of Lejre.

The Scyldings appear in many other Medieval chronicles and sagas, e.g. Svend Aggesen's "History of the Danes" (Olrik 1900–1901a), the lost "Saga of the Scyldings" (Friis-Jensen & Lund 1984), and "Rolf Krakes saga" (Lund 1983). Most of the works were written around or shortly after 1200. However, one of the sources is somewhat older than the others, and so is the oldest source to the history of Lejre: the short "Lejre Chronicle" (Olrik 1900–1901b) from the middle of the 12th century. This chronicle, which does not have an original name, also include a list of kings, where many of the Scyldings appear connected with Lejre as their royal residence.

Few of the world's good stories can stand the test of historical criticism. This also applies to the dramatic accounts of the sagas and chronicles (Skovgaard-Petersen

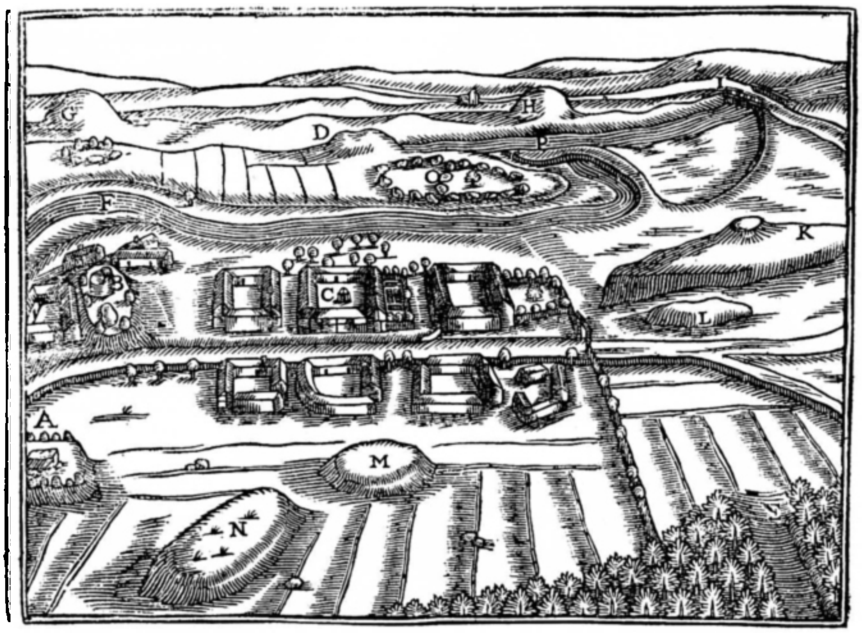

Fig. 1. Ole Worm's prospectus of Lejre seen from the west from 1643. Several burial mounds and stone ships are marked with letters. In the time of Ole Worm several of them where related to legendary kings. Photo: The Royal Danish Library.

1977). The Old English poem *Beowulf* has played a central part in connection with the early historiography. The principal motif, Beowulf's fight against monsters and dragons, is a collection of fables and tales without any historical basis. However, the action of the poem takes place in the land of the Danes, where Scyld Scefing (Skjold) and his family lived in the large hall Heorot (Hjort) in Zealand (Haarder 1984). Several of the well-known Scyldings, e.g. Roar, Halfdan, and Rolf, with related names, appear in the poem, in which Lejre is not mentioned. Parts of the poem known from a 10th century Anglo-Saxon manuscript are thought by some to date back to the 8th century (Backhouse 1984).

An analysis of the poem has shown that there is not much Danish history in the historical framework. The persons and events go back to the struggles between the Roman Empire and the neighbouring peoples on the Balkan along the River Danube, which took place during the 4th and 5th centuries A.D. (Lukman 1943). In addition to this the learned circles of Medieval Europe, which also Danish chroniclers were part of, "borrowed" to a large extent from the classical historical literature as e.g., Jordanes' "History of the Goths" when writing their national histories. Thus the oldest Danish historiography has become a mixture of foreign and local traditions.

The rejection of these works as reliable sources also means that the Lejre kings and Lejre's position as an early royal residence had been questioned (Skovgaard-Petersen 1977:36 ff). However, Lejre is mentioned a couple of times in more reliable written sources.

The German cleric Thietmar of Merseburg writes in his chronicle from around 1016 that Lejre (Lederun) in Zealand (Selon) was the "capital" of the kingdom (*caput regni*) and that human and animal sacrifices took place here every nine years (Trillmich 1970). Thietmar assigns the account of these events to the year 934, when Henry I lead a campaign against Denmark.

Particularly the sentence about Lejre is a later addition to the manuscript; it is, however, believed to be made by Thietmar himself. So there is reason to trust the informa-

Fig. 2. The Lejre treasure. Photo: The National Museum.

Fig. 3. Aerial view of the remains of the large stone ships and Grydehøj after excavation and restoration. Seen from the west. Photo: Flemming Rasmussen.

tion and to believe that the tradition about Lejre as an important locality was alive around the A.D. 1000.

A couple of Old Norse sources mention Lejre in a poetic context. In the famous poem "The Grotte Song" (Larsen 1943) from the Elder Edda the two giantesses Menja and Fenja predict that King Frode will loose the Lejre throne (Hleigrar stòll). The Grotte Song was written down during Medieval time, but the poem is thought to date back to the 10th century (Skovgaard-Petersen 1977:36).

The Danish and Norwegian fleets met in a great battle off the west coast of Sweden in 1062. In a contemporary scaldic poem describing the battle the Danish King Svend Estridsen is called "King of Lejre" (Hleirar) (Jensen & Kyrre 1948; Laing 1961) – it may have been an old custom to give the Danish kings this appellation (Skovgaard-Petersen 1977:36).

Although Lejre and the Lejre kings have a mythical character in the written sources preserved, there are reliable sources, as shown above, that mention Lejre. However, it is impossible to characterize the settlement from them alone. Yet it is beyond doubt that Lejre was remembered as an important locality.

The stories about Lejre were revived in the Renaissance and kept alive during the following centuries, and the men of learning of the time travelled to Lejre to examine the ancient Danish royal residence. In 1643 the father of Danish archaeology, the learned Ole Worm, published his great work *Monumenta Danica*. It contains the oldest picture of Lejre – a prospectus of the village with the ancient monuments existing at the time (fig. 1).

The break-through of modern science in the 19th century had the result that the royal residence of Lejre drifted into a storm of historical criticism. Historians rejected most of the traditions as pure legend without historical value, and archaeologists proved how several of the monuments traditionally connected with the Lejre kings were neolithic dolmens and passage graves (Worsaae 1843:91).

DISCOVERIES AND EXCAVATIONS AT LEJRE 1850–1968

Today it is possible to establish significant archaeological material to face the legendary tradition.

In 1850 an important find was made among the hills to the west of Lejre. This so-called Lejre treasure includes at least four silver vessels, a whetstone, a weight, a necklace,

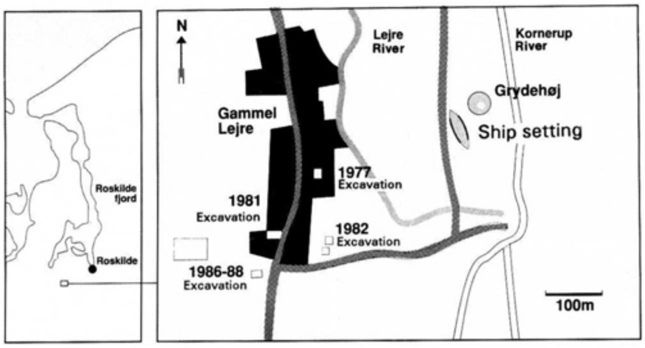

Fig. 4. The map indicates where excavations in the Lejre area have taken place since the 1940's. After T. Christensen 1991.

and a disc-shaped silver ingot (fig. 2). The largest of the silver vessels has been identified as an Anglo-Irish work of the 8th century (Wilson 1960), while a small solid silver cup from the 10th century is of local origin. The find, which seems to have been deposited all at the same time, has been interpreted as a treasure. However, the composition is a bit unusual and it can not be excluded that the finds actually come from one or more burials.

Archaeological excavations were started as late as 1944 by Harald Andersen of The National Museum, Copenhagen. Two areas were selected for investigation, one in the village of Gammel Lejre (1945), and one on the foreland between the Lejre and Kornerup rivers (1944–1968) east of the village (fig. 4). Here the remains of a large ship setting had been scheduled as a monument. It was the only one preserved out of a number of stone monuments originally situated here (fig. 3).

As a result of the excavations an c. 86 m long stone ship was reconstructed and a Viking Period cemetery was found (H. Andersen 1960). A total of 55 burials were excavated, most of them inhumation graves from the 10th century. The majority of the skeletons were found in simple grave pits and the grave goods only consisted of iron knives, whetstones, and simple buckles. This picture corresponds with the generally simple burial practice of the Danish Viking Period. A small number of richly furnished burials were found, however, including a woman's grave with a complete set of jewellery: Two oval brooches and a threefoil brooch. Another woman's grave contained the remains of a wooden casket which was partly decorated with enamel work. A man's grave contained a beheaded person, interpreted as a sacrificed slave, in addition to the buried man (S.W. Andersen 1977). There are no important differences between this cemetery and contemporary sites elsewhere in the country. The most distinguished burials of the Viking Period, the so-called horsemens' graves, are also found in the Lejre area. A spur inlaid with silver, probably from a scattered grave find, has come to the National Museum from a plundered burial mound to the east of Gammel Lejre.[1]

Immediately to the northeast of the ship setting there is a large burial mound: "Grydehøj". The excavation here in 1958 revealed a cremation grave presumably from the 6th/7th century. The remains of the burnt grave goods, iron fragments, fused bronze, and gold thread, indicate a chieftain's grave from the Germanic Iron Age, carbon-14 dated to 550 +/- 100 A.D.,[2] a type seldom seen in Denmark. A dating around the mid 7th century seems reasonable subject to the natural age of the wood samples (S.W. Andersen 1977:22).

EXCAVATIONS IN THE VILLAGE 1977 AND 1981

The excavations in 1945 near "Kongsgården" in Gammel Lejre were fruitless and were not followed up until 1977 (S.W. Andersen 1977:23). At that time a small construction work close to "Kongsgården" gave the opportunity of further investigations. Features such as fireplaces and post-holes indicated the presence of a settlement, which was dated by the finds to the last centuries of Danish prehistory (7th to 11th centuries).

In 1981 another chance of excavating occurred as one of the old thatched farms in the village burnt down. Sunken huts were found under the site of the fire (Sørensen 1982).

These two excavations made it possible to trace the history of the village of Lejre back to the Late Iron Age and Viking Period, and it seemed likely that the settlement connected with the burial site at the ship setting was to be found under the present village. However, surveys of the surface in the vicinity of the village proved that the prehistoric settlement was to be found not only under the village, more or less inaccessible, but also on the land to the south and especially to the west of the village.

Apart from the presence of finds such as pottery the settlement was revealed by the black colour of the soil. The discovery of the black soil made it possible to move the investigations from the back gardens in the village to the open fields, giving the possibility of establishing large excavation squares.

There were, however, certain restrictions laid on the investigations, as the state-owned areas, where the settle-

Fig. 5. Aerial view of houses III and IVab during excavation. Seen from the north-west. The ground-plans of the houses are marked with paper plates.

ments were found, were to be scheduled. Hence the excavations were planned as a combination of trial trenches serving to delimit the settlement and small excavation squares where single elements could be examined further. The following is an account of what was achieved using this procedure during the excavation campaigns carried out by Roskilde Museum in 1986–88.

EXCAVATIONS 1986–88

The Research Area

The settlement area may be divided into two by means of the topography (fig. 6):

Area 1. The area under and to the south of the village may be characterized as a flat sandy/gravelly table-land, bounded to the east by the Lejre River valley. In this area

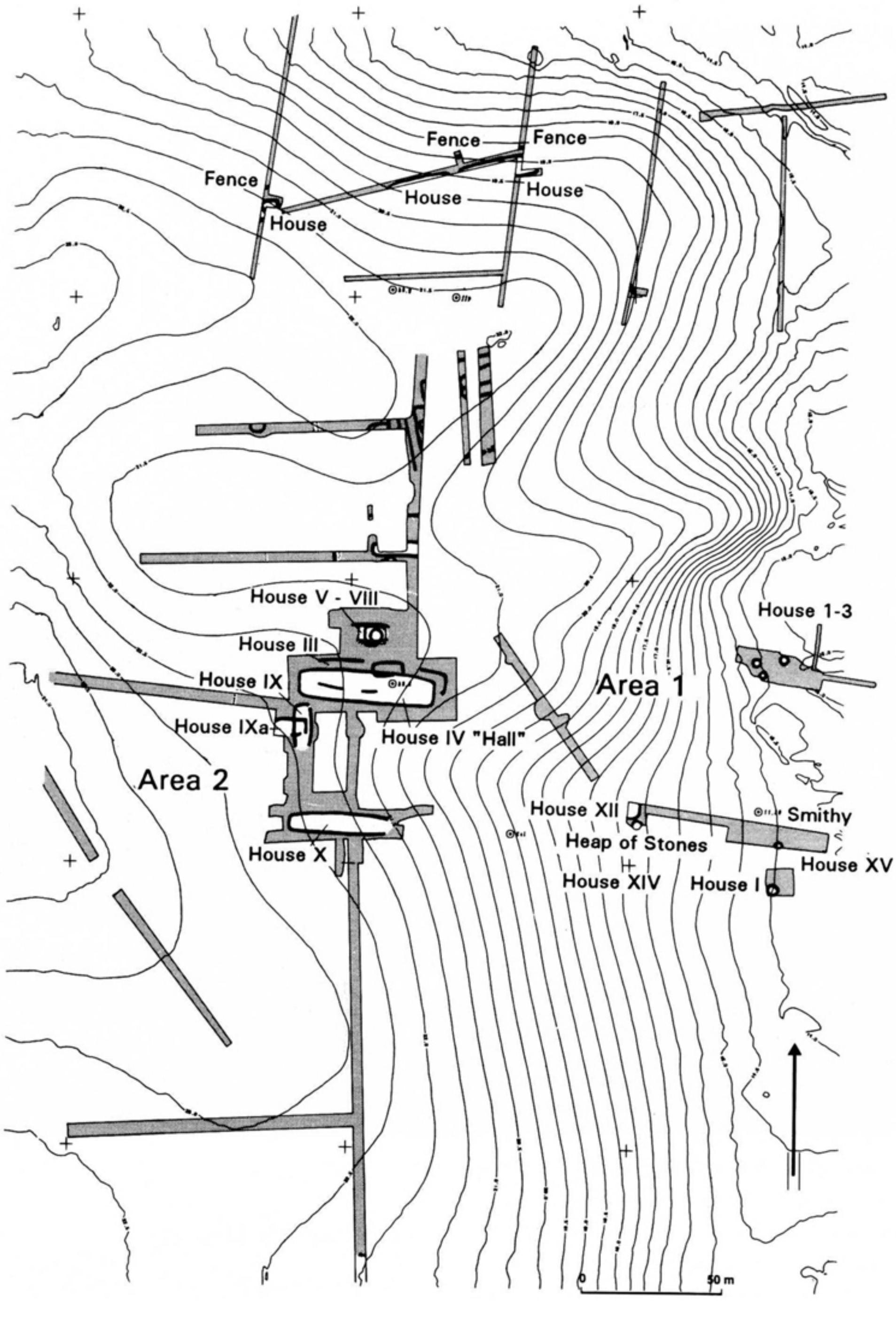

Fig. 6. Plan of the settlement area in Lejre with excavation sites and trial trenches indicated. After T. Christensen 1991.

the black culture layer, more than one metre thick, is deposited.

Area 2. Immediately to the west of the village the ground rises 5 – 7 m and forms a table-land intersected by glacial stream valleys, which cut the area into more or less marked hills. On three of these rather small hills to the west and south of the village most of the settlement area is found. Years of ploughing have totally destroyed any culture layers here. What is left is the characteristic black soil.

Method and Purpose of the Investigation

The purpose of the investigation was partly to delimit the settlement area which is to be scheduled, and partly to get some idea of the structure and exact dating of the settlement.

By means of trial trenches, two metres wide, it was possible to delimit a 200.000 sq.m. area with traces of settlement (fig. 6). The excavation squares were laid out to unearth single elements of the settlement such as buildings, fences, etc. Less than 5% of the settlement area has been excavated, and in the areas which were subject to further investigation only part of the structures unearthed were actually excavated, and of these structures if possible only 50% were removed.

This excavation strategy, which implies a much restricted excavation activity, of course creates a number of unanswered questions, but in return, it saves a large part of the monuments for posterity.

"The Hall" - House III, House IVab and House IVc

The remains of a great building, a 48.5 metres long house (house IV), appeared on a slope facing south (fig. 8). At first sight the plan of the area seems rather chaotic; there are one or more frame shaped trench figures and a confusing amount of post-holes. Thus it was clear from the beginning of the excavation that there were not just one, but several buildings of the same shape erected almost in the same place. In addition the location at the edge of a hill has resulted in a very varied "wear" of the area, so that the difference of height between the western part of the house standing on high ground and the lower southern part was more than a metre.

Considering the size of the houses once erected here, this place may well have been where the most important building was situated, going through successive phases of rebuilding, during a long period of settlement. We therefore named it "The Hall".

House III

As a consequence of the chosen excavation strategy house III was in principle not investigated. Consequently the description of this building can only be based on surface observations. The building, the gables of which were facing east and west, could be identified by means of a partly preserved wall trench and a line of external raking timber

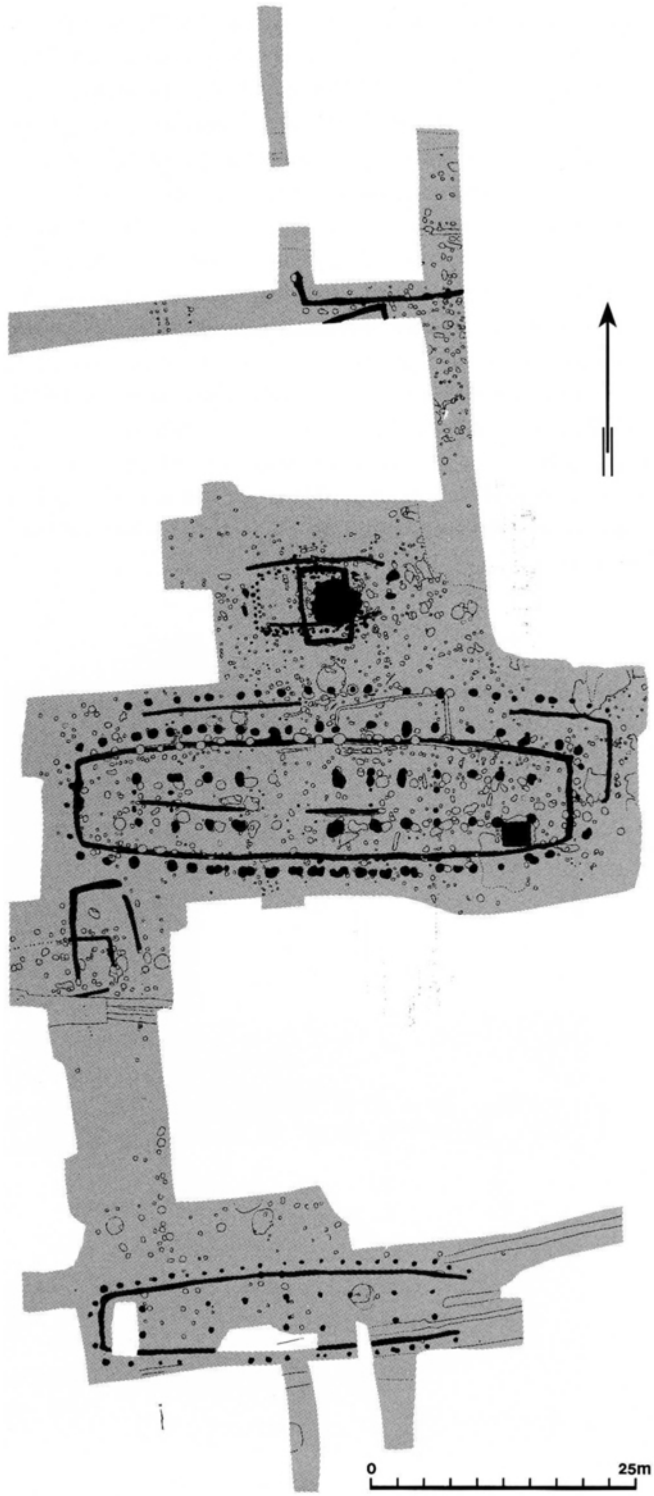

Fig. 7. Plan of the excavated areas around houses III and IV. 1:700. Drawing: Jeanette Glatved.

along the north wall. The remaining load-bearing constructions, the internal ridge posts and the external raking timber along the south wall, could not be distinguished directly, as the post-holes have been used again for the construction of house IV. House III is located to the north-east of house IV, for which reason it has been possible to use the same post-holes for the construction of this house. It seems to have taken place in the following way: The two rows of internal ridge posts in house III are identical with external raking timber along the north wall and the northern row of internal ridge posts in house IV. The post-holes for the southern line of external raking timber of house III have been used again for the construction of the southern row of internal ridge posts in house IV. The way of re-using the post-holes that is suggested here, indicates that house IV was erected immediately after the demolition of house III, in which way the task of constructing the huge building might have been less complicated.

House IVab and c

In principle these houses are identical with house III, but their state of preservation is far better, and consequently it is possible due to a meticulous excavation technique to give a more detailed description of the building, which is unique in Denmark. The house was reconstructed twice. The first of these rebuildings, house IVb, made use of almost all the old post-holes, for which reason these phases are named house IVab in the following. House IVc is identical with the second reconstruction. The walls could be identified as rows of posts standing by themselves without a foundation trench. The north wall had been located c. 1 metre southwards, thus making it possible to place the external raking timber for this wall in the wall trenches of house IVab. The location of the south wall, apart from the south-west corner, is identical with the wall line of house IVab.

Fig. 8. Plan of houses III, IVab, and IVc. a: House III; b: house IV ab; c: house IV c. 1:350. Drawing: Jeanette Glatved.

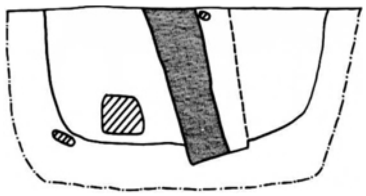

Fig. 9. Section of external raking post from house IV. 1:20. Drawing: Jeanette Glatved.

House IVab
Principle of Construction

The external walls of the house can be identified by a trench, as much as 0.5 metre wide, in which the foundations of the walls were laid. The longitudinal walls are slightly curved, whereas the gables are straight. The building is 48.5 metres long, 8 metres wide at the gables, and 11.5 metres wide at the centre of the longitudinal walls. The load-bearing construction consists of two rows of internal ridge posts in combination with lines of external raking timber along the exterior of the building.

Interior Constructions

The two rows of internal ridge posts form a three-aisled construction. There is every indication that these rows of posts curve slightly, so the distance from any internal ridge post to the nearest wall is 3 metres, although the uncertain factor concerning the re-use of post-holes must be taken into account. The distance between the posts in each pair varies from 4 metres nearest the gables to 5.5 metres at the centre of the building. The distance between the pairs is usually 3.5 metres, but the pattern is changed in a few places probably due to the division of the house. The large number of pits make it difficult to estimate the dimensions of the timber. The diameter of the different pits varies from c. 2 metres down to 0.75 metre, however most of them are c. 1 metre across. The depth of the pits was in most cases between 0.50 and 0.75 metre. In a few cases dating from the latest phase (IVc) imprints of posts or features in the soil had been preserved indicating the dimensions of the timber, which had been drawn up. In these cases the width of the timber lay between 0.15 and 0.30 metre.

The posts of the interior partitions are also part of the total interior construction. They were found in pairs, c. 2 metres apart, in between four of the sets of internal ridge posts. To judge from these posts the house was divided into at least five separate rooms.

External Raking Posts

The external raking timber could be identified as a regular row of post-holes placed at a distance of c. 1.5 metre to the walls, however, the distance at the gables was only 1 metre.

There were 22 posts along each longitudinal wall, i.e. a raking post at each set of internal ridge posts and in addition a raking post in between, in this way the distance between the raking posts is c. 1.5 metre, with the exception of the eastern part of the building, where raking posts are only found at the internal ridge posts.

These post-holes have also been re-used and worn down. The "typical" post-hole is 0.75 metre across and c. 0.50 metre deep. It was possible at several occasions to see imprints of post-holes in a good state of preservation, which made it possible to estimate the shape of the timber. The raking timber may be described on this basis as planks, 0.50 metre wide and 0.20 metre thick, slanting with the broad side against the wall (fig. 9).

At each gable there were three raking posts, placed one metre from the gable-end. It was impossible to find any imprints of the posts, but judging from the holes they seem to have been of a smaller dimension than the other raking posts.

The Walls

In the south-west corner of house IV, in particular, there were good possibilities of following the wall line on the surface. It could be determined by a c. 0.15 metre wide dark stripe of humus in the light grey soil of the foundation trench itself. During the excavation of the wall trench a feature was discovered, which to the knowledge of the author has not been described in the literature before: Underneath the 0.20–0.30 metre deep wall trench a row of pointed pegs was observed, driven down up to 0.50 metre below the bottom of the wall trench, at a regular interval of 0.38–0.40 metre (fig. 10). There seems to be no doubt that the pegs were placed exactly in the wall line. It is more difficult to prove the function. It is not possible from the excavation results alone to determine whether these

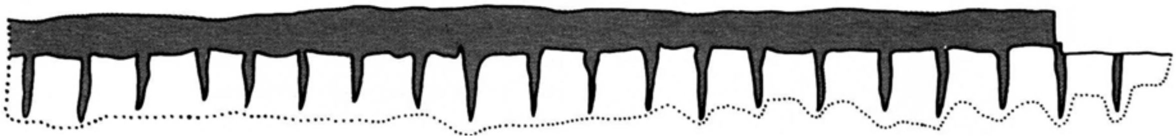

Fig. 10. Section of part of the wall trench of house IVab with pointed pegs driven into the ground. 1:50. Drawing: Jeanette Glatved.

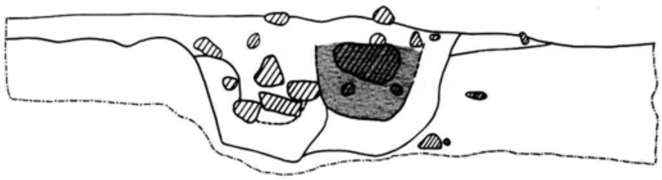

Fig. 11. Section of door-post with two phases, house IVab. 1:20. Drawing: Jeanette Glatved.

pegs were a sort of wedge meant for securing the planks during the erection of the wall, or if the wall planks themselves were pointed and driven into the subsoil.

Entrances

In four places the wall trench was interrupted by more deeply dug planks which evidently indicated the entrances (fig. 11). The best preserved post imprints show that the door cases were constructed of planks 0.50 metre wide and 0.20 m thick. Three of the four doors, two on each side, were 1.5 metres wide, whereas the fourth entrance in the north-eastern side of the building seems to have been a two metres wide gate.

Further Constructions in connection with House IV

In the south-eastern corner of house IV between two internal ridge posts and the wall a sunken hut was found, 2.5 × 2 metres and 0.5 metre deep. The construction has independent ridge posts at each gable. The small building respects both the internal ridge posts and the walls of house IV and must be part of it – possibly a cellar/store-room.

In the western part of the house, between two sets of internal ridge posts, an area could be identified which was clearly affected by fire. This may be the bottom part of a hearth, though it is impossible to prove.

A flat circular pit (1.25 metre across) full of stones made slightly brittle by fire could be seen in the south-western corner of the house. In this case also it is difficult to determine the relation to the building, but similar phenomena have been found in Viking Period houses from Trelleborg (Nørlund 1948:83, fig. 73 and p. 85, fig. 75), and that actually applies to the store-room as well.

Dating of the Houses III and IVab and c

Typologically the great houses almost form a hybrid between the halls of the Viking Period with curved longitudinal walls and external raking timber and the traditional three-aisled longhouse with to rows of internal ridge posts.

Many of the post-holes contained animal bones. Pottery was also found in some of the holes, but only occasionally were artifacts suitable for dating purposes found. From the wall trench of house IVab there is a comb of Viking Age type (fig. 12), and in one of the post-holes of the wall line of house IVc there were some sherds of soapstone vessels. The general dating to the Viking Period is not contradicted by the more anonymous find material.

Ten carbon-14 dates were obtained using samples from the post-holes of house III, house IVab, and house IVc (fig. 13). As it will appear, the dates can be divided into two groups – one from around 660 A.D. and the other from around 890 A.D. Such a remarkable factor of simultaneity, which is the case in both of the two groups, may reflect a massive building activity at the place, i.e. the period of construction for some of the huge buildings. Most of the samples were taken from "re-used" post-holes, which of course creates the problem of which buildings that are actually dated by these samples. One of the samples from the older group was taken from a post-hole belonging to the northern row of raking timber of house III, and can, therefore, without any doubt be connected with this building. That is also the fact with a sample from the younger group taken from one of the southern raking posts of house IV. The rest of the samples come from post-holes that have been in use for both houses. It should be mentioned, however, that most of the samples

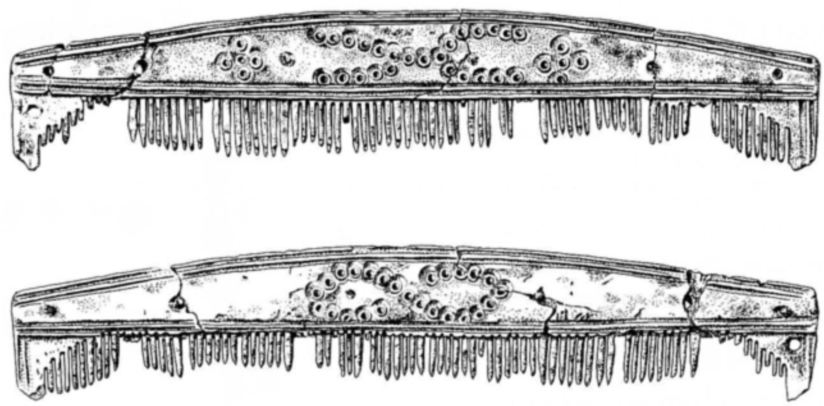

Fig. 12. Comb found in the wall trench of house IVab. Drawing: Hanne Jochumsen.

from the older group originate from the stratigraphically oldest post-hole phases, and for that reason they are much likely to belong to house III.

Bones have a low natural age, but they may in principal have come from an earlier settlement with the consequence that the huge buildings are wrongly dated. It should be noted, however, that the bones from house III and IV had sharp edges and were without any traces of disintegration or animal gnawing that might have indicated that the bones had been lying on the surface for longer time. It is, therefore, reasonable to trust the older series of datings and thus the erection of the oldest house (house III) being in the late 7th century.

The younger series of datings may indicate the time of erection of one of the phases of house IV.

The conclusion must be that a huge hall has been situated in this part of the Lejre settlement from the end of the 7th century until some time in the 10th century.

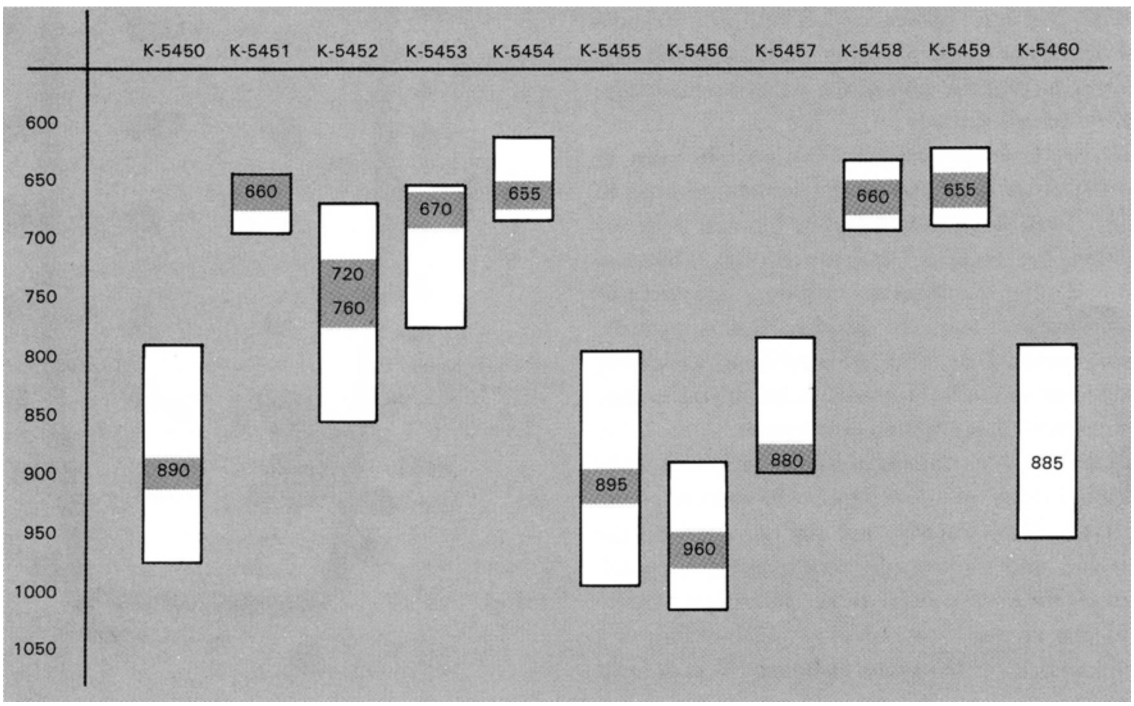

Fig. 13. Diagram with calibrated carbon-14 datings (A.D.) – calibrated after Stuiver and Pearson 1986. The datings K-5450–K-5459 are from house III, house IVab and house IVc. The dating K-5460 is from house V. Drawing: Jeanette Glatved.

House IV. Summary

Covering an area of almost 500 sq.m. the house has been an extremely large construction (fig 14). The heavy internal ridge posts in combination with the almost equally heavy raking timbers leave the impression that the construction was double secured. On the other hand the preserved post imprints show that the timber was not overdimensioned, e.g. the raking posts are somewhat smaller than the large post-holes might indicate, this is also the fact concerning the internal ridge posts. The whole building was actually far less massive than the huge post-holes on the drawing seem to indicate.

It is possible to calculate the degree of inclination of the raking posts from their imprints in the soil and thus calculate the height of the walls, supposing that the raking posts have supported the construction at the point where roof and wall meet. Taking the uncertainty connected with such calculations into account, the height of the walls may be estimated to between 3.5 and 4 metres. Naturally the large amount of load-bearing elements and the height of the walls raises the question, whether the building had a "second floor" or the many posts were there only in order to support the huge roof construction.

The location of the partition walls indicates that the house was divided into six sections. The four entrances are placed according to the partition walls and each lead to a section. A further division of the house seems likely, but cannot be traced directly.

Naturally the function of house IV must be seen in relation to the other buildings in the settlement area. If the house is viewed separately it can be difficult to determine, whether the building was meant for habitation alone, or it had other functions in addition, e.g. agricultural. However, nothing points in this direction as no partitions from a cowshed or other constructions indicating farming have been found. The sunken hut in the south-eastern corner must have been a store-room.

The location of the entrances in the longitudinal walls differ somewhat from the usual "rules" for houses of the Trelleborg type. They usually have the entrances in the gables as well as one entrance in each longitudinal wall. In these houses the large central room (the hall) is usually regarded as the centre around which the building was erected. The largest of the rooms in house IV is at least

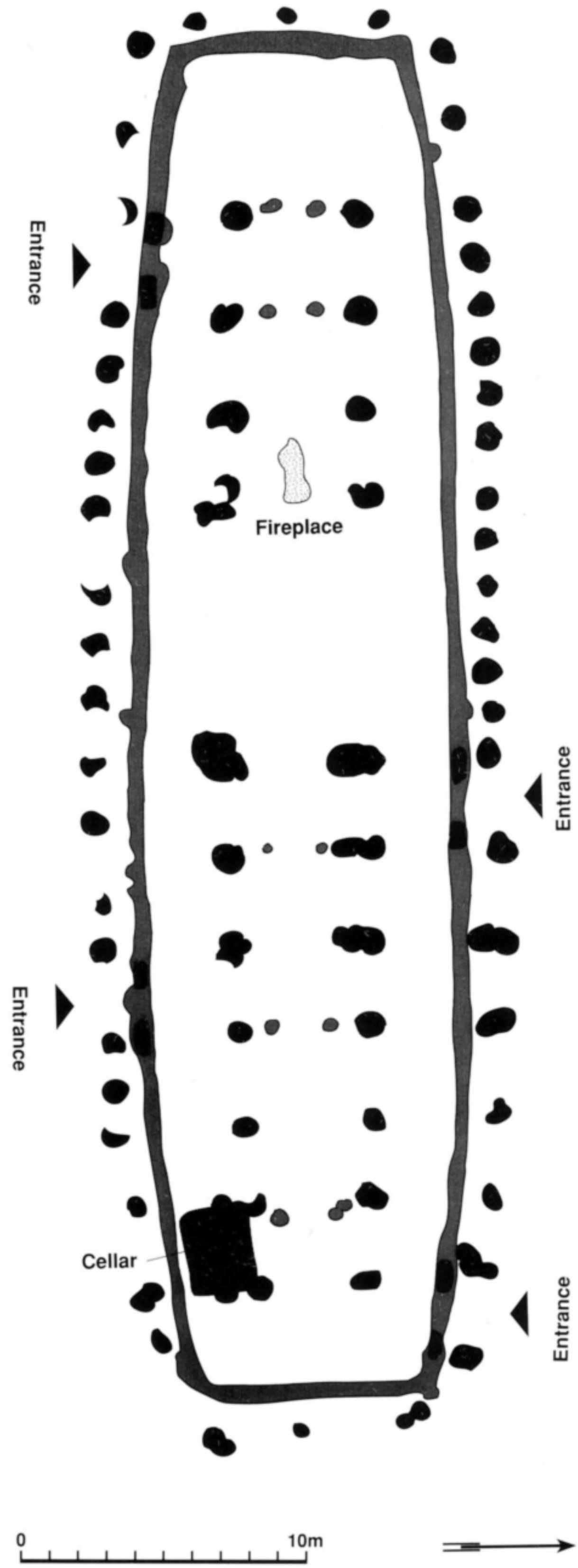

Fig. 14. House IVab. 1:250. After T. Christensen 1991.

100 sq.m., but may have been 200 sq.m. as judged from the partitions. When still comparing with the Trelleborg house-type this room must have been the centre of the building with the entrance in the centre of the northern longitudinal wall. The separate sections of the building each have their entrance. This implies that the house served different purposes such as habitation, storage, assembly hall, etc. as mentioned above. Distinctions have probably existed between not only the different functions of the building but also between its users, physically as well as socially. Masters and servants as you might say.

Houses V – VIII

10 metres north of house IV a group of four small buildings (V – VIII) were found to have succeeded one another in the same place (fig. 15).

House VI (fig. 15)

Oldest is a rectangular building, 5 × 8 metres, with a wall trench, 0.50–0.75 metres across. The up to 0.50 metre deep trench shows clear traces of at least one replacement of the wall. The impression of the wall timber indicates that the wall was constructed of 0.10 metre thick planks. The only entrance to the house, more than 1 metre wide, was found in the south-eastern corner. It was constructed of heavy planks dug deep into the subsoil. The southern plank was placed inside the room.

House VII (fig. 15)

House VII, which replaced house VI, is 15 metres long and 6.5 metres wide with curved longitudinal walls and a pair of ridge posts at each gable end. There may have been an entrance in the south-western corner of the house.

House V (fig. 15)

House VI and VII were superposed by house V. The construction of the house, a sunken hut measuring 4 × 5 metres, meant that the two other buildings were partly disturbed. At each gable end of the house, which was dug 0.40 metre into the soil, there was a thick post. The walls were indicated by pegs like the ones in the wall line of house IV. The number of pegs driven into the subsoil and

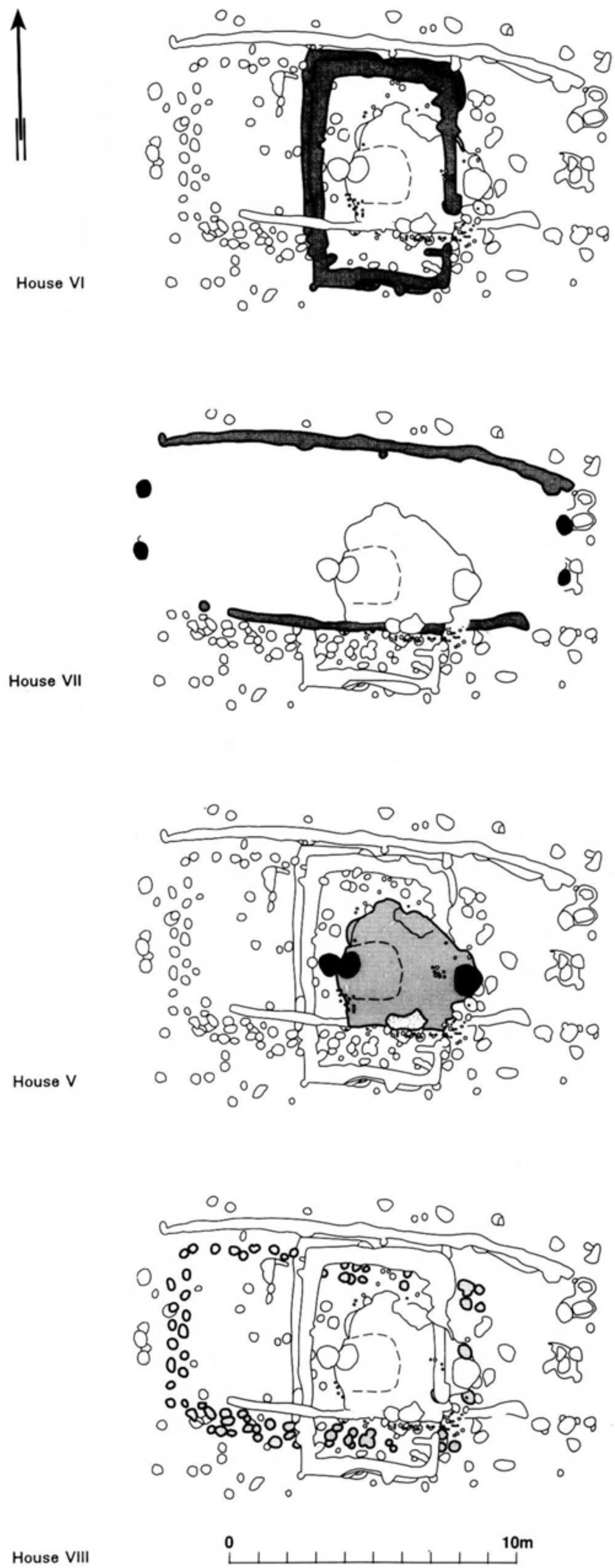

Fig. 15. House VI, VII, V and VIII. 1:250. After T. Christensen 1991.

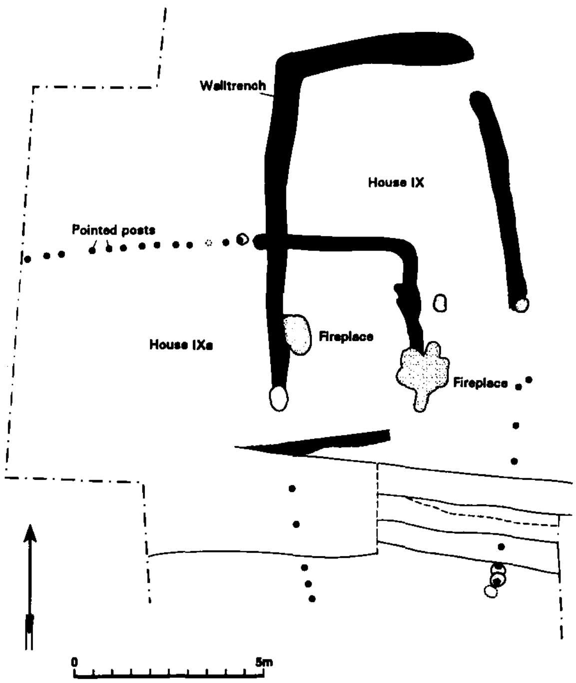

Fig. 16. House IX and house IXa. 1:200. After T. Christensen 1991.

the replacements of the posts at the gable-ends show that this building also has been renewed at least once. At the centre of the southern wall a fireplace 0.75 metre across was found, consisting of small stones, burnt brittle, mixed with soot and charcoal. The great number of pegs driven into the subsoil of the wall areas do not form a clear picture of the way of construction, however, the walls were probably made from planks. A carbon-14 sample dated to c. 900 A.D. from house V, stratigraphically the youngest of the four houses, is in agreement with the finds from it.

House VIII (fig. 15)

This is a rectangular house, 10 × 6 metres, situated east-west. The walls are constructed as a double row of posts, and the entrance seems to have been placed in the eastern gable-end. In spite of persistent efforts to make the stratigraphical position of the house clear, it was not possible to place it in chronological order. However, it may well be the oldest of the four buildings.

There can be no doubt that the four buildings, which differ very much in construction, have replaced each other within a limited span of years, and house V is probably the last and youngest of them.

House IX and IXa (fig. 16)

Immediately outside the south-western corner of house IV the remains of two smaller buildings, house IX and IXa, were found. The area has been seriously disturbed in recent times by ploughing and the construction of field lanes, and the prehistoric structures are consequently damaged.

A partly preserved wall trench indicated a gable and parts of two slightly curved longitudinal walls. The lack of internal ridge posts made it difficult to estimate the size of the building. However, during the excavation of the wall trench it became evident that pegs/planks driven into the subsoil had been in use here as well. By extending the sections through the presumed wall line, even in places where it could not be identified on the surface, it was possible to prove the presence of the pegs/planks and thus the position of the walls. In this way house IX could be identified as a building, 6 × 15 metres, standing north-south with its entrance in the north-eastern corner. A fireplace almost in the centre of the house is probably part of the building. There are some evidence of a row of external raking timber. Moreover it is worth noticing that the row of pegs driven into the subsoil of the north gable is slightly curved, which must indicate that both the longitudinal walls and the gables of this house must have been curved accordingly.

House IXa, 5.5 × 12 metres, is the building that replaced house IX. Apart from the fact that this house is orientated north-south the method of construction is the same. It was possible here as well to follow the pegs driven into the subsoil in the extension of the wall line. The fireplace belonging to the house was found in the east end of it.

House X (fig. 17)

House X was found 43 metres to the south of house IV and parallel with it. The western gable-ends of both houses are lying on a line. The longhouse, 36 × 7 metres, is in principal constructed in the same way as house IV, with internal ridge posts, external raking timber and a wall trench, under which a number of pegs were found driven into the subsoil. Nevertheless house X is totally different from house IV. Not only is the construction to judge from the excavated structures (post-holes and a wall trench) fare more delicate, but the lay-out of the house is also quite different. In spite of the later disturb-

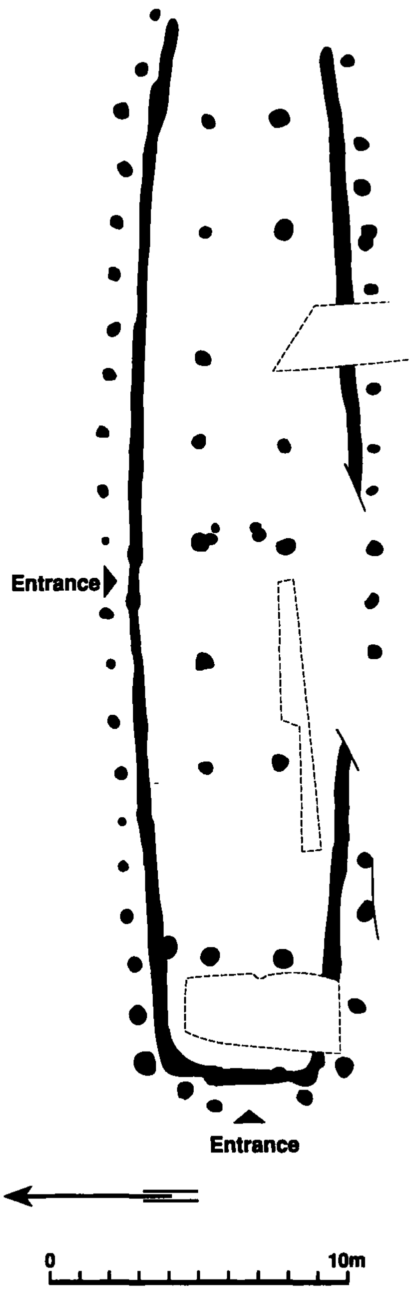

Fig. 17. House X. 1:250. After T. Christensen 1991.

ances there should be no doubt that a wall trench has never existed at the eastern gable of the house in which place a gate may have been situated. Also the western gable has had a large entrance, more than 2 metres wide. The entrance, 0.90 metre across, on the northern side was placed exactly at the only partition in the building. This building has probably been used as a storage house, stable, etc.

House XI

In the eastern part of house X the small pit house, house XI, was found (see plan fig. 7). The house may be a cellar or a store-room as it has earlier been seen with house IV, but the stratigraphical evidence seems to show that the house is younger than house X.

The remaining buildings (fig. 6)

In the trial trenches dug in this part of the settlement area traces were found of several buildings, which must belong to the settlement. In addition different sorts of boundary marks were found, such as ditches and lines of dense posts. The limit of the settlement to the north is best documented. Here a ditch with a fence indicates the boundary of this part of the settlement area.

Area 1. The Area with Occupation Layer

This area (fig. 6) is generally characterized by a brownish black occupation layer, in some places more than 1 metre thick, which naturally made area stripping by machine impossible. Therefore the investigations here were limited to a small sondage and a trial trench. These investigations, as well as the ones in area 2, served the purpose of creating an idea of the character of the settlement and the thickness of the occupation layer.

Sunken Huts (House I, XIII, XV, and House 1–3 from the 1981 Excavation) (fig. 6)

The six sunken huts excavated were all of almost the same construction: Oval pits, dug up to 0.75 metre into the soil, with a large post at each gable end. In some cases small fireplaces made of stones were found outside the houses and clearly connected with them. Apart from that the sunken huts showed no further examples of construction details; however, the ridge posts had been replaced in some cases.

House XII

In the northern end of the trial trench the corner of a post-built house was unearthed. The site was sealed by a layer, more than a metre thick, and it was, therefore, in a very good state of preservation. The load-bearing parts of the building were dug into the natural humus layer,

Fig. 18. Photo of oven in house XII. Photo: T. Christensen.

which was almost a metre thick here. The floor was a hard packed earth floor, and a fireplace/oven was constructed with a base of stones, covered with clay (fig. 18). On top a number of flakes of fired clay with impressions from osiers were found, some of them were pierced. The find is probably the remains of a collapsed oven. The excavated corner gives no clear indications concerning the size of the house. If the fireplace was situated in the centre of it, however, it was not a very large house. A portion of charred rye was found close to the oven (Robinson, this volume). The grain has been carbon-14 dated to 660 – 780 A.D., with 680 A.D. as the calibrated mean value.[3] It means that the oven and the building around it were contemporaneous with the oldest part of the settlement in area 2.

A Smithy

During the excavations in trial trench 13 a feature was found that may be interpreted as the remains of a smithy. Covering a c. 10 sq.m. area a massive layer of iron slag mixed with ashes and charcoal was found. In the middle of the layer a massive cake of melted iron was identified. Even though no furnace stones or hollows for the furnace were found, it is reasonable to interpret the structure as a smithy. In connection with the "smithy-layer", but superposing it was a 0.10 metre thick layer of sandy turf. It is impossible to determine whether it was a later applied

Fig. 19. Photo of the heap of stones. Photo: T.Christensen.

levelling layer, or for instance part of the smithy's collapsed roof or walls. Around the area a number of postholes were detected, which may have been connected with the construction of the smithy. The smithy had been erected directly on top of the natural soil. A number of plough-marks could easily be identified in the light sandy turf bearing witness of tillage in between the other activities indicated by the finds in the culture layer.

A Heap of Stones

The most remarkable structure, and maybe the real reason why the site was so easily recognizable on the surface, is a large formation of small fired stones mixed with soot, ashes, and charcoal, 20 metres wide, up to 1.5 metre high, and at least 40 metres long (fig. 19). The heap of stones was clearly stratified indicating that the depositing had taken place within a long space of time. The depositing had started in a hollow, but in the course of time it was filled up, and the structure ended as a heap of stones. The younger phases of the heap cover house XII, house XIV and to some extent the smithy. It seems reasonable to believe that all the stones deposited came from the same process. However, no finds have been found to help further the interpretation of the heap. The structure is remarkably sterile. The heap most of all looks like an enormous piling up of "used" fireplaces, and it may actually be the fact, but we will not go further into that problem here.

Four thermoluminescence datings from the top and the bottom of the heap support the theory of a long depositing period, as they include the later Iron Age and the Viking Age (fig. 20). So the heap is contemporary with the other settlement finds of the area.

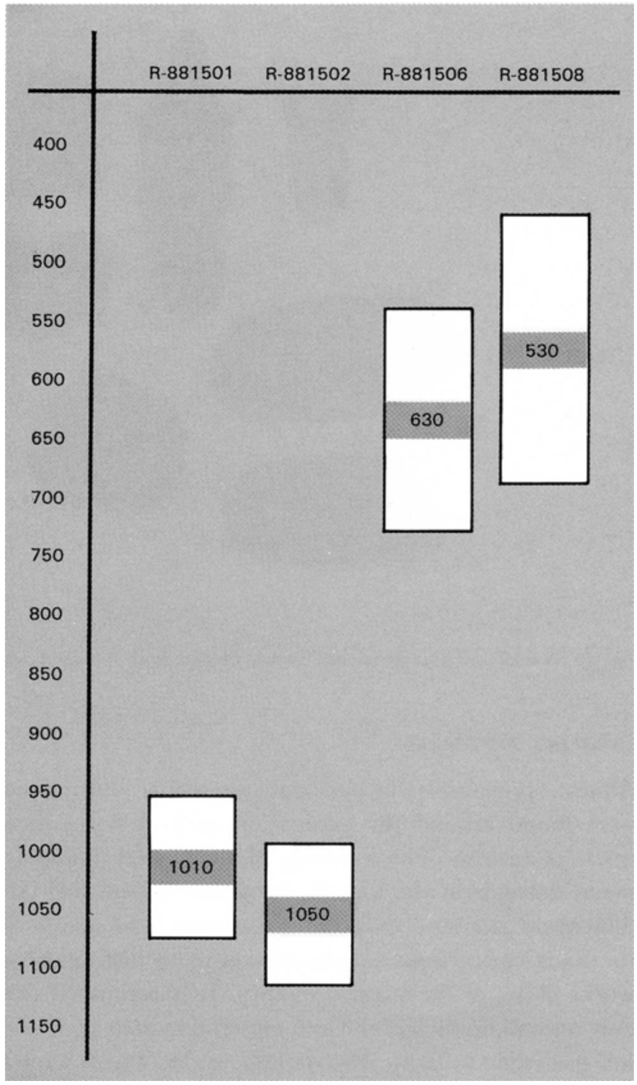

Fig. 20. Diagram with TL-datings from the heap of stones. The four datings are from the top and the bottom respectively. Drawing: Jeanette Glatved after Mejdahl 1990.

THE ARTEFACTS

The most abounding group of finds consists of the domestic coarse pottery, which is of so frequent occurrence during the Late Iron Age and the Viking Age. Most of the potsherds seem to come from unornamented vessels with vertical or introflexed rims and flat bases, which are characteristic of East Danish pottery (Madsen 1991:22 ff). The find material includes part of a large stamped vessel from the Late Germanic Iron Age, as well as a significant element of Late Viking Age Baltic pottery, which is mostly found in the layers filling the sunken huts of area 1.

Soapstone cooking pots are represented by fragments scattered all over the excavated area. None of the pieces show traces of secondary use, but a large percentage have holes for rivets.

The find material includes many groups of small objects such as nails and rivets, small iron knives, spindle whorls, whetstones of slate, combs, and fragments of combs. Tweezers, keys, needles, and strike-a-lights were found in small numbers.

Fig. 21. A selection of ornamented bronze objects from the late Germanic Iron Age. 2:3. Photo: Flemming Rasmussen.

Ornaments and Mounts

Almost 50 examples of personal ornaments and mounts were found around the excavation area, most of them made of bronze. The majority of them were found by metal detector in the topsoil, for which reason they are difficult to attribute to specific structures. The quality of the finds varies from simple imitations to distinguished works of art of the highest quality. It is estimated that only a small fraction of the find material hidden in the top soil has come to light. The datings of the objects stretch from the 7th century down to the 10th/11th century.

The finds from the Late Germanic Iron Age (fig. 21) include some rare and foreign pieces apart from the usual Southern Scandinavian types. The round piece fig. 21 h is a Norwegian brooch type (Helgen 1982:20, fig. 16). The necklace spreader fig. 21m has been changed into a large strap-end buckle. The curved piece fig. 21j is unique in Denmark, it may be a buckle, but it could also be part of a brooch.

The Viking Age finds (fig. 22) also include a number of ordinary types as well as a few unique finds. Among the rectangular brooches the fragment fig. 22e is unparalleled in Denmark. The threefoil brooches are more usual, which also applies to the circular brooches fig. 22j,n and the fragments of oval brooches fig. 22p. The exception is here a small silver fragment with a gripping beast fig. 23d. On the reverse side there are clear textile impressions, which indicate a process of manufacture similar to the one known from oval brooches. If this is really the case the piece must have been part of an unusually magnificent oval brooch. Finds similar to the simple iron fibula fig. 30 have been found in Sweden. The small silver head fig. 23a is of Russian origin, which also applies to the small silver horse fig. 23c and a gilt silver pendant. The bronze piece fig. 25 is part of a bronze band from a comb, a type that in Denmark has been found in the Ḥaithabu area.

Detector finds from the topsoil over settlements of the Late Iron Age and Viking Period have increased during recent years as have the number of sites where metal objects have been found (Vang Petersen 1991). Among the sites of this category Lejre must be considered rich in finds some of which are of unusual quality.

Handicraft

Combs, needles, and pins of bone and antler are items commonly found at the settlements of this period. However, it is more unusual to find cut-off points and burrs from antlers used for the manufacturing of the above mentioned objects. It should be pointed out that no traces of comb production have been found, for which reason the

Fig. 22. A selection of ornamented bronze objects from the Viking Age. 2:3. Photo: Flemming Rasmussen.

existence of this specialized production is not yet proven at Lejre.

Apart from the smithy a number of smith's tools were found around the settlement area, both as stray finds and in connection with structures (fig. 26).

A few pieces, a half-finished bronze needle, a matrix, a model, and a core, indicate the presence of ornament production (fig. 27).

Further Finds

Apart from the soapstone vessels and whetstones from Norway/Sweden and the ornaments mentioned above, glass beads and a few fragments of drinking glasses occur.

One of the stray finds from the topsoil was a silver coin of Viking Age type, probably minted in southern Jutland during the late 8th century (fig. 28). A number of weights were also found in the topsoil (fig. 29). Here the bipolar type dominates, but other types are also represented. A few fragments of scrap silver belong to this group of finds as well.

The general representation of finds shows a site with an rich and varying inventory of finds. Apart from the traditional settlement finds, which are to be expected in a site from this period, there are many types and groups of artifacts which stretch further than the local circles and connect Lejre with the North as well as with Eastern and Western Europe. In addition there are some indications of handicraft production and trade.

CONCLUSION

As will appear from this summary of the excavation results from Lejre, the present investigations have not yet been of an extent that makes it possible to answer all

Fig. 23. a: Human head 1,5 centimetre high; b: a pendant; c: fragment of a horse; d: a gripping beast. Silver. 3:2. Photo: Flemming Rasmussen.

Fig. 24. Gilt bronze mounting, probably from a casket. 1:2. Photo: Flemming Rasmussen.

Fig. 25. Fragment of a bronze band from a comb, length 2 cm. Photo: Flemming Rasmussen.

Fig. 26. Smith's tools. Photo: Flemming Rasmussen.

relevant questions, which could be put to such an exceptional settlement complex. However, some general yet important features may be deduced. Above all the division of the more than 150.000 sq.m. settlement area into a part for handicraft etc., area 1, and area 2, which consists of one or more enclosed farm complexes. The datings, archaeological as well as scientific, prove that the two areas have, at least partially, been in use at the same time.

The six sunken huts in area 1 must be understood in connection with the farm complexes in area 2, since different "service functions" such as various sorts of handicraft production, weaving, etc. may have taken place in area 1. Similar groups of sunken huts connected with farm complexes are known from several settlements in Jutland. The number of finds and the fact that the sunken huts were found in quite small excavation sites may indicate that area 1 is actually a so-called sunken hut settlement, which has functioned as a local trading centre apart from being part of the settlement complex. One should not compare with the great "international" ports of trade such as Haithabu (Jankuhn 1986), Ribe (Jensen 1991) and possibly Åhus in Scania (Callmer 1991), but compare with the number of minor ports of trade, which are quite numerous in South Scandinavia, although they have only been investigated to a small extent (Ulriksen 1990). At these sites the amount of imported finds is limited, and the presence of specialised handicrafts such as the silversmith, the comb-maker, and the bead-maker have only been proven in a few instances. What characterizes these sites, apart from the large number of sunken huts, is their location close to waterways and roads. In this particular case the location close to one of the important waterways in Zealand, just a few kilometres from the bottom of Roskilde Fjord, may suggest that the Lejre settlement also functioned as a local trading centre.

The settlement in area 2 on the hills west of area 1 and the present village has a much different structure. Here varying sizes of longhouses are dominating. Part of the settlement seems to have the great hall (house III and house IV) as the primary structure. The surrounding buildings may have served different purposes in relation to the hall, e.g. as kitchen (house V – VIII) and sleeping quarters (house IX and IXa). House X with the open gable may have been a storage house, but no buildings can with certainty be related to farming – we are here primarily thinking of the possible presence of cowsheds with traces of pens.

The settlement in area 2 bears a strong resemblance to the large Viking Age estates found in Jutland: Omgård between Holstebro and Ringkøbing (Nielsen 1979), one of the late Viking Age farms of the Vorbasse village in central Jutland (Hvass 1980), and Gammel Hviding south of Ribe (Jensen 1987).

One of the questions that has not been answered by the present investigations, is whether the Lejre settlement consisted of one or more contemporary farm units.

No doubt the economy of a large estate was based on farming, and, therefore, the possession of land must have been important. The hundreds of bones from livestock found during the excavations indicate clearly that agriculture played an important part in the economy of the settlement. It is worth noticing that bones from pigs dominate, contrary to the fauna material from several of the large estates in Jutland, where cattle seems to have held the leading position. As will appear from D. Robinsons paper in this volume on the botanical material from the excavations rye seems to have been an important crop. The interpretation of the feature in house XII as an oven for drying grain is interesting in this context, as it indicates that it was necessary to dry the grain before grinding.

We have tried to outline a settlement containing several functions. Area 1 is interpreted as a workshop area connected with the rest of the settlement as well as a seasonal local market place. Area 2 consists of one or more large estates. Here we find the great hall, a monumental building symbolizing the influential position of Lejre. Following this interpretation the noble family at Lejre gained its income from both trade and exploitation of land.

The archaeological material including the Lejre treasure, Grydehøj from the 7th century, and the cemetery as well as the ship setting(s) from the Viking Age, already constitutes Lejre as a central settlement in Denmark from the 6th/7th century until the 10th century. To this evidence can now be added the remains of a settlement which should be ranked as a noble estate on the basis of its economic functions and building capacity.

Other Scandinavian sites recently discovered have been interpreted as centres of the royal or noble elite, e.g. Borg on Lofoten in Norway (Johansen & Stamsø Munch 1990), and Fornsigtuna in Central Sweden (Allerstav 1991). This also applies to two settlements in England: Cheddar by the Bristol Channel (Rathz 1979) where the Wessex kings had an estate, and Yeavering (Hope-Taylor 1977), which is slightly older than Lejre and also have a mythical background. One could also mention Starigard, the old slav princely settlement in Oldenburg in East Holstein (Gabriel 1989). One feature that some of these settlements have in common with Lejre is the large hall in the centre of the settlement. In Oldenburg a number of specialized workshops have been identified. As mentioned in

Fig. 27. Core, model, and semi-finished bronze ringed pin. Bronze. Photo: Flemming Rasmussen..

Fig. 28. Coin struck in Haithabu. Carolus-Dorestad type. Shortly before 800. Malmer CE1/A2. Silver. 1:1. Photo: The National Museum.

Fig. 29. Weights. Photo: Flemming Rasmussen.

Fig. 30. Iron fibula. Drawing: Hanne Jochumsen.

the introduction, Lejre was the legendary seat of the Danish kings. The historical record, however, does not give any definite clues to understanding Lejre's position as a possible royal residence in Viking Age Denmark. Naturally the archaeological evidence cannot settle the case either, although the theory of a noble estate at Lejre is now well supported by the new discoveries. Did Lejre hold a position in later prehistoric times which was similar to the position held by the city of Roskilde in the Early Medieval Period? – Roskilde was chosen as the place of burial by the royal family. King Harold Bluetooth was buried here in the late 10th century, and the town prospered under the reign of his son Sweyn Forkbeard. In c. 1020 the powerful episcopal see of the bishop of Zealand was established here, a royal mint was in function in the 11th century, and the city became one of the most important centres in Early Medieval Denmark. There may well have been a connection between the dismantling of the pagan estate in Lejre, with its roots in the old tribal community, and the establishing of Roskilde, the "modern" Medieval city of the king and the church.

Translated by Michael Andersen

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NOTES

1. The National Museum, Copenhagen, no. 6907.
2. K-2352 – K2354, uncalibrated date.
3. K-5868, calibrated after Stuiver & Pearson 1986.

Appendix

List of animal bones from the excavations at Gl. Lejre 1986 – 1988 (Georg Nyegaard *det.*)

Fishes (*Pisces*):	No. of fragments:
Herring, *Clupea harengus*	c. 85
Salmon family, *Salmo sp.*	2
Eel, *Anguilla anguilla*	1
Garfish, *Belone belone*	4
Cod, *Gadus morhua*	c. 43
Plaice or flounder, *Pleuronectes platessa/Platichthys flesus*	13
Birds (*Aves*):	
Sponnbill, *Platalea leucorodia*	2
Grey-lag goose or domestic goose, *Anser anser/Anser domesticus*	17
Domestic goose, *Anser domesticus*	5
Mallard, wild or domestic, *Anas platyrhynchos/Anas domesticus*	7
Red-breasted merganser, *Mergus serrator*	1
Domestic fowl, *Gallus domesticus*	15
Crow, *Corvus corone*	3
Jackdaw, *Corvus monedula*	1
Blackbird, *Turdus merula*	1
Mammals (*Mammalia*):	
Beaver, *Castor fiber*	1
Water vole, *Arvicola terrestris*	7
Wolf/dog, *Canis lupus/Canis familiaris*	1
Dog, *Canis familiaris*	11
Fox, *Vulpes vulpes*	3
Badger, *Meles meles*	1
Cat, *Felis domesticus*	1
Grey seal, *Halichoerus grypus*	1
Pig/wild boar, *Sus scrofa/Sus domesticus*	1
Pig, *Sus domesticus*	1145
Roe-deer, *Capreolus capreolus*	4
Red deer, *Cervus elaphus*	23
Sheep/goat, *Ovis aries/Capra hircus*	379
Cattle, *Bos taurus*	635
Horse, *Equus caballus*	61

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Journal of Danish Archaeology vol. 10. 1991, pp. 186–190

Reconstruction of the Lejre Hall

by HOLGER SCHMIDT

The excavated house IV at Lejre differs from all other known Viking Age house sites in several ways. It must have been a rather unusual building. The size alone indicates this, as both the length of 48.3 metres and especially the width of 11.5 metres exceed the measures of almost all other houses.[1] The unbroken wall lines curve outwards both at the longitudinal walls and at the gables, for which reason the ridge of the roof must also have been curved so that the principal shape of the house was convex. However, in this house the characteristic aerodynamic shape typical of the period is slightly modified, as the central parts of the longitudinal walls were almost straight.

As many other houses from the early Viking Age the house was constructed according to an additive system of main bays, but the bays were only 3.2 metres wide compared with the normal 5–6 metres (Stoumann 1980; Hvass 1980; Nielsen 1980). In spite of a completely regular bay width two sets of posts were omitted in the centre of the house so that a huge bay of 9.5 metres was found here. This phenomenon is hardly accidental, as it seems to have been the ambition of the Viking Age society to create large open living-rooms, and precisely the central bay with the hearth was already in Iron Age houses often larger than the other bays.[2]

The excavated wall trenches and post-holes give no direct information about the building timber. However, on the basis of better preserved Viking Age houses it can be assumed that heavy split oak planks were mainly used.[3]

In this reconstruction attempt all the planks have been given the same thickness of 15 cm (6″), whereas the width varies. The main construction consists of a sort of a frame system. The planks have been raised in pairs with the large dimension across the house and at the top connected with mortised plank-shaped tie-beams. The frames carry both the longitudinal side purlins and small plank shaped posts, which again carry the ridge. This three-dimensional system carries and supports all other constructive elements in the house, the roof principally, but also the longitudinal walls are secured by plank shaped beams mortised to the posts. The rigidity of the construction is partly due to the mortise joints of the planks and partly to the end fixing of the posts in the ground. Certain joints are furthermore secured by from nature bent pieces of timber like the knees known from the Viking ships.[1] On the basis of the huge bay in the centre of the house a superior structure with 4 enormous bays, each of them 3 main bays wide, and two smaller gable bays is outlined. Each of these enormous bays constitutes the maximum timber length available, for which reason all longitudinal beams are joined in theses places. Finally each main bay is secured by external raking timber.

The walls are built of stave planks, dug into the ground and secured in a groove beneath the wall-plate. The height of the wall is estimated from the degree of inclination of the external raking timber and from the distance to the walls, 3.5 metres at the centre of the building and 3.0 metres at the gable ends. Both longitudinal walls have two doors.

Partition-walls dividing the house into 5 rooms are found in the main bays, and here the stave planks are secured in grooves beneath the beams and the wall-plates. Only the posts and door planks, which form part of the partition-walls, are dug into the ground. The bottom end of the stave planks are fitted into groundsills, which are mortised together with the timber dug into the ground, as it is known from some houses of the 9th century in Haithabu and Elisenhof (Schmidt 1992: 197).

As the excavation has proven traces of external raking timber opposite the centre of many of the main bays, it is proposed in the reconstruction that each main bay is equal to two wide trusses. The side purlins have been moved right out to the outer side of the frame in order to support the centre of the rafters or even to make it possible to construct the rafters in two parts of almost the same size. The aerodynamic principal form is accentuated by the hipped roof, which is caused by the external raking timber at the gable ends. Small louvers are found above the hips.

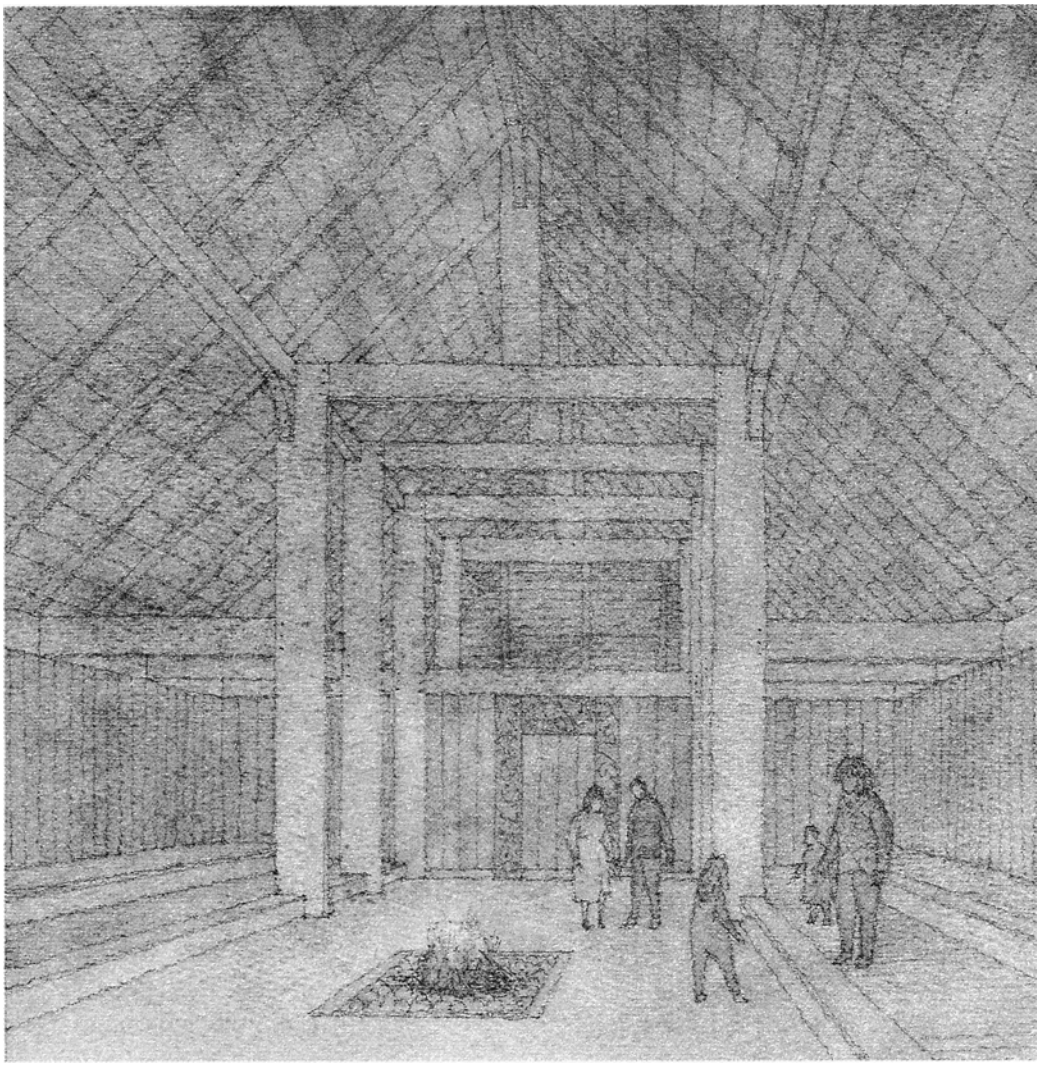
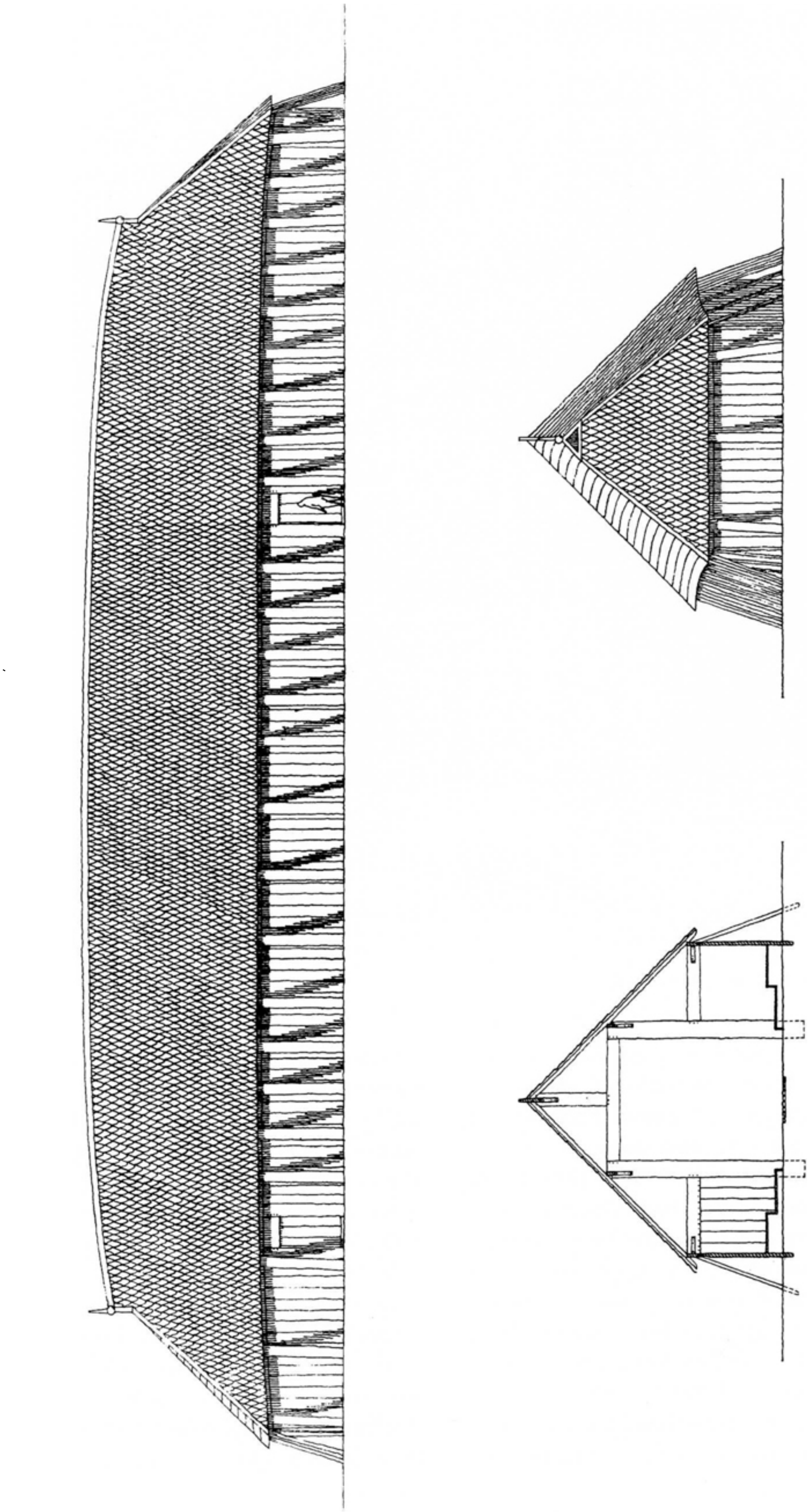


Fig. 1. Attempt to reconstruct the Lejre hall. H.S. 1992.

The shingled roof is inspired by some house shaped Viking Age tombstones known as hogbacks, which still exist in a surprising number in Northern England and Scotland. Their roof surface is often decorated with a pattern showing that the large houses of the period with curved longitudinal walls often had shingled roofs (Schmidt 1973:76). There may even have been a certain status connected with shingled roofs, since they are so carefully depicted in pointed, concave, rounded or quadrangular shapes. Oak shingles have been found in Denmark in connection with excavated Viking Age sites at Trelleborg and Hviding (Schmidt 1973:77; Jensen 1987:7). As the interior of the house is open to the ridge, and the underside of the roof is, therefore, visible, the shingles are attached upon a layer of boards, which also contributes to the stabilization of the roof.

The side aisles of the Lejre hall are in the very large central part almost constantly 3.0 metres wide, which is almost exactly twice the width of the side aisles of other excavated Viking Age houses (Stoumann 1980; Hvass 1980; Nielsen 1980). In the halls of that period the side aisles were used as raised living spaces. This is evident from sites in both Denmark and Iceland (Olsen & Schmidt 1977:110, 114; Stenberger 1943), and it is described in the Norse sagas, where it is even mentioned how the construction could be rising tier upon tier (Guðmundsson 1889:180 f). The extraordinary width of the Lejre hall, which is chiefly due to the double width of



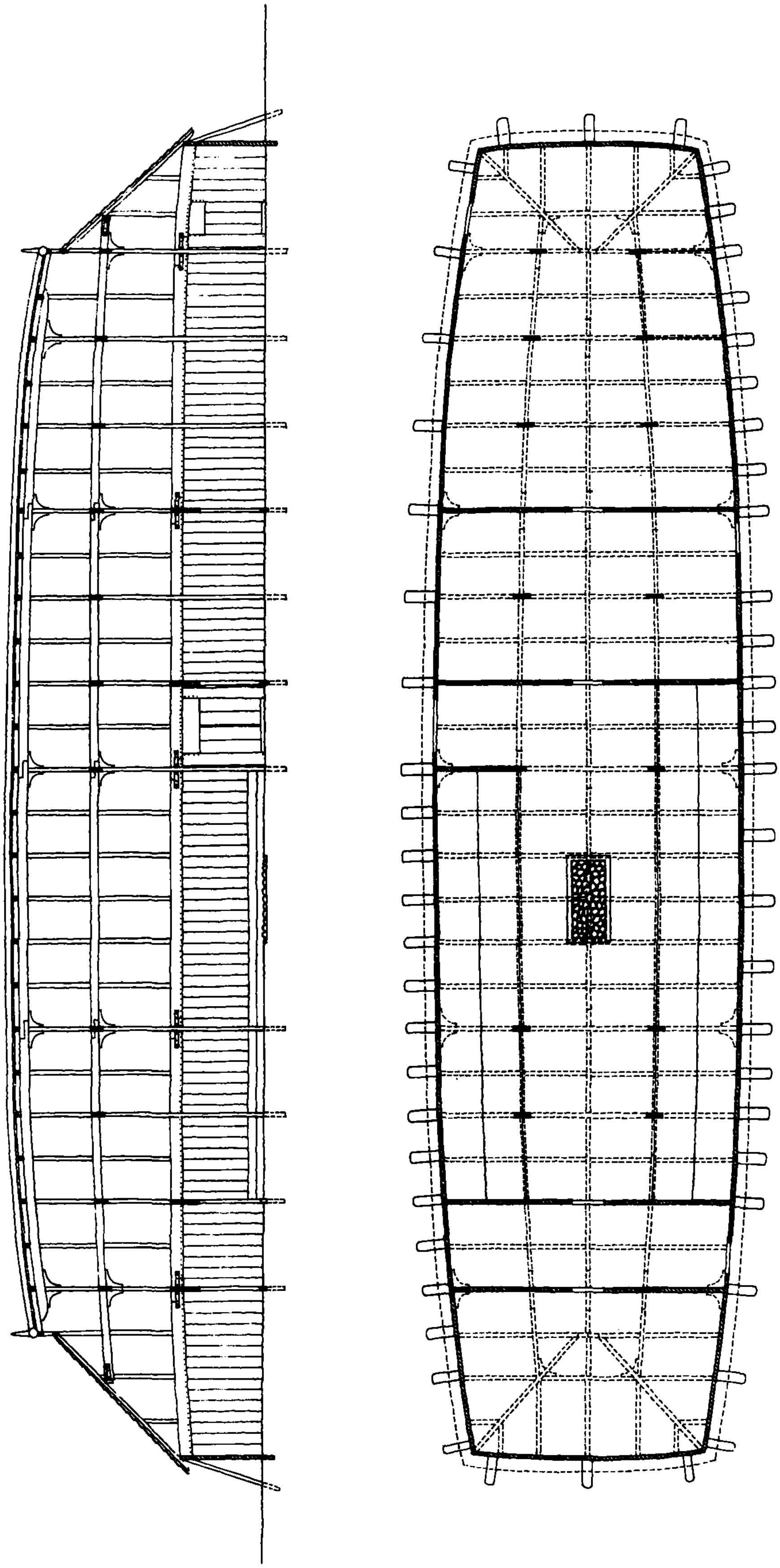


Fig. 2. Reconstruction of the Lejre hall. Plan, section and elevation, scale 1:250. H.S. 1991.

the side aisles, is, therefore, tentatively explained as a space built up in steps giving the room a very large number of seats. This construction is as the rest of the house made of oak boards. However, the space around the hearth had a simple earth floor like the other rooms of the house, as it has been proven archaeologically at Lejre (Christensen 1991:54 and above).

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NOTES

1. From Sædding houses are known that are 56 metres long (Stoumann 1980:106), whereas a house from Esbjerg Gammelby is 44 metres long (Vorting 1972:21) and a house from the Aggersborg village is 41 metres long (Olsen & Schmidt 1977:146). Viking Age houses are usually not more than 7.5 metres wide.
2. Schmidt 1992:195. However, it is uncertain whether the fireplace was situated in the huge bay as shown in the reconstruction.
3. Olsen & Schmidt 1977:116. Oak timber was preserved at Vorbasse and Omgård (Nielsen 1980:194), which was also the case at Haithabu and Elisenhof (Schmidt 1992:195).
4. A similar "knee" was found among the re-used timber of the farm Hedegård from the height of the Middle Ages near Halkær (Schmidt 1992: 201).

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Journal of Danish Archaeology vol. 10. 1991, pp 191–198.

Plant Remains from the Late Iron Age/Early Viking Age Settlement at Gammel Lejre

by DAVID ROBINSON

INTRODUCTION

During excavations at Gammel Lejre in 1986 (Christensen, this volume) a series of soil samples were taken for botanical analysis with the intention of investigating the agrarian economy of the site and the exploitation of plant resources. The samples taken were as follows:

House IV – the Great Hall: Samples were taken from postholes for internal roof-bearing posts and external supporting posts from both the east and west ends of the house. A total of 32 samples were collected representing all phases of the house.

Pit House V and Pit House XIV: A total of 12 and 6 samples respectively were taken at various points from the fills (*i.e.* floor layers) in these two pit houses.

Oven 473: A single sample was collected from a concentration of carbonised grain associated with the oven.

DATING

Precise dating of the individual postholes by allocating them to particular phases is difficult because most of them have been repeatedly re-used. Radiocarbon dates have been obtained for animal bones from some postholes and these suggest a period of use extending from c. 700 AD to c. 900 AD (Christensen, this volume). A sample of carbonised grain from Oven 473 gave a calibrated radiocarbon date (K-5868) of AD 680 (± 1 stand. dev. AD 660–780), i.e. in the earliest part of the occupation period.

METHODS

The soil samples were collected and processed by the excavators, under the direction of Tom Christensen, Roskilde Museum. The soil samples varied in size but the standard sub-sample size was 500 ml. The sub-samples were processed by flotation (Robinson & Jørgensen 1991) and the dried flots and residues were sent to the National Museum's Science Research Unit (NNU) for analysis. Here the various macroscopic plant remains in the samples were sorted and identified. The remains are stored at the National Museum.

RESULTS

With the exception of the sample from Oven 473, the numbers of plant remains recovered from each individual context were too small to enable statistically valid comparisons between contexts (van der Veen & Fieller 1982). At the same time the picture which emerged from each successive analysis was a remarkably consistent one. As a consequence of this and in order to make the results more accessible, the data from all samples from each individual structure have been combined. In the case of the Great Hall, the samples from the eastern and western halves have been treated separately. The results are presented in Table 1.

Where possible, the rye and barley grains have been measured and the results are presented in Table 2. With the exception of those from the oven, the grains were in a poor state of preservation. Measurement was difficult and the measurements are not as reliable as those performed on well-preserved specimens.

House IV – The Great Hall, West End: Twelve samples representing a total volume of six litres yielded 86.5 carbonised grains of which 42 (48%) were hulled barley (*Hordeum vulgare*), 21 (24%) were rye (*Secale cereale*), 4 (4.5%) were oats (*Avena sp*), 1 (1%) was naked barley (*Hordeum vulgare* var. *nudum*), and 18.5 (21%) could not be identified due to

Gammel Lejre												
Botanical analyses												
Latin name	English name	Part	House IV west – 12 samples 6 litres		House IV east – 20 samples 10 litres		Pit House V – 12 samples 6 litres		Oven 473 – 1 sample 0.5 liter		Pit House XIV – 6 samples 3 litres	
			total	%	total	%	total	%	total	%	total	%
CULTIVATED												
Avena sativa	Oats	Cary		4,5	19	17	1	6			2	0,6
Hordeum vulgare	Hulled Barley	Cary	42	48	28	25,5	1,5	9			113	38
H. vulgare var nudum	Naked Barley	Cary	1	1								
Secale cereale	Rye	Cary	21	24	20	18	2	12	700	100	44,5	15
		Rach									8	
Triticum sp	Wheat	Cary							1	0,1	1	0,3
Unidentified cereal		Cary	18,5	21	41	37	12	71			141,5	44
		Rach									5	
GATHERED												
Corylus avellana	Hazel	nfrg	1		5		5					
Rosa sp	Rose	Seed			1							
ARABLE/RUDERAL												
Agrostemma githago	Corn-cockle	Seed	1						3			
Artemisia vulgaris	Mugwort	achn									2	
Chenopodium album	Fat Hen	Seed	1				4,5		4		200	
Plantago lanceolata	Ribwort Plantain	Seed									1	
Polygonum aviculare	Knot-grass	Seed									2	
P. aviculare/convolvulus		fr									3	
P. convolvulus	Black Bindweed	fr									1	
P. persicaria	Persicaria	fr			19		1		2		3,5	
Rumex acetosella	Sheeps Sorrel	fr									1	
Stellaria media	Chickweed	Seed									2	
Veronica hederifolia	Ivy Speedwell	Seed			4		1					
OTHER												
Bromus sp	Brome	Cary							3		1	
Cirsium sp	Thistle	achn									0,5	
Fabaceae	Pea Family	Seed									8	
Galium sp	Bedstraw	Seed									3,5	
Papaver sp	Poppy	Seed									1	
Poaceae	Grass	Cary					1					
Rumex sp	Dock	fr									2	
Vicia sp	Vetch	Seed							4		1,5	
Claviceps sp	Ergot	sclr							1,5			
Unknown							7				2	

Abbreviations: Total = total number in sample; % = percentage of total grain in sample; cary = caryopsis; rach = rachis; nfrg = nut fragment; achn = achene; fr = fruit; sclr = sclerotium.

Table 1. Botanical analysis of plant remains from Gammel Lejre.

Measurements of rye grains, average (minimum-maximum)

	Oven 473	Great Hall	Pit House XIV
Total	50	25	9
Length	5.6(4.7–6.6)	5,2(4,3–6,4)	4,3(3,5–5,0)
Breadth	2.1(1.6–2.6)	2,2(1,7–2,7)	1,8(1,6–2,0)
Thickness	2.0(1.6–2.7)	2,0(1,6–2,6)	1,8(1,5–2,4)

Measurements of barley grains, average (minimum-maximum)

	Great Hall	Pit House XIV
Total	14	25
Length	5,1(4,3–6,2)	5,2(4,3–6,2)
Breadth	2,8(2,3–3,5)	3,1(2,2–3,6)
Thickness	2,2(1,8–2,7)	2,2(1,8–2,7)

Table 2. Measurements of rye and barley grains from Gammel Lejre

their poor state of preservation. In addition, there was a carbonised fragment of hazel (*Corylus avellana*) nut shell and one seed each of the arable weed species corn-cockle (*Agrostemma githago*) and fat hen (*Chenopodium album*).

Seventeen rye grains and thirteen barley grains could be measured.

House IV – The Great Hall, East End: Twenty samples representing a total volume of ten litres yielded 108 carbonised cereal grains of which 28 (25.5%) were hulled barley, 20 (18%) were rye, 19 (17%) were oats, and 41 (37%) could not be identified. In addition there were 5 carbonised fragments of hazel nut shell, a rose (*Rosa* sp) achene, and seeds of persicaria (*Polygonum persicaria*) and of ivy speedwell (*Veronica hederifolia*). Eight rye grains and one barley grain could be measured.

Pit House V: 12 samples representing a total volume of six litres yielded 16.5 carbonised cereal grains of which 2 (12%) were rye, 1.5 (9%) were hulled barley, 1 (6%) was oats, and 12 (71%) were unidentified. In addition there were five fragments of carbonised hazel nut shell and seeds of the arable weed species fat hen, persicaria and ivy speedwell. Seven seeds could not be identified. Two rye grains could be measured.

Pit House XIV: Six samples representing a total volume of three litres yielded 302 carbonised grains of which 113 (38%) were hulled barley, 44.5 (15%) were rye, 2 (0.6%) were oats, 1 (0.3%) was wheat, and 141.5 (44%) could not be identified. In addition there were 8 rachis segments of rye and 5 unidentified cereal rachis segments. Non-cereal remains included seeds and fruits from a range of weed species: mugwort (*Artemisia vulgaris*), fat hen (*Chenopodium album*), ribwort plantain (*Plantago lanceolata*), knotgrass (*Polygonum aviculare*), black bindweed (*Polygonum convolvulus*), sheep's sorrel (*Rumex acetosella*), and chickweed (*Stellaria media*). Other remains which could not be identified beyond genus level, but which almost certainly represent weedy species, include those of brome (*Bromus* sp), thistle (*Cirsium* sp.), pea family (Leguminosae), bedstraw (*Galium* sp), poppy (*Papaver* sp), dock (*Rumex* sp), and vetch (*Vicia* sp). Two seeds remain unidentified.

Nine rye grains and twenty-five barley grains could be measured.

Oven 473: One sample with a volume of 500 ml yielded 6.8 grammes (c. 700 grains) of carbonised cereal grains. All 700 grains were of rye with the exception of one wheat grain. In addition there were sixteen seeds of other species, including the arable weeds corn-cockle, fat hen, and persicaria and remains of brome and vetch. The sample also contained 1.5 sclerotia of the fungus ergot (*Claviceps* sp).

Fifty randomly selected rye grains from this sample were measured, no barley grains were present.

DISCUSSION

In any interpretation of carbonised plant remains from an archaeological excavation, it is important to remember that the material which is preserved represents only a tiny fraction of the total plant material which has passed through the site during the period of its occupation. These few plant remains have been preserved by contact with fire under special conditions such that they were charred and preserved rather than burnt and destroyed. At Gammel Lejre a large number of samples were taken from many different contexts. Despite the fact that these also represent several phases over a period of c. 200 years, the picture which emerges from each of them with regard to cultivated species is remarkably similar.

The arable economy

The analyses show that the arable economy was firmly based on hulled barley, rye, and to a lesser extent oats. Wheat was apparently of no great significance and other crop species are not represented. There is also a striking lack of imported or exotic species. This is in agreement with what we know from other analyses from this period in Denmark, for example from Ejstrup in Vendsyssel (Robinson & Michaelsen 1989), from Øster Aalum in Thy (Rowley-Conwy 1988), from Kregme in northern Zealand (Robinson & Moltsen 1992), from Trabjerg in western Jutland (Aaby *et al.* 1992) and from later Viking Age sites at Århus, Søndervold (Fredskild 1971), Viborg, St. Skt. Pederstræde (Jensen 1986), and Viborg Søndersø (Robinson *et al.* 1992).

The arable weed flora

Arable weeds are, as the name suggests, plant species which grow in close association with cultivated crop plants. Today the term has mostly negative connotations in that weeds are generally undesirable in a cultivated crop. We have however considerable evidence for the fact that this was not the case in the past and that weed seeds were an important and welcome supplement to the diet particularly in times of shortage (Drury 1984; Robinson 1987). In the Iron Age we even have examples of the intentional collection of weed seeds for food. At Ginderup there was a find of pure corn spurrey (*Spergula arvensis*) (Jessen 1933), at Fjand there was a pottery jar full of fat hen seeds (Helbæk 1954) and from Borremose we have a pure collection of persicaria seeds (Robinson 1992).

With the exception of Pit House XIV, weed seeds are a rarity in the samples from Gammel Lejre. It seems likely that they were harvested along with the crops and are incidental contaminants, rather than being intentionally collected for food. The majority of species present, such as fat hen, ribwort plantain, knot-grass, black bindweed, persicaria, sheep's sorrel, and chickweed are common arable weeds and ruderals with archaeological records extending back to the earliest agricultural societies. Other weed species such as corn-cockle, mugwort, and ivy speedwell became common in later times but were either absent or very rare prior to the Viking period.

Corn-cockle is primarily considered as a weed of rye. It appears first in grain finds from the Roman Iron Age (Jensen 1985) and it was not until the Viking and Early Medieval times that it became an important and despised weed. The seeds of corn-cockle are large (2–3 mm in diameter) and they are covered with sharp spikes, which damage the wall of the digestive tract even though they have been ground. The seeds contain toxic saponins including one specific to the plant called githagenin. Large concentrations of corn-cockle seeds in grain and flour can cause illness and even death. Today this is no longer a problem as corn-cockle is now a very rare plant due to the use of modern agrochemicals.

Mugwort and ivy speedwell are still very common arable and garden weeds. They are not well represented in the archaeological record and these finds from Gammel Lejre are the earliest we have from the area which now constitutes present day Denmark (Jensen 1985).

Ergot

The sample from Oven 473 contained 1.5 sclerotia of the fungus ergot. Ergot is a fungus which infects members of the grass family resulting in the infected spikelets being replaced by long brown or purple-black sclerotia which contain a range of toxic alkaloids. Rye is a favoured host among cereal species and there are many historical records of poisoning resulting from the consumption of contaminated rye grain or flour. The symptoms are loss of blood circulation to the extremities which results in gangrene, accompanied by vivid nightmarish hallucinations. In the Middle Ages the illness was given the name St Anthony's Fire (Bove 1970).

The alkaloid content of individual sclerotia varies enormously, so it is difficult to ascertain how toxic a particular level of contamination is. Contamination of the order of 1% is generally enough to produce symptoms in humans, but prolonged consumption of grain or grain products contaminated with over 5% ergot is necessary before serious poisoning results. The level of contamination in the grain from the oven at Gammel Lejre is very low and falls well within the present day European Community limits laid down for grain harvested in Denmark (Levnedsmiddelstyrelsen 1988). Infection of the rye crop was therefore either very limited or active measures were taken to remove the sclerotia from the grain.

Distribution of plant remains within the site

The results from house IV the Great Hall and from Pit House V are very similar. The samples contain primarily cereal grains, non-grain cereal remains are absent and there are relatively few weed seeds. In the samples from the Great Hall there is an interesting difference between plant assemblages in the east and west ends of the house. In the west end hulled barley and rye are found in almost equal amounts together with relatively few oat grains. In the east end there are virtually equal amounts of all three grain types – hulled barley, rye, and oats. The elevated proportion of oat grains in the east end of the house could possibly be interpreted as evidence for the presence of a byre or stable but this is extremely uncertain. In Medieval times the primary use of oats was for animal (i.e. horse) fodder and throughout the Iron Age and Viking periods it was normal for animal accommodation to be found in the east end of the house.

The sample from the Oven 473 is almost totally comprised of rye grains with only very occasional grains of wheat, weed seeds, and sclerotia of ergot. Non-grain cereal remains are absent. This sample represents processed grain which has been threshed, winnowed, and sieved to remove impurities. It seems probable therefore that it was in the oven for the purposes of being dried prior to grinding in a quern and that an accident led to it becoming charred. Experiments have shown that drying and roasting grain makes grinding considerably easier and gives a product of a much higher quality (Anne Bloch Jørgensen pers. comm.); drying is an absolute necessity if the grain has a moisture content over 20%.

The samples from the floor of Pit House XIV contain a higher concentration of grain than those from Pit House V. They also contain non-grain cereal remains (rachis segments) and weed seeds from a large number of weed species. There is a degree of similarity between the plant assemblage in this pit house and that from the pit house at Ejstrup (Robinson & Michaelsen 1989). The pit houses from Øster Aalum (Rowley-Conwy 1988), Kregme (Robinson & Moltsen 1992), and Århus Søndervold (Fredskild 1971) were found to contain a similar admixture of carbonised grain and weed seeds.

It seems likely that the plant remains in Pit House XIV represent partly-processed grain or grain processing biproducts, in contrast to those from the Great Hall, Pit House V and Oven 473, which comprise processed cleaned grain.

The relative sizes of the rye grains from these structures (table 2) tends to confirm this interpretation in that the rye grains from the Oven and the Great Hall are on average larger than those from Pit House XIV. However one must bear in mind the fact that it was only possible to measure twenty five rye grains from the Great Hall and nine from Pit House XIV and that poor preservation made measurement difficult.

The Oven sample (473), which we know represents prime grain (*sensu* Hillman 1981, 1984), contained grains with the greatest mean size. However grains from the Great Hall were only marginally smaller, suggesting that they too represent prime grain. In contrast, the rye grains from Pit House XIV were considerably smaller, which is consistent with them being tail grain which has been removed from the prime grain by sieving (Hillman 1981, 1984). If we look at the size of the barley grains however, another picture emerges. The barley grains from the Great Hall and from Pit House XIV are almost identical in size, with those from the pit house having marginally the greatest mean size. It is possible that barley and rye were processed and used in different ways at the site.

Rye in the Iron Age and Viking Period in Denmark and a new consideration of the Fyrkat rye

Ever since Helbæk's publication of the Fyrkat grain and his views on the origin and migration of rye in Europe (Helbæk 1977), there has been a great deal of discussion about both the origin of the Fyrkat rye (was it homegrown or imported?) and the introduction and integration of rye into Danish agriculture. Helbæk was of the opinion that, although rye was present as a weed around the time of the birth of Christ, and was of growing importance during the Iron Age, it was not until the Viking period that it became an established, adapted and integrated crop plant. Recent analyses have cast doubt on this view. Well-developed rye grains made up over half the contents of a small pottery cup in a late Roman Iron Age grave at Præstestien near Esbjerg (Robinson & Siemen 1988) and the stomach contents of the Huldremose woman, who dates from the pre-Roman Iron Age, were found to comprise a mixture of rye bran and remains of the cornfield weed corn spurrey (Brothwell *et al.* 1990). It appears that rye was of considerable importance already in the early Iron Age, but this can only be confirmed by further analyses of grain finds from the early Iron Age.

On the question of the Fyrkat rye, Helbæk was categorical "only one thing can be taken as given without further consideration: the Fyrkat rye was not cultivated on Danish soil" (Helbæk 1970, translated by Rowley-Conwy 1988). He thought that it was most probably imported from eastern Europe, perhaps from the Dvina or Dniepr regions. He gave the following reasons:

1. Size: the mean grain size of the Fyrkat rye is considerably greater than that of any other Danish find.
2. Purity: there are very few contaminant grains and weed seeds.

3. Exotic contaminants: the few weed seeds which were present include species not previously recorded from Denmark.

In order to explain the first two of these, size and purity, Helbæk argued that there was a requirement from a high agronomic level with each cereal being cultivated separately, carefully weeded and processed separately. At the same time there must be systematically organised trade in basic commodities with the buyer making demands regarding purity and quality. Helbæk maintains that these requirements could not be met in Viking Age Denmark.

Helbæk's conclusions have been questioned by among others Rowley-Conwy in his publication of the Viking Age grain find from Øster Aalum in northwestern Jutland (Rowley-Conwy 1988). With regard to purity, Rowley-Conwy cites his own work (Rowley-Conwy 1978, 1984) which shows that there was a separate cultivation of barley and various wheat species as early as the Bronze Age. With regard to size, Rowley-Conwy draws attention to the fact that the Fyrkat rye is from a storage deposit whereas other finds, including that from Øster Aalum, with which it is compared, are from scattered waste deposits. He then draws on Hillman's extensive ethnoarchaeobotanical work on crop processing in the Middle East (Hillman 1981, 1984) and concludes that the size difference between the Fyrkat rye and other finds is because the former represents prime grain whereas the latter comprise tail grain which has been removed from the prime grain by sieving. He supports his conclusion by reference to the large rye grains from storage deposits at the Swedish Iron Age site of Vallhagar. These are however

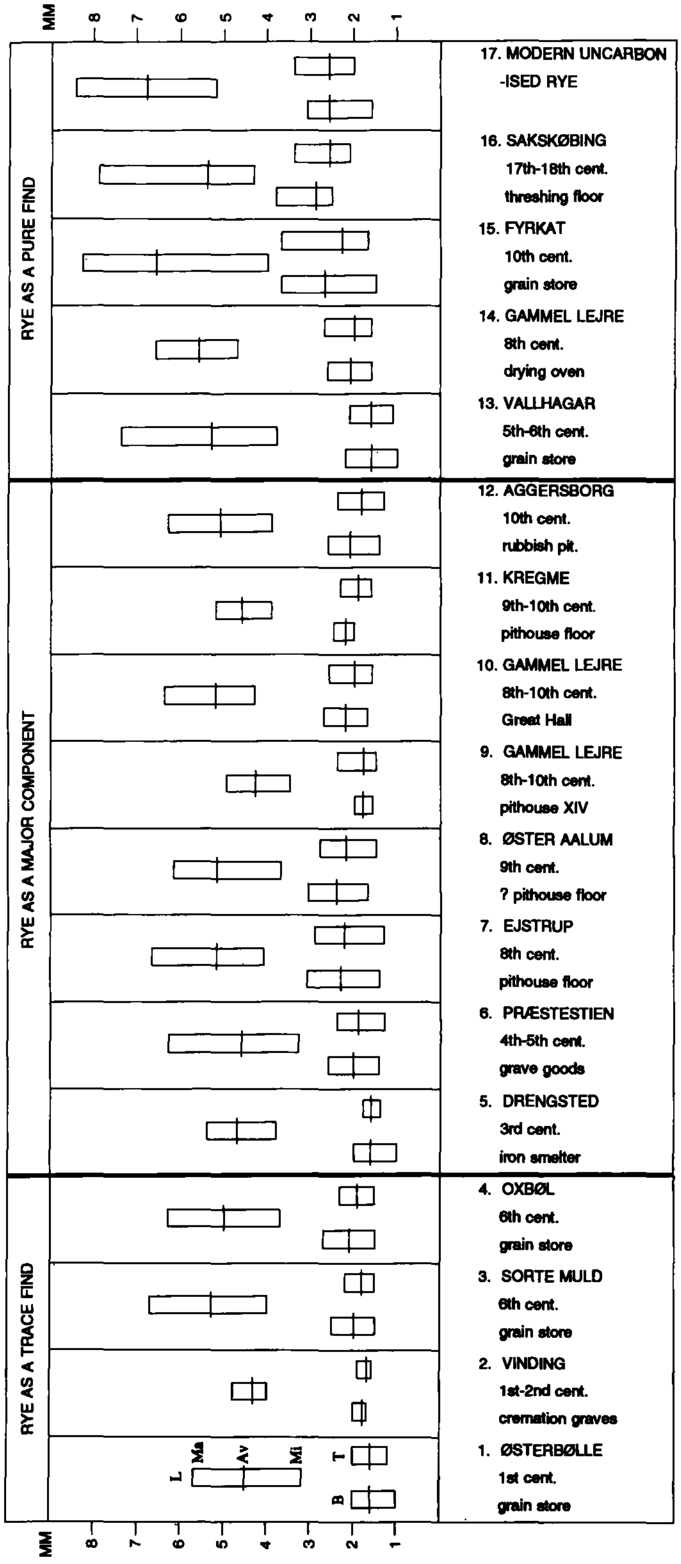

Fig. 1. Measurements of rye grains from Iron Age and Viking Period sites in Denmark. Measurements from Iron Age Vallhagar (Sweden), 17th-18th century Sakskøbing, and modern uncarbonised rye are included for comparison.
Sources:
1,3,4,5,12,15 – Helbæk (1977)
2 – Robinson (1992)
6 – Robinson & Siemen (1988)
7 – Robinson & Michaelsen (1989)
9,10,14 – this publication
11 – Robinson & Moltsen (1992)
13 – Helbæk (1955)
16 – Robinson (1991)
17 – modern rye measured by the author.
Abbreviations: L = Length, B = Breadth, T = Thickness, Ma = Maximum, Mi = Minimum, Av = Average.

still much smaller than the Fyrkat grains. Rowley-Conwy's arguments are quite convincing, but as he admits himself he takes no account of possible changes in the size of rye grains in both space and time. This weakness, he suggests, could be overcome by having examples of both type of deposit from one period at one site. This requirement is *almost* met at Gammel Lejre. We have examples of both prime grain (the Oven) and scattered waste with tail grain (Pit House XIV) but the number of measurable grains from the latter is small and we cannot be sure that the two grain finds are contemporaneous. One thing worth noting however is that the rye from the oven at Gammel Lejre is larger than that from Vallhager, which brings us back to the question of size. There are still no Danish finds which approach the Fyrkat rye in size (fig. 1). The grains are on a par with modern cultivated rye produced with all the advantages of selective breeding, artificial fertilisers, and herbicides. It is size, along with the presence of the so-called exotic species, which remains the strongest argument for the Fyrkat rye having been imported. For this reason alone I must join Helbæk and state that in the light of the evidence, including that which has emerged in the intervening two decades, the Fyrkat rye seems almost certain to have been imported.

SUMMARY

The analyses show that the arable economy at Gammel Lejre was based on hulled barley, rye and oats, the latter possibly serving primarily as animal fodder. Wheat is poorly represented and remains of other crop plants are absent, as are exotic or imported plants.

A range of weed species are represented in the samples but the total number of seeds is not great. This suggests that they were harvested incidentally along with the crop rather than collected intentionally for food.

A comparison of the plant assemblages from the various structures on the site reveal some interesting differences. Samples from House IV (Great Hall) and Pit House V appear to represent processed grain; non-grain cereal remains are absent and weed seeds are rare. The east end of House IV has an elevated oat content relative to the west end. This could possibly be seen as evidence for a stable, but this is very uncertain. Samples from the floor of Pit House XIV contain a higher concentration of plant remains than those from House IV and Pit House V. They also contain non-grain cereal remains (rachis segments) and a relatively large number of weed seeds. This, along with the relatively small average size of the grains, suggests the presence of tail grain – a processing biproduct (Robinson & Boldsen 1991).

The grain sample from the oven has obviously been processed and carefully cleaned; a very few weed seeds and sclerotia of ergot were the only contaminants. It seems likely that the grain was in the oven for the purposes of being dried prior to grinding on a quern, as drying greatly increases the ease of milling and the quality of the end product.

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Debate

The Danish Single Grave Culture – Ethnic Migration or Social Construction?

by CHARLOTTE DAMM

In a recent article Kristian Kristiansen argues that the Single Grave Culture in Jutland "represents a classic example of a migrating, tribal people, settling within a very short period of time in a new, sparsely populated environment" (Kristiansen 1991:214). "The burden of falsification", he continues, "now lies on the shoulders of supporters of the autonomous hypothesis" (ibid.).

As most other archaeological hypotheses the suggested migration of a Single Grave people can never be falsified nor confirmed (Olsen 1987; Wylie 1982). We will never know whether the emergence of the Single Grave Culture was caused primarily by immigration or by local developments. Some hypotheses are, however, more plausible than others, and Kristiansen's challenge should not go unanswered.

THE MIGRATION HYPOTHESIS

In his introduction Kristiansen (1991:212) presents some premises for any study of migrations or, I suppose, any study of cultural change. First of all any such study should be contextualized, culturally and structurally. Secondly, it must take into account the history preceding the event in question, and, finally, the reasons for any migration have to be explained within a broader framework. I agree whole-heartedly with these premises, but feel that Kristiansen to a certain extent has failed to follow the suggested guidelines himself. Towards the end of this paper I will comment on this in more detail.

Kristiansen offers five arguments in support of the migration hypothesis (1991:212). The presentation of these arguments, or rather of the interpretations of the archaeological data that these arguments represent, reveals Kristiansen as relying on the culture historical tradition as employed by for instance P. V. Glob and C. J. Becker. Let me briefly review and comment on the five points.

1. *The Single Grave Culture appears at once and fully developed.* This is of course in line with the traditional view that culture must develop gradually and according to typological rules. Abrupt geographical or chronological discontinuity in the typological development is consequently interpreted as representing a border between two cultures, possibly a migration.

2. *The two cultures (the resident Funnel Beaker Culture (hereafter: TRB) and the immigrating Single Grave Culture) are mutually exclusive in the earliest phase.* The validity of this argument may in fact be questioned. Rostholm's investigations in central Jutland are resulting in the discovery of an increasing number of late TRB sites in the main habitation areas of Single Grave Culture (Rostholm 1982). Jørgensen (1985) has demonstrated that in the Vroue area most early single graves are located only a few kilometres from the TRB burial sites. Nevertheless I will accept that the settlement distributions differ between the two groups.

3. *In the few exceptional cases where geographical overlap do occur the TRB comes to a complete stop and is replaced by the Single Grave Culture.* This argument is theoretically in line with the first argument: Kristiansen does not accept abrupt typological or geographical change within a culture (although he does accept geographical movement over longer distances, these being termed migrations).

4. *There are no traces or indications of contact between the Single Grave Culture in central Jutland and the TRB groups still existing in eastern Denmark.* Material differentiation is taken as evidence for isolation and/or hostility between groups. This again is one of the main theses in the culture historical tradition (Lüning 1972).

5. *The subsequent stages of the period suggest a slowed down but continuing migration of the Single Grave people into eastern Denmark.* This is based on the fact that typologically late battle axes and Single Grave pottery are found more widely in Denmark. Kristiansen does not consider the possibility of gradual adoption of new types by the TRB groups. Apparently he believes that types developed in one group can not be incorporated in other groups, this suggesting some kind of cultural or technological barrier between different groups preventing such interaction.

It is of course perfectly valid to rely on the theories within the culture historical approach. Kristiansen's paper, however, is written to initiate a debate on "the geographical movement of social groups" (1991:210) within what he terms modern archaeology in contrast to traditional archaeology, and he does open his paper with a critique of this. It is therefore somewhat disappointing not to be presented with any new arguments in favour of the migration hypothesis, nor with a new approach, theoretically or methodologically, to the material in the case study.

It is to Kristiansen's credit that he opens up the debate about migrations, their identification and complexity. We need discussions and analyses of such events. Nevertheless investigations of complex problems in prehistory demand an understanding of archaeological cultures and of material culture that goes beyond that of the culture historical interpretations.

Furthermore, just as the autonomous hypothesis as presented by Kristiansen leaves many questions open, there are a number of points which are not considered in the migration hypothesis. It does not explain why the migration into central Jutland was not more strongly resisted by the existing population or why the later continuous expansion was possible. Why did the Single Grave people settle in the immediate vicinity of the TRB (as at Vroue)? What happened to the TRB people whose settlements in central Jutland came "to a complete stop"? Where did all these people come from? And why did they migrate?

THE SOCIAL CONSTRUCTION OF AN ETHNIC GROUP

As I admit to be a supporter of "the autonomous hypothesis" rather than of a migration theory I will, in response to Kristiansen's challenge cited earlier, propose a model that in my opinion accounts for the observed material changes at the transition from the TRB to the Single Grave Culture no less convincingly than Kristiansen's argument. It is not possible here to present a very detailed argument (see Damm 1991b), so I will confine myself to a more summary argumentation without detailed references to finds.

To summarize my hypothesis I suggest that the material which we associate with a Single Grave Culture is the result of local development and the construction of a distinct ethnic group, whose primary goal is social and symbolic differentiation from the TRB. This division of the TRB into two distinct ethnic groups, one in western and central Jutland and the other in eastern Denmark, originates further back in the Middle Neolithic TRB, most clearly seen in the development of two different burial customs (Damm 1991a). The underlying structure associated with the social and material patterns becomes increasingly different in the two regions. In Jutland this ultimately leads to a complete break with the traditional TRB society, while the structure in eastern Denmark is incompatible with the trends (Single Grave/Corded Ware Cultures) coming to dominate the rest of northwestern Europe. As noted also by Kristiansen these differing structures persist until Early Bronze Age. In the following I will briefly comment on some of the most important points.

EMERGING DIFFERENTIATION

At the transition from the Early to the Middle Neolithic in Denmark the number of people receiving burial in monumental graves diminished drastically. There is general agreement that the Early Neolithic society was most likely a competitive segmentary tribal society (Gebauer 1988; Kristiansen 1982, 1984; Sjögren 1986; Tilley 1984) with relatively open access to high status which was demonstrated in the burials. The many dolmens and earthen graves show that a large number of persons were receiving a conspicuous burial.

There is notably fewer of the larger passage graves constructed in the early Middle Neolithic. Offerings of pottery outside these took place only two or three times during the first century or two after the construction of the tomb (Gebauer 1979; Madsen 1988) indicating that burials in the passage graves were seldom. In other words multiple burials did not make up for the smaller number of tombs. Simultaneously the size of the settlements grew (Madsen 1982; Skaarup 1985). Taken together the size of the passage graves, the size of the settlements and the fewer persons being buried in the spectacular megalithic tombs suggest that with the early Middle Neolithic less persons were acquiring more power and influence, probably legitimized through the megalithic tombs (Damm 1991a; Tilley 1984).

I consider it unlikely that the rather large group of people who were deprived of their access to status, demonstrated in megalithic burial, silently accepted this. I suggest that the dissatisfaction with the existing social order was solved differently in eastern and western Denmark.

In eastern Denmark the solution was to allow a larger number of persons (men, women, and children) to be interred in the megalithic tombs. Later the excarnated bones were sorted and placed in piles along the walls of the chamber. Each pile consisted of bones from several individuals. Some piles had limb bones at the bottom, then smaller bones such as ribs, while the skulls were put on top. In other tombs long bones were placed in one pile, shoulder-blades in another etc. The effect of this was the elimination of the individual and a strengthening of the collective (Shanks & Tilley 1982). From being the tombs of a very few leading persons, the megalithic tombs now became the burial place for leading families.

In western Denmark a different solution was chosen. In MN A II–III the first stone packing graves emerge (Becker 1967). These sets of usually two parallel graves and one mortuary house are arranged in long rows. No skeletal remains are preserved from any stone packing grave, but phosphate analyses from Øster Tørslev (Stidsing 1989) indicate that at least the final resting place for the dead was in the so-called graves, while the grave goods were placed separately in the mortuary house.

So instead of letting more people be buried inside the megalithic tombs, a number of persons were buried in individual graves, at times immediately adjacent to megalithic tombs (*e.g.* Vroue), at other times perhaps some distance from these. The idea here was probably to let more people receive a formal burial in the vicinity of the megalithic burial ground, letting some of the associated status of the latter shine on the graves outside. This, however, had a very different effect than the collective burials in megalithic tombs in eastern Denmark. While the latter emphasized the collective and the group as an indivisible whole, the stone packing graves made it possible to focus on the individual, and created a contrast between those buried in megalithic tombs and those buried in stone packing graves.

The two grave-types became catalysts for two very different structures. At the time of construction the megalithic tomb was probably meant to glorify the lineage. Through time it became the place where the ancestors were buried. The increasing number of persons being buried in megalithic tombs resulted in a pooling of ancestors at the tombs, which probably increased the ancestral power and consequently the naturalizing and legitimizing effect, thus continuously emphasizing the collective as well as the status of the families being buried there. This left little room for the individual and reduced potential conflicts.

In contrast to this the division between those buried in megalithic tombs and those who were not became even more conspicuous with the appearance of the stone packing graves. The more stone packing graves the clearer was the difference, and the clearer it became that those buried outside represented a larger part of the social group. The number of stone packing graves accelerated during the last phases of the TRB. The majority of the graves date from the final period, MN A V.

It must be assumed that this increasing focus on the individual, which was partly due to the stone packing graves, was accompanied by similar developments in other social relations. At several sites ox teeth have been found on the edge of the graves in the stone packing grave sets (Becker 1960; Stidsing 1989), indicating that ox heads were placed here. This suggests that cattle were important in ritual as well as social contexts. An increasing emphasis on husbandry may well have been associated also with change in the dominant economic relations. In contrast to simple agriculture, husbandry is often associated with individual ownership (Håland 1985:105). The megalithic tombs were used alongside the stone packing graves. The result may well have been a situation where one group in society based its power on authoritative resources, e.g. control of esoteric and ritual knowledge, while another groups attempted to achieve power and influence through allocative resources such as cattle.

ESTABLISHING THE SINGLE GRAVE CULTURE

During the Middle Neolithic TRB two different structures had been established, one in eastern and one in western Denmark. From being two different solutions to a social conflict the burial customs came to act as catalysts for constantly accelerating developments moving in opposite directions. In western Denmark the group represented by stone packing graves came to stand in still greater contrast to the group receiving burial in the megalithic tombs. At some point this opposition grew so distinct that the stone packing grave group in the existing society broke away and established itself as a new and independent ethnic group.

During the late TRB the contradiction between the stone packing grave group and the group associated with the megalithic tombs grew and probably resulted in the two actually perceiving themselves as different in some respects. The notion of ethnic identity involve attaching significance to perceived differences between people as well as to sensed affinities among them (Bentley 1987:34). Bentley notes that ethnic mobilization is often related to political and economic change and to change in systems of domination (ibid.:43). Ethnic movements may represent "attempts to institute new regimes adapted to changing political and economic circumstances". "Even where change occurs over many generations, it erodes this integration (of preconscious assumptions about the world) as it produces people who are disposed to perceive the world differently and so, in a phenomenological sense, live in different worlds" (ibid.: 44). Thus the emergence of a new ethnic group was not simply the strategic choice of a group of people who saw personal advantages in this. The structural basis for it had developed from the material existence of two burial types. This material division in itself created or emphasized social and emotional perceptions of distinction, all of which contributed to the development of a irreversible situation.

It was of course of primary importance for this new group to distinguish themselves from the traditional TRB society. It is therefore not surprising that the two groups are associated with very different material culture. Ethnic distinction is dependent on a "them and us" dichotomy. Ethnicity does not develop in isolation, but is a social construction arising from relations between groups, in this case a desire to differentiate from each other and therefore to stress differences. This explains why the material culture of the Single Grave Culture differs significantly from that of the TRB.

Thus when battle axes became a central symbol for the Single Grave group, battle axes, a not uncommon type in the late TRB society, disappeared completely in eastern Denmark. Instead there was an increased emphasis on well polished flint axes of type B in this region. In the Single Grave area flint axes were still common, but there was less emphasis on their manufacture, and perhaps the access to good quality flint was complicated by the break with the TRB. (The better sources for senonian flint are all located in northeastern Jutland or eastern Denmark, outside the primary territory of the Single Grave group). These examples demonstrate that important changes were taking place in the symbolic system.

Some stone packing graves were apparently still constructed during the early Single Grave period (Damm 1990). To me this only emphasizes that we should not view prehistory as made up of neat boxes. Also prehistoric people experimented or deviated from the majority. It also suggests one reason for seeking territories that did not conflict with the existing TRB areas. Although strongly diminished some TRB-groups in Jutland persisted for a while yet. The new groups therefore settled partly in neighbouring, but well-known areas (as at Vroue), partly perhaps in the less densely settled regions of central Jutland, which, if the theory of greater emphasis on husbandry and barley holds true, were indeed very well suited for this economic system, as the lighter soils of central Jutland made good grazing land and could support the less demanding barley.

THE ART OF "BRICOLAGE"

The characteristic material that constitutes what we term the Single Grave Culture is, as all agree, not primarily of local origin. The set of types that make up the pan-european horizon consists of battle axe, corded beaker, and amphora. Characteristic is of course also the individual graves with the dead placed in "hocker". The widespread distribution of this set of elements has been one of the main arguments employed by those favouring migration, and is rarely mentioned by the autonomists other than as representing fashions. It is, however, evident that the pan-european elements are not evenly represented in all regions where the Corded Ware/ Single Grave/Battle Axe Cultures appear. Amphoras are rare in both Denmark and Holland, while they are numerous in Central Germany. The early battle axes are on the other hand particularly common in Denmark, and only here do they constitute a clear chronological horizon. Also the burial custom differs somewhat between regions. In all areas individual inhumation graves dominate, but they may be orientated east-west or north-south, may be flat graves or covered by mounds and may or may not include children's graves. There are few circle graves or ring ditches in Central Germany, instead stone cists are numerous. Crypt graves are known from Poland. The hocker position is common to all groups, but may be more or less extreme. In fact the diversity in combinations of elements is remarkable.

It has not been possible for the migrationists to establish the area of origin or the mother culture precisely because the prototypes for all these elements are nowhere found together. The regional diversity is usually explained as the result of rapid adaption to local conditions (Kristiansen 1991:215). I will instead suggest that the similarities across the North European lowland is the result of widespread processes of bricolage and mutual borrowing between groups.

It appears to me as if processes of differentiation similar to those in Jutland were in progress several other places in Europe. Investigations of the period contemporary with the latest TRB in Denmark reveal, for example, that in Holland some late Havelte settlements are found in earlier apparently uninhabited areas, and individual burials become increasingly common during the Havelte period (Bakker & van der Waals 1973; Fokkens 1982). In Central Germany single graves with the dead in hocker position appear on the periphery of the distribution of the Bernburg Culture, in fact in the Nordharz region where also the earliest Corded Ware is found. Also in the Globular Amphora Culture in Central and Northern Germany there are examples of single graves and hocker position.

It is inconceivable that the various groups in Northern Europe did not have mutual contact. Rather than assuming a migration from the Eastern European steppes I consider it likely that a break with the existing society in one of these groups lead to general uprising and the emergence of a new social and material order in large parts of the North European lowland. When creating their new ethnic identity these groups partly built on important existing symbols and partly borrowed from other groups with similar structures and ideas.

"Bricolage" is french for the act of using and adapting existing elements in a fresh manner (Tilley 1990:27). The term was introduced to the social sciences by Levi-Strauss in "The Savage Mind" (1966) and originally refers to a sort of handy-man, who uses whatever is at hand to achieve a given end. The objects employed may not be directly related to the purpose for which they are used.

I suggest that the Single Grave/Corded Ware groups when establishing their new ethnic identity used bits and pieces from existing symbolic structures in a process of bricolage. Basically no new elements were introduced: but elements from a wide geographical area were combined in a new way. The new symbols partly referred to the old structure in the local region and partly introduced new symbols, which on the one hand demonstrated the opposition to the traditional system and at the same time stressed connections and solidarity with other groups.

Thus, as the curved beaker is earlier in Holland than anywhere else (Lanting & Mook 1977) it probably originated there, while it is natural to assume that the origin of the amphora lies in Central Germany in the Globular Amphora Culture. The use of the battle axe as a symbol in the Corded Ware/Single Grave Culture may originate in the Danish region. The battle axe was clearly an important symbol in the TRB culture. In the late TRB it is found in increasing numbers in megalithic graves as well as in stone packing graves. It is my assumption that the axe was related to the symbolic marking of leading persons in society, and that its presence also in stone packing graves indicates that persons in this subgroup of society were becoming more influential and powerful. This would again provide additional understanding for why and how it was possible for part of society to break with the existing society and establish itself as a new ethnic group.

ADAPTING TO NEW TRENDS

The structure in eastern Denmark was, with its emphasis on the collective, incompatible with the general trend where the individual played a more prominent role. Things were, however, not as before. It was not only imperative to relate to new ethnic groups, the Single Grave/Corded Ware groups, but in addition developments were taking place on another front. We understand very little of what the Pitted Ware material in Denmark represents. One thing, however, is clear: it was becoming influential in the late TRB and its presence is undeniable in early MN B, contemporary with the early Single Grave Culture. Either the Pitted Ware material represents a third ethnic group that was in close contact with the Danish TRB, or it indicates developments within the TRB. In any case the TRB was of course not a static society, nor did it develop in a vacuum.

It seems as if processes of bricolage started also in eastern Denmark, although they proceeded with varying success. Certainly in the second half of MN B elements from the Single Grave Culture is found more widely in Denmark, and the Single Grave Culture itself was also modified.

Many of the elements that most distinctly differentiated the Single Grave Culture from the TRB disappear. There are no longer any amphoras, no ring ditches or circles graves and the hocker is gradually replaced by the ordinary stretched position. Although there are still strong similarities between the various Single Grave/Corded Ware groups these are less conspicuous than in the establishing phase. On the other hand the distinctions between eastern and western Denmark are reduced.

In northwestern Jutland, most notably Himmerland, new and old structural principles are combined with great virtuosity. Here there are single graves in mounds, but also newly constructed stone cists in which successive burials took place. In contrast to the excarnation of megalithic tombs, these are ordinary inhumations. Battle axes and beakers are usual. Some are identical to those found in Single Graves, while others are primarily of types intermediate between axes/beakers of central Jutland and the Danish islands. Tanged arrowheads from the Pitted Ware group are also incorporated.

On Funen and Zealand there are but a few stone cists. Otherwise burials continue in the megalithic tombs. Battle axes and beakers are now appearing, although of slightly different types than those in Jutland. The number of axes and beakers is however still rather insignificant, and suggests that the adoption of these objects was never a success.

It would appear that northern Jutland, although lingering behind central Jutland, nevertheless was sympathetic to the development. It should be remembered that stone packing graves are known from numerous sites in the region, and also that several of the stone packing graves that must be contemporary with the earliest Single Graves (with objects such as type B flint axes or Pitted Ware arrowheads) are found here on the periphery of the Single Grave area. Thus the groups in this area had participated in the development that ultimately lead to the emergence of the new social and ethnic identity. For some reason they did not go along with this immediately, but only shortly afterwards constructed an associated and partly parallel phenomena.

This was not the case on the islands. This was the stronghold of the original TRB society. The B flint axes bear witness that the TRB society did not disintegrate, but otherwise the groups persisting on the islands are materially very inconspicuous. The tanged arrowheads typical of the Pitted Ware group are rather common in megalithic tombs in the northern regions. It may be assumed that these demonstrate a more profound integration of marine hunting (and possibly fishing) and what social effects this may have had, but we can not exclude the possibility that they are instead evidence of the presence of a third group, the Pitted Ware Culture, in the region. Whatever the case, it would appear that the traditional authoritative system could not be maintained. On the other hand it could not simply be substituted by the Single Grave Culture, which was structurally incompatible with existing and deeply embedded principles, as in fact it had emerged and been constructed as an opposition to the TRB.

EVALUATING REMARKS

Let me now return to the premises Kristiansen laid down for studies of cultural change/migration. Starting with Kristiansen's final point he calls for explanations for any migration, rather than letting migration be an explanation in itself. With regard to the Single Grave/Corded Ware Culture this is not possible at the moment, as the origin of the migration can not been determined. This of course weakens the hypothesis. Kristiansen appears to favour a Central European origin with Kurgan influences (1991:215), and later suggests that social and economic constraints caused the full scale movement of these social groups (ibid.:219), although he does not describe or analyze these.

As his second premise Kristiansen reminds us to take into account the history preceding the proposed migration. In his own case study this is unfortunately done only by general comparisons between the TRB and the Single Grave Culture (predominantly through the five points described earlier). No attempts are made at a more detailed analysis of the developments leading up the transition to the Single Grave Culture.

Finally Kristiansen stresses that migrations should be contextualized, culturally and structurally. Of course Kristiansen does briefly summarize typological similarities and other cultural elements of relevance, but in my opinion not sufficiently to say that the Single Grave/Corded Ware cultures are contextualized culturally. He does not appear to consider structural contexts at all, no matter how you interpret the word "structure".

With regard to both of the last two premises I feel that Kristiansen has not thoroughly considered the nature and the cultural and structural contexts of the TRB, nor of the Single Grave/Corded Ware cultures. He has not fulfilled his own premises. The hypothesis of the Single Grave Culture as a migrating social group fails to convince me, not least because these points were not developed further in the case study.

In my own interpretation of the transition from the TRB to the Single Grave Culture, the period preceding the actual transition is of primary importance for the understanding of the events. The whole argument builds on the concept of structural change and structural incompatibility, and the role played by various cultural elements is emphasized in the discussion. I have thus followed the premises set by Kristiansen.

I have not proved that the Single Grave Culture was the result of an autonomous local development. I have, however, demonstrated that such a hypothesis is at least as plausible as a migration theory.

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From MN A to MN B – A South Swedish Perspective

by LARS LARSSON

The paper by Kristian Kristiansen in volume 8 of this journal is to be appreciated as an inspiring but also provocating contribution to the discussion about the diffusion of the Battle Axe Culture in Northern Europe (Kristiansen 1991). My own interest in the matter is rooted in the problems concerning the final Funnel Beaker Culture and its relation to the Battle Axe Culture in Scania, South Sweden, which is a more limited perspective, concerning a shorter period of time, than the process dealt with by Kristiansen.

The way in which Kristiansen refers to the conditions in South Scandinavia, such as the duality of the Funnel Beaker and Battle Axe cultures, or the relation between the Middle Neolithic (MN) A and B, following Nielsen's terminology (Nielsen 1979), gives a far too simplistic picture of the social conditions during the period in question.

A find assemblage of a special character was found at the causewayed enclosure at Stävie in western Scania, the first site of this type discovered in Sweden (Larsson 1982). Clearly the shapes and decoration of the pottery from Stävie was closely related with the pottery of the final period of the Funnel Beaker Culture according to Danish chronology, the MN V (Davidsen 1978). This stage had not previously been documented in the Swedish material (Nielsen 1979:57; Davidsen 1978). However, working with the publication about Stävie it became clear, that elements characteristic of the MN V were relatively well represented in Scania, and the same was found during subsequent studies. Identification of such find assemblages allows us to view the latest phase of the Funnel Beaker Culture in a new perspective (Larsson 1982, 1986, 1992). It also turned out that the flint tools and the flint technique observed at Stävie were related not with the Funnel Beaker Culture but with the Pitted Ware Culture. We are thus facing a find complex composed of a Funnel Beaker pottery tradition and a Pitted Ware flint technology.

THE CHRONOLOGICAL RELATIONS

The various material cultures in existence during the Middle Neolithic of southern Sweden – the Funnel Beaker Culture (TBK), the Pitted Ware Culture (GRK), and the Battle Axe Culture (SYK) – should be subjected to a differentiated analysis with regard to a number of factors as proposed by Kristiansen (1991). Aspects such as the chronology, the utilization of the landscape, and the ideological foundation of society should thereby be taken into account. Besides, it is not fruitful to regard South Scandinavia as a culturally homogeneous area. A study of the relationships between the three aforementioned cultural types is thus synonymous with a study of the structure of not only one but several complex societies.

As to chronology, Danish material places MN V within the period 2340–2160 bc (2910–2620 BC),[1] with a mean value of 2270 bc (2890–2790 BC) (Malmros & Tauber 1977:81; Davidsen 1978:170; Tauber 1986, Table 1). This value can be compared with the mean value of 2180 bc (2860–2630 BC) for the Scanian sites with elements of MN V character. This difference may indicate that typical elements for MN V existed in Scania for a somewhat longer period than on East Zealand. In addition they are present at sites whose material composition differs noticeably from that encountered in the Danish TBK. West Denmark also contains similar examples of elements from the late TBK assimilated by GRK (Rasmussen 1984:97, 1991). Datings from sites with a mixture of elements such as Kainsbakke, East Jutland, have produced values between 2370 bc (2920 BC) and 2000 bc (2500–2470 BC), with a mean value of 2175 bc (2860–2620 BC) (Rasmussen 1991:17–18).

The Swedish datings from the SYK all originate from features which have been dated to the late part of the culture (Larsson & Larsson 1991; L. Larsson 1992). A variation in dates between 2060 bc (2570–2500 BC) and 1860 bc (2290–2210 BC) gives a mean value of 1980 bc (2460 BC). It is clear from this that the late SYK was contemporaneous with the late EGK which is dated to c. 2000 bc (2500–2470 BC). In spite of a rather greater range of variation for the Scanian datings, these cannot be used in support of a claim to the effect that the SYK was in existence for a longer period in relation to the EGK.

The early EGK has produced radiometrical values with a range of variation between 2290 bc (2900–2790 BC) and 2040 bc (2560–2500 BC), with a mean value of 2170 bc (2860–2620 BC) (Malmros & Tauber 1977: 91; Tauber 1986, Table 1). In his detailed study of the SYK, Malmer states that the early phase was shorter, but hardly very much shorter, than the late phase, basing his argument on the find material (Malmer 1962: Abb. 33). From this it follows that the SYK was introduced at about the same time as the EGK in Denmark.

The relationship in southern Sweden between the early SYK and the late TBK, or to elements belonging to it, is more uncertain. The Scanian datings of the latter culture produce the mean value of 2180 bc (2860–2630 BC) – a value which agrees more closely with the early EGK – 2170 bc (2860–2620 BC) – than with the final phase of the TBK in Denmark, with a mean walue of 2270 bc (2890–2790 BC). This is a good support for assuming that the late TBK in the south of Sweden existed at the same time as the early SYK.

THE CULTURAL RELATIONS

With regard to the relationship between the TBK and the GRK, the results of a number of investigations have been published in recent years which to a certain extent change

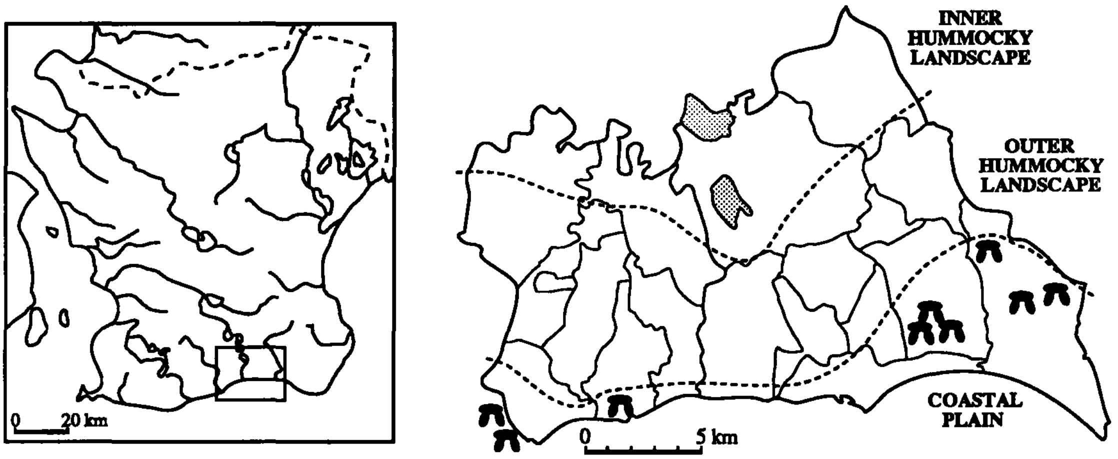

Fig. 1. Map of southernmost Sweden, marking the research area (left) and the project area subdivided into three zones (right) combined with the distribution of megalithic tombs.

our view of these two cultural phenomena. An interest is now being shown in what characterizes these two cultures (Welinder 1978; Nielsen 1979; Becker 1982; Wyszomirska 1984). This mainly concerns the question of what is to be designated as characteristic of the GRK. This culture, like the TBK, does not exhibit a comparatively uniform combination of artefacts and style. The additional existence of a noticeable difference, not only in the material culture, but also in the economy, has proved to be associated with considerable problems of interpretation (Browall 1986:28 ff.). Certain areas are completely dominated by hunting, fishing, and gathering, whilst animal husbandry and arable farming are well represented in other areas.

Clear indications of a mixture of elements from both the TBK and the GRK have been documented in the area of southernmost Sweden (Larsson 1982, 1985; Rasmussen 1984:83 ff.; Strömberg 1988). The organic finds indicate a mixed economy, with animal husbandry and arable farming being supplemented by hunting and fishing. This agrees well with the utilization of the resources of the landscape during the final phase of the Danish TBK (Davidsen 1978:140 ff.). This is a feature which is not known to be associated with earlier phases of the Middle Neolithic TBK.

The reasons for this mixed economy are not entirely clear. The explanation which can be considered the most plausible is that the controlling factors which society was unable to influence contributed to the change. A deterioration in the climate, for example, may have resulted in the increased utilization of those natural resources which were available on land and in the water. Another reason could be that to derive ones livelihood from hunting and fishing became socially acceptable in a way it had not previously been. Control mechanisms of a social nature can have a significant influence on the choice of food and the way it was supplied and shared by the people.

In certain parts of southern Scandinavia, therefore, it is not possible to speak of clearly identified material cultural units. The finds instead point towards a cultural assimilation between the existing TBK settlement and an expanding GRK. This cultural assimilation may have been encouraged by the fact that the two cultures appear to share a common origin. Therefore, the fusion of these population groups was facilitated by a common basic approach to society. Furthermore, the regional characteristics of the GRK indicate that its structure was such as to permit new elements to be readily accepted.

The problem is how the SYK is to be related to this acculturation. An examination of the situation in central Sweden fails to reveal any cultural assimilation tendencies between the GRK and the SYK during the late Middle Neolithic (Welinder 1978:109 f.), neither would such assimilation have happened between the EGK and the coeval complex in eastern Jutland with elements mainly of the GRK (Rasmussen 1985:97).

At the same time it is difficult in the south Scandinavian SYK complexes to identify any tradition from the TBK which might reasonably be expected to have existed in the event of a linear change from the late TBK to the early SYK. It is also very important to pay attention to the study of relationships, not so much from a supraregional south Scandinavian perspective, but rather as they relate to a number of regions, in order better to appreciate the cultural and economic relationships as well as the ideological ones.

Approximately at the same time the south Swedish TBK was under influence from two spheres: One is represented by the GRK and led to a considerable assimilation process. The other influence was caused by the SYK and does not seem to have had any impact on the communities of the TBK tradition, neither did it affect the GRK tradition. The alternatives seem to have been either to continue the existence or to perish.

The combination of elements from the TBK and the GRK which has already been identified, referred to here as the Stävie Group (Larsson 1982), may have continued to exist for a period which also includes that of the early SYK.

Although the finds dating from the SYK are comparatively sparse in terms of ecological facts (Møhl 1962), there is no clear evidence to suggest the existence of any major difference between the forms of occupation of the SYK and those of the Stävie Group (Hjelmquist 1982, 1985; Persson 1982). Settlement material from this phase indicates the cultivation of both wheat and barley. As has previously been pointed out, on the other hand, significant differences may have existed in the social organization – a factor which may have had major consequences for relations between the societies.

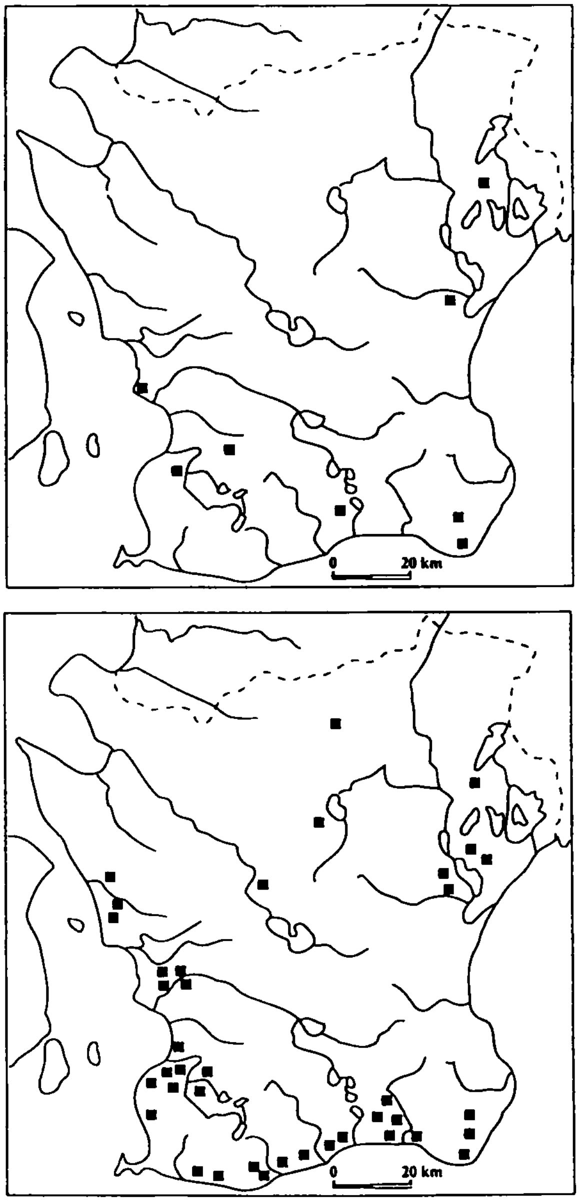

Fig. 2. Scania, with the distribution of graves from the early (top) and the late (bottom) Battle Axe Culture.

A CASE STUDY

Investigations concerning the change from MN A to MN B have been carried out and were further developed during the research program, *The Cultural Landscape during 6000 years. A multidisciplinary study on Man and his environment in southernmost Sweden.* The aim of the project, generally named *the Ystad Project*, was to study changes in the cultural landscape over a long period within an area in southern Scania (Larsson 1985, 1992) which involves a 25 km long coastal area with a width of about 20 km north-south.

The Ystad area can be divided geologically into three zones (fig. 1). The zone closest to the coast consists of a coastal, sandy plain. The coastal plain is of varying width within the project area with the greatest width at about 3 km. Behind this plain the terrain becomes an undulating landscape – a hummocky landscape. This can be divided into two different zones: The zone nearest the coastal plain is dominated by heavy clay soils – this is the outer hummocky landscape. The inner hummocky landscape has a large expanse of gravelly and sandy, and consequently less productive, moraines.

The settlement in the area during the Early Neolithic and the first half of the Middle Neolithic has been subjected to intensive research (Larsson & Larsson 1991; M. Larsson 1992). As a result, a number of settlement concentrations can be identified which in most cases coincide with the location of the megalithic graves in the coastal zone (fig. 1). A continuity of settlement, in the shape of settlement sites of a scale rarely exceeding 1000 sq.m., can be followed from a late part of the Early Neolithic until Period III of the Middle Neolithic TBK. Occupations corresponding to Danish MN IV–V do occur but in reduced numbers. These sites appear to have been of limited extent and were probably widely distributed both within the coastal strip and into the outer hummocky zone. This theory is supported not least by the presence of considerable numbers of late thick-butted flint axes.

Although the number of sites confirmed to belong to the Stävie Group has increased noticeably in recent years, traces of settlement dating from an early part of the SYK are entirely lacking (Strömberg 1989). One of the important tasks of the Ystad Project therefore became to find settlements belonging to the SYK. By means of investigations in the Ystad area we have been able to find evidence of a number of sites. Those situated in the hummocky zone were, in the same manner as other Stone Age sites in this area, erased by agricultural activity to such a degree, that neither occupation layers nor features were preserved. The only surviving evidence was a flint material which does not permit

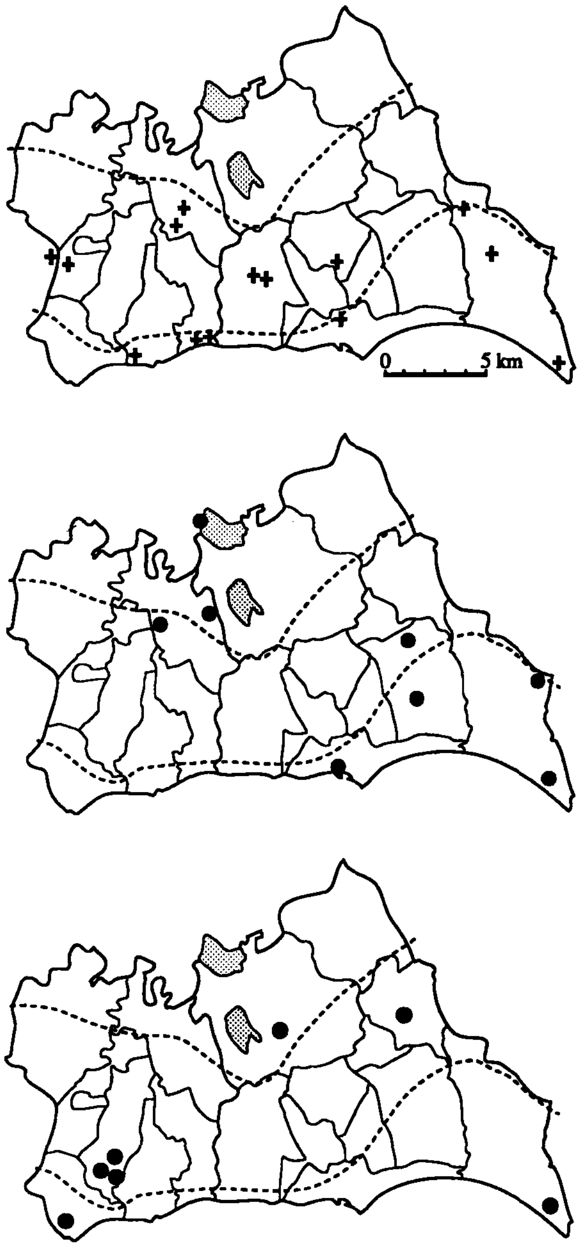

Fig. 3. Graves (top), sites (middle), and hoards (bottom) from the Battle Axe Culture in the project area.

any precise date. In the coastal zone where the destruction caused by ploughing is not so bad, a settlement from the late SYK with the remains of a house-site was investigated (Larsson 1989). This settlement had many points of resemblance with the remains of settlements from the late EGK (Hvass 1977; L. Larsson 1992).

For the purpose of examining the SYK from a point of view which takes in both its older and more recent phases, the graves are still the only adequate basis for the study of the distribution of the settlements.

As previously proposed by Malmer, the graves are concentrated on the best soils in the coastal regions of Scania (Malmer 1962). If the situation is examined in greater detail, however, in terms of both time and space, clear differences in distribution can be observed. The graves from an early part of the SYK are distributed in the innermost parts of the areas with the best soil, which corresponds to the hummocky landscape (fig. 2). During the late SYK, however, the majority of graves are situated in areas near the coast (fig. 2).

As far as the Ystad area is concerned, the graves are distributed both in the hummocky landscape and in the area near the coast (fig. 3). It should be emphasized that the graves in the hummocky landscape tend to be older than those in the coastal zone. The former have a markedly monumental location in opposition to those situated near the coast. In the hummocky landscape SYK graves are sometimes situated in the same positions as the burial mounds of the Bronze Age. The explanation can be that the grave as a symbol of society was given more emphasis during the earlier part than during the later part of the SYK.

An occupation in both the coastal zone and the hinterland can also be deduced from the distribution of settlements and hoards (fig. 3). This is a situation markedly different from the distribution pattern of the late TBK (fig. 1).

The distribution pattern can be explained in the following way:

An acculturated cultural form of the TBK and the GRK – the Stävie Group – existed in the area for a couple of centuries (Larsson 1986, Fig. 6). The representatives of the Stävie Group used the best soils adjacent to the coastal plain as well as the outermost parts of the hinterland. A well established and thriving community, supported by the Stävie Group, was able to withstand the influence of the new ideology for a couple of centuries. Consequently, the representatives of those who welcomed the new ideological influences were obliged to look for pastures and arable land outside the established settlements. Therefore, new social groups associated with the SYK were established in the hummocky zone peripherally in relation to the traditional areas of settlement. Nevertheless, the SYK proved to be a most vigorous form of social organization, as a consequence of which it spread down to the coast and incorporated, with more or less resistance, the traditional areas of settlement.

THE SOCIAL RELATIONS

In spite of the acculturation tendencies which can be traced in Scania during the Middle Neolithic period, the influences exerted by the SYK complex on the Continent appear not to have been accepted. These were very likely changes of a kind which had significance over and above economic change. The new forms of artefacts, and the change in the grave ritual, may be associated with the acceptance of a new ideology with marked religious and social archetypes (Malmer

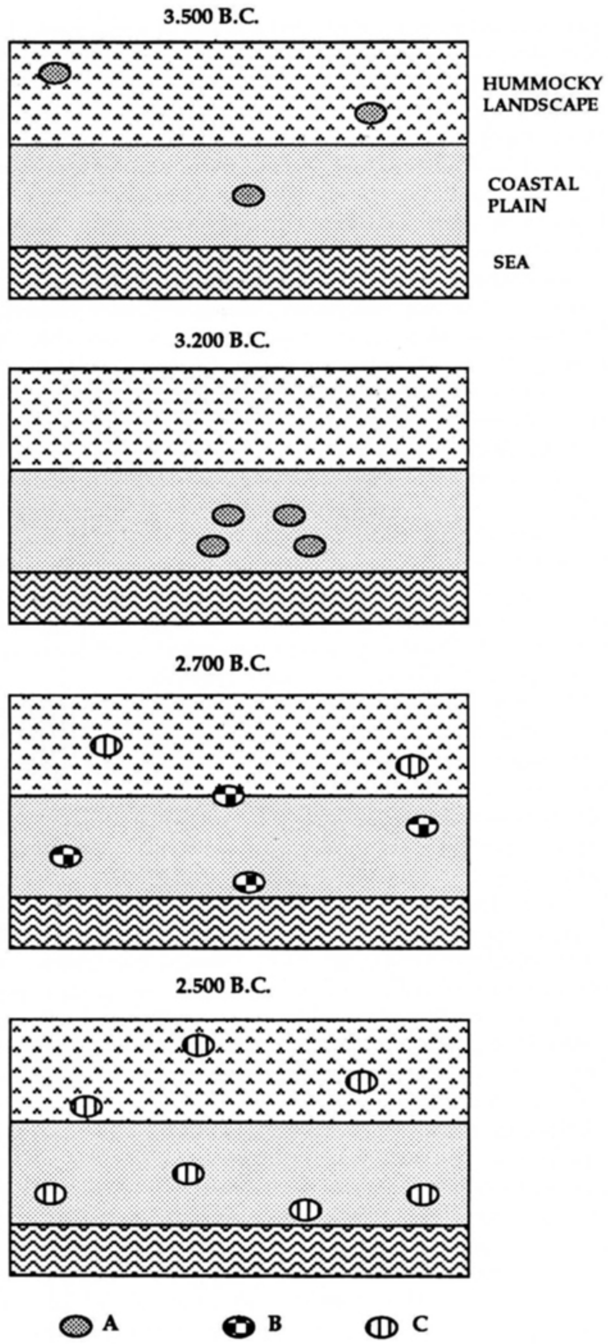

Fig. 4. Model for the settlement distribution during EN and MN A–B. A, sites from the Funnel Beaker Culture. B, sites from the Stävie Group. C, sites from the Battle Axe Culture.

1962:810 f.). The SYK was probably characterized by its strongly individual-oriented structure, with its highly regulated burial practicies. The continued use of the Megalithic graves during the late TBK, which is confirmed not so much through the pottery as by the axe forms, exhibited a more group oriented pattern of traditions during the earlier part of the same culture.

The evidence so far indicates clear foreign influences at the establishment of the SYK. But what was the nature of these influences? Going from one extreme to the other, should we believe in immigration of small missionary groups or in large scale movement of people? We hardly accept a large scale immigration of peoples who by themselves should have managed both to seize the most fertile ground on which to base their economy and to demonstrate their ideological supremacy. If this had been the case, we should observe a direct succession from the TBK to the early SYK especially in the coastal region. We would rather see the establishment of small groups with a strong ambition to recruit supporters and to change the ideology in existing societies. In some areas the new immigrants were successful. In certain parts of southern Sweden, for example in northeast Scania (fig. 2), this movement very probably experienced an unrestricted period of innovation. However, in parts of West Scania and South Scania it failed to gain foothold amongst the established societies. Only at a later stage – about two centuries later – did the social order of the SYK spread down into the old occupation districts, taking complete control over them.

The fact that there is no evidence of the initial traces of the SYK in the old districts can be interpreted as being indicative of the existence of differences between the social structures of such a kind as to exclude the possibility during an introductory phase of fusing together the established and the new social orders. This does not necessarily mean that there were fundamental differences from an economic perspective, as some researchers would have it. What emerge more clearly from an ethno-archaeological viewpoint are those attitudes and systems which rule out contacts of a permanent nature in the form of for example marriage. A factor such as the value attached to members of society may be of considerable importance in determining whether close contacts occur between two societies. In the case of the EGK, for example, it is felt that a re-appraisal can be identified between the roles of men and women, with the importance of men increasing at the expence of women (Randsborg 1986: 147 ff.). Marriage between partners from a patrilineal and a matrilineal social system is also made very difficult, in spite of the existence of great similarities with regard to most socio-ecological factors (Hodder 1982:153). It has also been noted that family groupings which have an identical economy and thus make use of the same resources, leading to repeated confrontations, consequently prefer to mark their individuality in the material culture with different forms of jewellery and different ornamentation on clay vessels (Hodder 1982:13 ff.).

An important theme in the discussion about the transition from MN A to MN B has been the pollen evidence indicating an increase in human activity during the final part of the Middle Neolithic, *i.e.* during the SYK. In previous papers dealing with the expansion phases during prehistoric times, this second expansion phase was taken to represent the time of major change towards the rapid establishment of a permanent cultural landscape which has had a noticeable influence on the environmental picture (Berglund 1969). The findings of new studies have revealed the dating of this period of steeply increased human activity to be incorrect, and that it should instead be moved to the point of transition between the Early and Late Bronze Age (Berglund *et al.* 1991).

What this means is that the last part of the Middle Neolithic must be reinterpreted. According to new interpretations of the pollen analyses, the degree of utilization has thus not been found to be any greater than during the expansion phase of an early part of the Neolithic period (L. Larsson 1992, Fig. 58). Stagnation, or even a regression in the cultural landscape, can be demonstrated between these comparatively weakly marked periods of expansion. One factor which can explain the stagnation could involve the critical treatment of the sources, to the effect that an established area of coppiced woodland acted as a filter which prevented the distribution of pollen, with an associated decrease in certain species of trees (Göransson 1988). In this case, any increase in the environmental indications influenced by humans could be interpreted as a change associated with a limitation of coppiced woodland.

A marked clearing of woodland during the time of the EGK such as has been demonstrated in Jutland (Odgaard 1991) cannot be documented in South Scania. We should rather compare with the conditions in eastern Denmark where the indications for a cultural landscape are rather limited (Andersen 1991). In the Ystad area there is evidence for a continuous although restricted human impact in the inland area.

The concentration of the settlement which can be confirmed archaeologically to the transition between the Early and Middle Neolithic (Fig. 4) can also be associated with a change in the form of production – mainly animal husbandry in addition to a relocation of settlement to the coastal zone. From animal husbandry practiced in the vicinity of the settlement during the EN, the concentration of settlement was eventually to coincide with the introduction of transhumance. The reduction in the importance of pigs and the increase of cattle (Madsen 1982, Fig. 17) may be dependent precisely on the fact that the former species was more difficult to adapt to transhumance while the latter species was well adapted to this form of operation.

During certain parts of the annual cycle the livestock was moved northwards from the coastal area to the inland region used previously. This can explain why a settlement concentration is not reflected in the pollen chart as an increase first and foremost in grazing indications. A concentration of the settlement meant that quite a large area with extensive human influence was replaced by limited areas, but with a considerable cultural landscape influence together with a surrounding area with a reduced human influence.

At the same time as evidence can be given of the concentration of settlement, the seasonal sites used for the exploitation of fish cease almost entirely. Transhumance is dependent on seasonal settlement, but for entirely other reasons than previously. As in the case of the recent examples from continental Europe, transhumance may be the reason why several villages or farms coordinated their animal husbandry when it was practiced away from the permanent base. This can explain why megalithic graves and so-called central sites are present in a settlement pattern based on small farm units. The growing of crops was the main activity open to the individual farm, whereas animal husbandry during the summer months could be practiced jointly by several farm units. A system of this kind also means that the cattle could be kept in the immediate vicinity of the farm during those parts of the year when the whole herd of cattle was driven together at the permanent base, but without causing damage to the crops or to the adjacent grazing land which were needed in order to supply those parts of the herd which were not taken to summer pasture.

A society with a significant element of transhumance may have contributed to the two agricultural processes having taken on divergent forms. Arable farming was practiced by the individual farm unit, *i.e.* it assumed a more individual character, whereas animal husbandry increasingly took on the appearance of collectivism. It may thus be presumed that the sub-division into arable farming and animal husbandry was clearly sex related – a hypothesis for which clear parallels exist in the ethnographic material. Animal husbandry was a male dominated occupation in most societies, whereas the cultivation of crops was mainly done by women.

The concentration of the settlement which started during the EN/MN transition may have had its distinct advantages. Nevertheless, it resulted in the impoverishment of the land in the longer term. The renewed interest in again making use to a greater extent of sources of livelihood such as fishing and hunting may have arisen from the fact that the growing of crops was not producing such good results as it had previously. Competition for the grazing land may also have arisen, since the element of animal husbandry appears to have been significant within the SYK. Animal husbandry may have been practiced in a fashion which corresponds more closely to true nomadism (Kristiansen 1991). The animal husbandry within the SYK may thus have been performed in a way which was in conflict with the traditional collective manner.

By the establishment of the Stävie Group the old sources of livelihood were returned to once more as a possible means of compensation for the fact that areas which were previously used for transhumance had been taken over by social groups which were part of the SYK. The element of hunting and fishing is indicated by the specific position of the sites, for example on the shore. Another indication of change is the limited quantity of settlement remains, with regard both to the area covered by the site and to the quantity of finds. It is possible that what we have here are the traces of a certain relocation of the settlement. The loss of people to the new cultural phenomenon – the SYK – may also have functioned as an element which exposed traditional society to considerable disruption.

The late SYK saw the start of the development of a social system which was established during the Late Neolithic. New crops in the form of barley assumed considerable significance. The importance of sheep probably also increased (Hedeager & Kristiansen 1988:45). The reason for this may be that better use now was made of the wool by spinning and weaving rather than by plaiting. The existence of different forms of houses and evidence for very big houses (Nielsen & Nielsen 1985) may indicate that society was organized in a somewhat different way than previously (Kristiansen 1987: 45).

However, it has emerged from both the results of excavations and the survey of ancient monuments that the pattern of settlement which can be traced during the Late Neolithic/ Early Bronze Age does not differ to any appreciable degree from that which existed during an early part of the Middle Neolithic. The way the fields were exploited in the old settlement districts by and large remained the same, indicating a close relationship in agricultural practice with the disappearing TBK society. On the other hand there may well have been considerable changes with regard to the structure of society and the ideological sphere.

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NOTE

1. Calibration of C-14 dates (in parentheses: BC) before c. 2000 bc is done according to Pearson *et al.* 1986; after c. 2000 bc according to Pearson & Stuiver 1986.

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Reviews

Progress in Old World Palaeoethnobotany: A retrospective view on the occasion of 20 years of the International Work Group for Palaeoethnobotany. Edited by Willem van Zeist, Krystyna Wasylikowa & Karl-Ernst Behre. Rotterdam: Balkema 1991. 350 pages with six plates and numerous figures, tables and line drawings.

As the sub-title suggests, this book is a product of the International Work Group for Palaeoethnobotany (IWGP) which was founded in 1968. Its aim is to trace developments in palaeoethnobotany in the intervening period (nominally 20 years). The book is divided into two sections, the title of the first section is Thematic Subjects and of the second – Regional Surveys of Palaeoethnobotanical Research.

Thematic Subjects comprises six papers, five in English and one in German with an English summary. These six papers lead us expertly through the practicalities of planning, executing, interpreting and understanding paleoethnobotanical research.

The first paper is by Udelgard Körber Grohne and it has the modest title of "Identification methods". In effect it is a superb introductory guide to practical palaeoethnobotany which includes recognising and describing sediment types, sample preparation and the identification of various plant macrofossil remains – seeds, fruits, chaff etc in their various preserved states – carbonised, uncarbonised, mineralised, dessiccated, and as impressions. The processes of preservation are also discussed before Körber-Grohne goes on to explain the identification of microfossils such as cell fragments, pollen and diatoms from archaeological deposits. The paper ends with a discussion of fabric – i.e. cordage, woven textiles, nets, and wickerwork. In each case appetising slices of information are supported by a wealth of well-chosen references, although one does wonder at the omission of even an oblique reference to the Troels-Smith method of sediment description.

Ulrich Willerding addresses the particularly important problems of "Presence, preservation and representation of archaeological plant remains". Willerding makes the point that although archaeobotanical analyses can give us a wealth of information about nutrition, economy, agricultural products and the environment, the macrofossil assemblages we find in our samples are not directly equatable with past situations. The assemblages are modified by characteristics specific to the plants, the sediments and human behaviour. We have to evaluate the probability that a particular species will be present initially in a deposit and then that its component parts – seeds, leaves etc. will survive given the type of preservation (carbonised, uncarbonised etc.) and the prevailing conditions in the sediment (waterlogged, well-aerated etc.). These evaluations are important both in research design (sampling strategies) and in the interpretation of our results.

The subject of "Sampling in palaeoethnobotany" is taken up and expanded in the next paper by Martin K. Jones. He approaches the subject at three levels – landscape, site and context. At the levels of landscape and site he discusses the problems of studying economic relationships between groups of people. At the levels of site and context he discusses the problems of selecting sediment for analysis with regard to both field practice and statistical considerations. His arguments are constructed within the framework of sampling theory and he emphasises the importance of research design and the way in which changing objectives change the requirements of sampling. He concludes his essay with a look to the future in palaeoethnobotanical sampling, emphasising the importance of ecological integration, collation of sampling strategies between different places and periods and of the inclusion of plant remains other than the traditional seeds and fruits in the paleaoethnobotanical database. This chapter is a must for anyone considering embarking on even the most modest of archaeobotanical projects.

Themes evident in Martin Jones's paper are taken up by Glynis E. M. Jones who explains at length how we can use "Numerical analysis in archaeobotany" in a pattern searching and problem-orientated approach to the subject. In doing so, she draws parallels with, and uses techniques commonly applied in, the closely-related field of community ecology. She then makes the point that many archaeobotanists are dealing with very complex problems with exceedingly large data sets and goes on to outline various ways in which we can analyse and process these data. She stresses the need for units of observation, analysis and interpretation to be vigourously defined.

Many archaeobotanists are uncomfortable in the presence of rigid definitions particularly with regard to the ecological behaviour of plants, as is evident in Behre and Jacomet's paper later in this book. Some also tend to be suspicious of large numbers and seemingly inpenetrable formulae. Glynis Jones has done more than most to make this increasingly important aspect of the subject more accessible. That is not to say that it will not require great application on the part of many researchers in order to become fully conversant with these techniques.

One of the most important papers in this book is Karl-Ernst Behre and Stefanie Jacomet's "The ecological interpretation of archaeobotanical data". Great progress has been achieved in this field during the last two decades, mainly due to the increased attention paid to the remains of non-crop plants, the improvements in techniques for the examination and identification of non-carbonised material and the development of specific research strategies. Using examples largely from their own "home" research areas in Northern Gemany and the Alpine foreland, Behre and Jacomet's masterly synthesis describes the development and practice of reconstructing former cultural landscapes and environmental conditions through ecological interpretation of archaeobotanical data. They begin with a consideration of the natural vegetation around settlements sites and then examine various ways in which the modification of this vegetation by human populations can be studied and elucidated. The grouping of species on the basis of ecological criteria is given great attention and they conclude, as Willerding did in his paper, that the present is not necessarily a direct key to the past. A variety of factors decisively influence the subfossil record and also represent the essential difference between ecology and palaeoecology. As a result of this, Behre and Jacomet warn against the rigid use of phytosociological criteria and ecological indices in the ecological interpretation of archaeobotanical data. They advocate instead a more flexible approach which requires not only a detailed knowledge of plant ecology but also of earlier forms of exploitation and an understanding of the phytosociological changes which human activities have provoked. Behre and Jacomet then show their mastery of this art in discussions of forest exploitation and management, the development of pastures and meadows and the location and cultivation of fields. Case studies involving the reconstruction of past landscapes and environments are then presented from settlements on saltmarshes, floodplains and river clay areas in Northern Germany, on morainic landscapes in the Central European Lowlands and the loess plains, before moving on to the Alpine foreland and a consideration of palaeoecological investigations in towns. The amount and detail of the data presented is at times overwhelming and this chapter is no "easy read". However patience pays dividends and systematic reading leaves a very positive impression of what can be achieved through the co-ordinated problem-based archaeological and palaeoecological investigations of waterlogged sites with an abundance of non-carbonised, non-crop remains.

The final paper in this section is by Willem van Zeist of Groningen who discusses "Economic aspects" of the archaeological plant record. Apart from a consideration of their possible role in revealing trade connections, Van Zeist avoids any consideration of the main crop plants – cereals, legumes etc. Instead he begins with a comprehensive review of the plant resources utilised by hunter/gatherer societies before moving on to considerations of subjects such as the history of fruit growing, trade in plant produce, evidence for the brewing of beer and other fermented beverages and the development of grassland and hay meadows. Each section is a small masterpiece in itself, supported by a wealth of relevant references.

The second section of the book – Regional Surveys of Palaeoethnobotanical Research – comprises nine papers, of which six are in English and three are in German with English summaries. As the title suggests, the papers are reviews of palaeoethnobotanical research in the Old World presented on a regional basis. The regions are as follows: The Near East – Naomi F. Miller, Southeast Europe – Helmut Kroll, Central Europe south of the Danube – Hansjörg Küster, Germany north of the Danube – Karl-Heinz Knörzer, East-Central Europe – Krystyna Wasylikowa and colleagues, South and Southwest Europe – Maria Hopf, Western Continental Europe – Corrie C. Bakels, The British Isles – James R.A. Grieg and The Nordic Countries – Hans Arne Jensen. Enormous amounts of data have been concentrated and then presented on a chronological basis for each region and it would be impossible to provide a summary here which would do justice to the individual papers. I will however make some general comments. It is obvious that the intensity of palaeoethnobotanical research various enormously from region to region. The European part of the former Soviet Union, for example, is almost a blank and other regions have been poorly studied. Some of the papers (such as those by Kroll and Knörzer) amount to little more than a catalogue with a location map and could have benefitted from being "fleshed out" both with information about sites and the plant species represented. Others are considerably more informative. Miller's review of the the Near east is fascinating in its problem-orientated approach and lucid text. Similarly James Greig's presentation of the British material is a mine of information and a joy to read. Closer to home, Hans Arne Jensen's chapter on the Nordic countries is a clear and comprehensive catalogue of finds, peppered with occasional information of a more interpretative nature. However, reading Jensen's paper directly after a detailed appraisal of Behre and Jacomet's contribution makes it abundantly clear, that with regard to both expertise and resources, we in the Nordic countries have some way to go before we can begin to interpret data and reconstruct landscapes and the environment in a similar fashion to our Swiss and German colleagues.

Despite some inevitable deficiencies, this is a very important book the total value of which is much more than the sum of its parts. Not least important are the copious references. This book is the key to modern palaeoethnobotany in the Old World and should be compulsory reading for anyone involved in the interpretation of past landscapes and environments. I would suggest furthermore that it should be on the bookshelf of every archaeobotanist, either practising or aspiring, and also of every archaeologist and historian with the slightest environmental bent.

David Robinson

A. Degn Johansson: *Barmosegruppen. Præboreale bopladsfund i Sydsjælland.* Aarhus Universitetsforlag 1990. 108 pp., 45 figs. English summary.

Seldom has a book on the Mesolithic arrived more opportunely from the point of view of research as the publication of the site of Barmosen in south Zealand. For the past two decades Mesolithic research has been concentrated primarily on the late Mesolithic. Cemeteries and well preserved find layers have tended to focus interest on the Ertebølle Culture. Even if important new results on this later stage are only to be expected, it now seems high time to direct research towards the initial stage of the Mesolithic. In this respect Barmosen takes a key position.

The sites of Barmose I and Hasbjerg II in SW Zealand were excavated in 1967–71 and 1971 respectively. A preliminary but nevertheless substantial report appeared as early as 1971 (Johansson 1971). This article gave rise to considerable discussion regarding the site's chronological position. The combination of early-looking microliths with flake axes of advanced shape invited differing opinions to the chronological homogeneity of the material. This discussion acquired significance for the understanding of settlement sites far beyond eastern Denmark, a question to which we will return.

Both settlements are bog sites. Both were of limited extent, and the excavation, at least of Barmose I, seems to have been complete. The area occupied measured 6×4.5 m with a large hearth about in the middle of the concentration of flint. The hearth was indicated by a considerable concentration of charcoal and by burnt flint. Parts of a floor of poplar bark was also found. The sharp demarcation of the flint suggests that a physical obstacle such as a wall had hindered further spread. To judge from the distribution of the flint the hut was of rounded shape covering an area of about 22 square meters, thus having a size and shape as well as a situation by open water in agreement with that of other bog sites from Boreal times. The publication contains a full account of the material, supported by many good illustrations.

The quantity of finds is considerable, as shown by the total weight of no less than 100 kg. This amount of flint may indicate repeated visits to the site, but it should not be forgotten that the technique used required a large amount of raw material. The greater part of the implements are made on flakes or coarse blades.

The large lanceolate microliths are of especial interest. The short retouch at the point comes mainly from the use of a micro-burin technique. In four cases micro-burins could be fitted together with microliths. Although the author does not use the term, others have described these as microliths of Vig type, after the well known discovery of a urus together with three similar specimens in a bog at Vig (Hartz & Winge 1906).

With one exception the axes can be classified as flake axes, and all of these have flat flaking over most of the surface. Some have damaged cutting edges and other indications of having been used for chopping. The spatial scatter of the axes and lanceolate microliths agrees, which appears to support their contemporaneity.

Organic material is relatively limited owing to the poor conditions for preservation. The only bone implements that could be identified was a fragment of a serrated bone point and fragments from the rear part of a number of others. Several scattered finds of serrated points south of the excavation suggested a nearby fishing ground.

Of the 20-odd lumps of resin found two showed the marks of teeth. The tooth-marks show that the pieces had been chewn by two children, one 7–8 and the other about 11 years old!

The faunal material indicates among others the presence of urus, red deer, roe deer, wild pig, and pike. However also domestic cow is recorded, which implies secondary disturbance. This may explain why three charcoal samples gave such different radiometric datings.

Hasbjerg II was found in a peat layer close to land. The distance from Barmose I is 4 km, but the site lies in the well known bog at Sværdborg, which is not connected with Barmose. A total excavation of Hasbjerg II was not possible. So far as can be seen Hasbjerg II was very similar in size and shape to Barmose, but the finds were considerably fewer, weighing 30 kg. In contrast with the previous sites Hasbjerg II produced some triangular microliths. The blade technique is also better than at Barmose I.

Barmose I and Hasbjerg II are in no way isolated discoveries. In his examination of the chronological position of both sites Degn Johansson refers to a number of other sites from southern Zealand, which he regards as belonging to the early Maglemose Culture.

On the basis of a number of east Danish sites the early Maglemose Culture is divided into four phases with the following characteristics:

Barmose phase, type site Barmose I. Large lanceolate microliths with short lateral retouch are the only microlithic form. Flat-flaked flake axes are completely dominant, and the blade technique is very coarse.

Bjerby Enge phase, named after a site in Åmosen in central Zealand and without proper type site. Large microliths predominate,. but some have retouch right along the side. Occasional isosceles triangles may occur. The axes include a few core axes. The boundary between flat-flaked flake axes and symmetrical core axes is diffuse. A characteristic trait is the occurrence of extremely long and wide flake axes. The largest was no less than 28 cm long, and some others have lengths of over 15 cm.

Hasbjerg phase, type site Hasbjerg II. Isosceles and somewhat asymmetrical triangles occur. Flat-flaked flake axes provide at least half of the axe material. Blade removal by pressure technique occurs.

Flaadet phase, type sites are Flaadet on Langeland and Nykær in south Zealand. Still half the microliths are large lanceolates. Core axes dominate, and among them narrow symmetrical specimens with narrow cutting edge are especially frequent. Blade removal by percussion and pressure are equally well represented.

As the C14 dates are few and inconsistent the Danish datings cannot be used. Therefore Degn Johansson compares the site with the datings from the north German peat bog complex at Duvensee.

The Barmose phase is regarded as older than Duvensee 8, which is dated to 9640±100 → 9410±1107 bp (Gob 1990) while the Bjergby Enge phase is contemporary with it. The Hasbjerg phase is later than Duvensee 8, but earlier than Duvensee 2, which is dated to 9420±130 → 9280±100 bp. The final phase, Flaadet, is typologically contemporary with Duvensee 2 and Duvensee 1, which are dated to the interval 9200±300 → 8755±70 bp. In the author's opinion the Barmose phase should be earlier than the first half of the eighth century b.c. He suggests the interval 7700–7500 without explaining his reasons. According to Degn Johansson's terminology then only the Barmose phase can be regarded as Pre-boreal, for the boundary with the Boreal is defined by the appearance of hazel, which has been dated to 7,500 before Christ. However it should be noted that this event is dated differently in different parts of southwestern Scandinavia.

In a special digression it is asked how Pre-boreal flake axes compare in shape with the Ertebølle ones. From measurements Degn Johansen regards the differences as considerable. He points out the similarity of the early flake axes with core axes. The straight to slightly convex sides, the greater length and thickness, and the narrower cutting edge are characters which distinguish the early Mesolithic flake axes from those used in late Mesolithic times.

The book on the Barmose group has made accessible a well executed and highly informative study that can support various opinions on the earliest Maglemose Culture. The beginning of the Mesolithic in the southernmost part of Scandinavia and in the western part of the Scandinavian peninsula are two important sets of questions. The first is not given attention by Degn Johansson, but the second is.

With regard to the Late Glacial/Post-glacial boundary (the Younger Dryas/Pre-boreal transition) various courses have been suggested which the change from Late Palaeolithic to Mesolithic society may have followed. One thing is that the study of insect remains has shown that the climatic transition was rapid and pronounced (Lemdahl 1988). Even if the insect fauna indicates a fast rise in the temperature, this need not mean that the rest of the fauna changed as rapidly. An example is that C14 datings from the eponymous site for Ahrensburg – Stellmoor – with values between 10,140±105 and 9,810±100 bp lie very close to the geological dating of the transition from the Late Glacial to the Post-glacial. C14 dates have shown also that in Bornholm and Scania the reindeer survived into Pre-boreal times (Aaris-Sørensen 1988; Larsson 1991). It is reasonable that there existed a combination of Late Glacial fauna and new arrivals. With the transition there probably occurred an immigration of bison, wild horse, and urus (Aaris-Sørensen 1988). Somewhat later in the Pre-boreal appear red deer and wild pig, which are two animals especially typical of the Mesolithic environment.

Two alternative processes of change can be postulated. One is based on the material culture of Late Glacial times, which evolved. The other presupposes a faster transformation, in which the principal factor was a distinct break, based rather on influences from or the direct participation of continental communities already adapted to Boreal conditions (Fischer 1978).

At the site of Bonderup in central Zealand there are conditions which support a smooth transition from a Late Palaeolithic to a Mesolithic tradition (Fischer 1982). The finds came from a gytje layer pollen-dated to an early part of the Pre-boreal (Fredskild 1982). The finds included a point of Ahrensburg type, double-platform cores typical of the Ahrensburg culture, and a triangular microlith. There was also found a large flint implement that was seen as prototype of an axe.

If we travel south into the northern part of continental Europe, whose landscape was affected by the final ice sheet, the evidence suggests a faster and more dramatic change. C14 dates from the bottom layer at Friesack 4, west of Berlin, give 9680±70 → 9560±100 bp to the middle part of the Pre-boreal (Gramsch 1987). Another site in the same area, Friesack 27, is thought to be somewhat older, with a dating of 9850 bp (Gramsch 1991). This may be compared with the values given above of c. 10,000 bp for the Ahrensburg culture at Stellmoor near Hamburg. The Friesack material is entirely Mesolithic in character with no trace of Late Palaeolithic forms. Coarse lanceolate microliths dominate, but triangles are also present. This should indicate strong influence from the south, which entirely changed the material culture in the course of about a century. The osteological material from these sites shows no trace of tundra fauna. This can show that the area immediately south of Scandinavia passed early in the Pre-boreal through a rapid change not only of material culture, but also of fauna, while in south Scandinavia the change from the Late Glacial was slower. Does that mean that the introduction of Mesolithic material culture was slower? It can have been equally fast if one accepts a scenario placing less weight on the ecological factors. Here important problems have to be solved. The newest published dates can perhaps be used to support a retardation of the historical development in southernmost Scandinavia.

After comparison with the north German sites in Duvensee Johansson proposes a dating of 7700–7500 b.c. for Barmose I. The three C14 datings for the site give the interval 9240±150 to 8330±100 bp. The wide range of the dates is regarded by Johansson as indicating that they cannot be used to date the settlement. Five new accelerator datings give values between 9370±90 and 8930±90 bp (Fischer 1991). These seem to agree with the original earliest dating from the site, but are substantially younger than the datings adopted by Johansson.

Much remains to be done to relate Degn Johansson's conclusions with much of the rest of south Scandinavia. There are several possible explanations for the lack of finds from Pre-boreal times. A natural suggestion is that the population was low. Other possible explanations are based on culturegeographical or climatological factors. In a several investigations of lakes and bogs the water level was found to have been remarkably low in Pre-boreal and part of Boreal times (Digerfeldt 1975; Gaillard 1974). As locations by open water were preferred, the sites lay in areas that after the succeeding rise in the water level were flooded and sealed by organic sediments. The Pre-boreal and early Boreal shore zone lay so close to the present edge of the bog that it was less attractive for peat exploitation than the parts of the bog in which the Boreal and early Atlantic sites lay.

The Barmose group has more direct implications for our understanding of the earliest settlement of the west coast of mainland Scandinavia. This is an aspect in which Degn Johansson is much interested. The Swedish Hensbacka and the east Norwegian Fosna cultures are involved. These have not least been under discussion in connection with the first flate-axe chronology (Cullberg 1974: Welinder 1974). Degn Johansson points out that at any rate from central Bohuslän northwards the sites of the Hensbacka culture lie higher than the so-called regression minimum dated to c. 7600 b.c. Thus, based on certain deductions, the Hensbacka/Fosna culture is dated to the period 7800–7300 b.c. Degn Johansson has examined part of the material and thinks considerable similarities can be seen between the settlement finds of the Hensbacka culture in one of its middle phases, the so-called Djupedal phase, and those of Barmose I. He points out however the strong Late Palaeolithic traditions which mark the Hensbacka culture.

Degn Johansson regards the oldest Duvensee settlements, Barmose I, and Djupedal in Bohuslän as all expressions of the same techno-complex. Local groups start to appear only at the beginning of the Boreal. He points out the lack of sites, and postulates a material culture in the early Pre-boreal consisting of small monolateral tanged points in microlithic technique, simple flake axes like those of the Hensbacka culture's Toskärr phase, large lanceolates, and broad-bladed flake axes corresponding to the Hogen phase of that culture.

In this perspective it is right to consider the finds from the recently published settlements of the Myrvatn group in an area south of Stavanger in SW Norway (Bang-Andersen 1990). The sites are considered to be the result of short-term occupation. Site D produced hearths and a ring of stones interpreted as a tent circle. Here there was found a mixture of small tanged points, monolateral points, a hybrid between the monolateral point and the microlith, and lanceolate microliths. The find distribution suggests a difference between encampments with tanged points, with transitional forms, and with microliths. C14 dates give the interval 9610±90 → 9420±80 bp for samples from all the encampments. This can be taken as the time during which traditions from the Ahrensburg culture were replaced in SW Norway by a material culture corresponding to that of the Barmose group. The change would have agreed with the dating of the Barmose phase. There appears thus to be no clear retardation in the introduction of material culture into the Scandinavian peninsula. The environment at Myrvatn was periglacial, with the reindeer as the only large animal that could be hunted. Thus we find here a change in the material culture that cannot be connected directly with an ecological change. On the other hand it should be remembered that these were inland sites where the ecological conditions did not change so quickly as at the coast, where the base sites are supposed to have been situated.

The question remains whether the introduction of the Maglemose Culture into south Scandinavia was connected with an immigration of population with a form of society adapted to the new ecological conditions. If so, how extensive was the immigration? Was it only in certain peripheral areas that the late Palaeolithic traditions survived? Were reindeer hunted with lanceolate microliths in south Scandinavia too? Themes like immigration, innovation, and the importance of social and ecological factors in the mechanism of change need to be explored. Is it purely by coincidence that the questions that need to be asked when examining the introduction of the Mesolithic are so similar to those debated at its close, or are they only questions of general kind in the analysis of obvious cultural change? [Translated by David Liversage]

Lars Larsson

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Ian Hodder: *The Domestication of Europe. Structure and Contingency in Neolithic Societies.* Basil Blackwell, Oxford, 1990. 331 pp.

In his former writings, Ian Hodder has interpreted anthropological and archaeological data in an unconventional and provocative way (*i.a. Symbols in Action* 1982, *The Present Past* 1982, *Reading the Past* 1986). Symbols and structure are the keys to his understanding of the past. As with all good crime stories, one has to read most of his new book, *The Domestication of Europe*, to fully understand the title. Domestication is conceived of in a wider sense, meaning the process of gaining control over nature. Thus "domestication in the social and symbolic sense occurred prior to domestication in the economic sense" (p. 31). The book also comments on structuring human society from the beginning. However, the focus of the book is on the development of society during the Neolithic periods in Europe. It is not a general survey of the European Neolithic but a selection of 'case stories', beginning in the Early Neolithic in the Near East, Anatolia, and South-East Europe, continuing through Central and Northern Europe and ending with Northern France and Great Britain. The beginnings of cultivation and animal husbandry and the emergence of early permanent settlement take us from Natufian and PPN sites in the Levant to Catal Hüyük and Hacilar in Anatolia and Lepenski Vir on the Danube. Arriving at the Early Neolithic and Chalcolithic of South East Europe, with ample evidence of structured settlement, houses, and symbolic expressions within the domestic sphere, Hodder introduces the concept of the 'domus' (lat. *house*), later to be contrasted with the 'agrios', meaning wild, and the whole rest of the book goes on to demonstrate how the domus principle was exercised, transformed, and widened through later stages of the Neolithic as opposed to the agrios. A third concept, the 'foris', meaning the outside or doorway, is used mainly in the chapters dealing with the Central European Neolithic referring to the emphasis on boundaries and entrances. The concepts of domus and agrios function as the mesh through which the evidence is filtered throughout the book. For instance, Hodder describes how the domus symbolism was transferred from the *Bandkeramik* long houses to the earthen long barrows of Central, Northern, and Western Europe. This symbolic transformation coincided with the change from large settlement compounds of the late *Bandkeramik* groups to the more scattered settlement, probably based on smaller family cells, of the ensuing communities of *i.a.* the Funnel Beaker Culture. The domus symbolism was carried further on in the lay-out and organisation of the megalithic monuments, causewayed camps, and – in the West – henge monuments as the most outstanding features of the domus. Hodder plays a second and parallel theme in the book concerning the roles and division of space between the sexes. This division is to be found in both domestic and funeral contexts.

The way the book is arranged it covers roughly the same story and geographical area as Childe's *The Dawn of European Civilization* but it presents a very different archaeological approach and goes far beyond the characterization of archaeological 'cultures'. *The Domestication of Europe* is a stimulating, intelligent, and thought-provoking account written by an author who, in his own words, allows himself of highly imaginative reconstructions. The book is not a conventional text-book but rather an exercise in modelling and interpreting the past. There are a lot of questions asked and possible answers given. The questions "centre on changes in symbolic structure which correspond with other types of change" (p. 16). The use of linguistic oppositions such as the domus and the agrios makes it possible to include widely spaced and apparently different phenomena in the same conceptual framework.

I find it difficult to argue with the book because of its structure and logical consequence. However, reading through the chapters one gets the feeling that the domus symbolism is carried too far. The arguments become constrained because all observations are related to a few, preconceived concepts. Another objection is more specific and concerns the role attributed to the Corded Ware/Single Grave Culture:

There is a certain bias in the book because of the elaboration on the theme of the expansion of the domus symbolism. The author is not occupied with such aspects as the decline of the Neolithic societies used to illustrate the cases or the transformations leading into the world of the Bronze Age – exept where Britain is concerned. The case of Great Britain, supported by the evidence from northwestern France, shows an increasing input of labour throughout the Neolithic and into the Early Bronze Age in creating ever larger ritual manifestations (p. 265 and fig. 9.7). In this respect Britain is rather unique compared with the rest of Europe. The culmination of the process occurred during the Beaker Period in Britain, and Beakers are in fact associated with most of the major monuments. Hodder states that "Overall, therefore, Beakers emerge within the context of existing structures" (p. 268). The whole idea of cultural transformation in the Beaker Period, which includes the rise of a warrier elite as reflected in individual graves in contrast to the former collective burials, seems to have affected the author's attitude towards the role of the Corded Ware and Bell Beaker cultures in general. The reservations on page 305 towards migration as a possible explanation for the advent of the Corded Ware complex is an expression of the same attitude. Migrations or not, we may well accept the insular evidence but can hardly ignore the continental evidence, which in my North European perspective shows a much more radical change from the old domus-oriented megalithic culture system to the expansive, individualistic phase of the Single Graves. It is impossible to adhere to Hodder's claim that "It is as if there is really nothing new in the Scandinavian Corded Ware. All the cultural principles are old ones." (p. 218). Probably the Corded Ware/Single Grave phenomenon constitutes the most radical break in cultural development in Scandinavia since the beginning of the Neolithic. This is contrasted with the situation in Britain where no Corded Ware interrupted the growing process of social integration which we may assume was based on the old idiom of the expanding domus. In Northern Europe the old complex cultural system of the Funnel Beaker Culture collapsed some time before and about 2800 bc, when the Single Grave and Battle Axe cultures made their appearance. This collapse released the enormous energy formerly spent on ritual activities such as the building of megalithic graves and causewayed enclosures. As a consequence, settlement and economy expanded beyond previously known limits, and a new social order was created – and new interpretations of the domus and agrios principles may have been adopted.

P. O. Nielsen

BENGT ODENSTEDT: *On the Origin and Early History of the Runic Script. Typology and Graphic Variation in the Older Futhark. Acta academiae Gustavi Adolphi 59. Uppsala, 1990. Distributor: Almqvist & Wiksell International, Stockholm, 188 pp.*

1990 has been a prosperous year for runology. The Third International Conference on Runes and Runic Inscriptions was held in Norway, and in Sweden no less than three doctoral dissertations appeared, two in Uppsala and one in Lund, and at the end of the year this publication by Bengt Odenstedt, professor in English in Umeå. Through systematic investigations of the various forms of the older runes it is Odenstedt's aim to throw some light on the early history as well as the origin of runic writing. O. concentrates on and tries to isolate the different variants (allographs) of the 24 runes of the older futhark, their geographical and chronological distribution, deliberately leaving out as far as possible the difficult problems connected with interpretation, content, and context. After a short introduction , describing aims, methods and material, chapters 2–19 are devoted to analyses of the single runes with tables, showing the form of approximately 275 allographs, with a summary and conclusion concerning typology, original form, and genetic development of each rune. On this background the "position of the continental and Anglo-Frisian runic forms in the history of the older *futhark*" is discussed, compared with the Scandinavian variants and the "author concludes, on the basis of greater variety of forms, that the runic script was used earlier and for a longer period in Scandinavia than elsewhere" (Abstract) and "that *people on the continent learnt the runic script later than the Scandinavians. It is reasonable to assume that knowledge about runes came to the continent from Scandinavia,* perhaps in the fourth century." Later *"contacts with Scandinavia ceased and runes developed independently in the two areas; hence the absence of late Scandinavian features on the continent"* (p. 133). In the final chapter (pp. 145–173), which is a (slightly) revised version of "Om ursprunget till den äldre *futharken", Saga och Sed* 1984 (1986) pp. 7–116, O. after a short survey of the main theses about the origin of runic writing, argues for the opinion, that runes were created at the beginning of our era on the base of the Roman alphabet, c.f. H. Pedersen and F. Askeberg, and not for practical purposes, which was the point of view of Erik Moltke. The older runes were chiefly used epigraphically, and like Anders Bæksted in *"Målruner og troldruner"* (1952). O. is inclined to consider the runic script "a luxury which Germanic people had seen Romans practice and which they no doubt envied and tried to imitate, with very little success." (p. 173).

According to O.'s preface "no systematic investigation of the various forms of the older runes has so far been made" (p. 9). One would however be inclined to think, that a discussion of Richard L. Morris: *"Runic and Mediterranean Epigraphy "* (Odense University Press 1988) would be relevant. Here the forms of the runes are discussed in connection with the thesis that runes were created some centuries B.C., and were based on archaic Greek or Latin alphabets (cf. review by Klaus Düwel, *Germania* 69, 1991, pp. 230–234) – i.e. the theory, which repeatedly, mainly on linguistic premises, has been advanced by Elmer H. Antonsen (lately for instance in *"The Origins of Writing"*. Red. Wayne Senner (University of Nebraska Press Lincoln and London 1989) pp. 137–158), and which is dismissed rather shortly by O. (pp. 147–150) – with regard to the linguistic arguments that the two e-runes mirror a Proto-Germanic sound-system (p. 150). However, further reading and a closer examination of the bibliography soon reveals that O.'s manuscript must have been finished about five years before the date of printing, a fact which ought to have been mentioned in the preface, since the book is not up-to-date, either for important literature on the subject or for, for instance, the new finds from Illerup and Vimose. The Illerup chape is missing, and the important Vimose lancehead with the same inscription as the two lanceheads from Illerup, though mentioned (p. 113) is not included in the list of inscriptions investigated (pp. 17–23) and does not count in the statistical tables or in the conclusions, i.e. pp. 68, 118, 130. As a whole it is a question whether the important material from the Illerup deposits (and the obvious connection between Illerup and Vimose) was in fact wholely integrated and all (earlier?) conclusions reconsidered.

In my opinion in principle the methods and conclusions in the first part of the book need some consideration. It is no doubt true that "thorough knowledge of the various forms of the runes is after all the basis of all runological research" (p. 10) but the definition and selection of this apparently neutral basic material is certainly not without problems. The systematic investigation is based on the study of published photographs of the inscriptions in the standard publications, with the aid of a powerful magnifying glass (p. 14) and the descriptions, mainly in Krause-Jankuhn 1966 (*Die Runeninschriften im älteren Futhark* von Wolfgang Krause mit Beitragen von Herbert Jankuhn. Abhandlungen der Akademie der Wissenschaften in Göttingen. Philologisch-historische Klasse. Dritte Folge, Nr. 65, Göttingen, Vandenhoeck und Ruprecht 1966) obviously in general without any attempt at personal investigation or use of comparative material, for instance Carl J. S. Marstrander's important "De nordiske runeinnskrifter i eldre alfabet. Skrift og språk i folkevandingstiden. I. Danske og svenske innskrifter". *Viking 1952,* pp. 1–277, or the investigation of the much debated Grumpan-bracteate, Vg 207, *Sveriges Runinskrifter,* (which is the basis for my statement, questioned by O. p. 117). According to O. very little could be found in the runological literature concerning graphic typology and variation, but O. has not been aware of Elisabeth Svärdströms introduction to *Västergötlands Runinskrifter,* which appeared 1970, just as he has overlooked the important informations presented in the article, "Runerne", sp. 937 ff., in *Danmarks Runeindskrifter* (1942), ("which has surprisingly little to say on the subject of runic forms" (p. 13)). O.'s material is rather limited, according to his own account, it excludes 1) "forms that cannot be seen clearly in the photographs", 2) "all cryptic or individual forms which cannot be related to known runic forms", 3) "runic forms the transliteration of which is disputed" (pp. 14 f.). The forms included derive from a selection of 178 unquestionable runic inscriptions, listed on pp. 17–23, but whole groups are missing, for instance all the English runic coins "because good photographs or drawings of them were not available to me" (p. 16), and which is most remarkable and regrettable, the important group af bracteates is also omitted, "because they are frequently impossible to interpret and often contain a number af highly individual or distorted runic forms" (p. 16). The fact that all bracteates except three futhark-inscriptions and the Undley bracteate are excluded – i. e. such perfect inscriptions as the Seeland 2 and Tjurkö 1 – to my opinion much reduces confidence in O.'s results. For instance the "unique" j-variant of the Thames scramasax (pp. 73, 74) can be found on the Seeland bracteate, so the conclusions concerning the j-rune are wrong. Further, a subjective evaluation took place when O. copied each rune that could be "distinguished and identified" (p. 14). Though O. is aware of the problems of different writing technique on wood, metal, and stone, he is comparing allographs all reproduced on smooth paper and selected, according to O.s subjective judgement as typologically important; for instance with regard to rounded or angular forms. But when is a particular rune a sort of poor abortion and when a proper child of the writer's intention? I have never seen the j-rune from the Krogsta inscription rendered like O.'s version (pp. 71, 73). It is evident that the e-rune on the second silver shield handle mounting from Illerup has two horizontal straight branches, but to my opinion its writer just cut twice, just as he did in the right top of the g-rune. This e-rune could by no means be normalized to a form like O.'s, and is probable not a missing typological link at all (pp. 97 f., 99, 167).

Though indeed – as also admitted by O. – the statistical figures given are not quite exact "they should nevertheless be sufficiently correct to reflect the proportions between various forms in different areas and periods" (p. 11). This seems somewhat doubtful, especially since the bracteates are missing and it implicates that the datings could be taken to be safe. The 178 inscriptions are listed in chronological order from 175 to 750, mainly according to Krause-Jankuhn 1966 without further considerations and no attempts at more detailed investigations, i.e. concerning archaeological datings – "the overall chronological picture should be sufficiently correct." (p. 17). This method of dating is relative and to a very high degree based on runological-typological considerations, and in details far from safe, at least concerning the stone inscriptions. It seems somehow begging the question to come to conclusions on the typological development of the rune symbols on a material dated in this way. It is no wonder that most of O.'s results accord rather well with the generally accepted views. Besides, the ethnic and geographic distribution involves another problem. Apart from the English and Frisian inscriptions, O. operates with 99 Scandinavian, 6 Gothic and 44 Continental inscriptions (p. 16), without specification, and it is a matter of discussion which are these 6 Gothic inscriptions. But in the further classification of these inscriptions, he operates with an early *Scandinavian and Gothic* group c. 175–c. 400 (A), a *Scandinavian* group (B) c. 400–c. 750 and a group of *continental* inscriptions (C) dating from c. 400 to c. 750. Thus the 5 early, unquestionable continental inscriptions, according to the list: Kowel, Rozwadów, Dahmsdorf (on spearheads c. 250), Leţcani (distaff, c. 300–400), and Pietroassa (ring, c. 350–400) in a way disappear with their special variants in the survey (Table 55, p. 130), and O. leaves them out of account when he says (p. 131) "there are no continental inscriptions that are older than 400" and concludes: "It is reasonable to assume that knowledge about runes came to the continent from Scandinavia, perhaps in the fourth century" (p. 133).

In a Scandinavian context it is useful that O. tries to shed more light on the Anglo-Frisian runes, though his observations are preliminary and it might be questioned, if not too much importance is attached to the disputed Undley bracteate, earlier treated by O. (and according to John Hines manufactured in Schleswig-Holstein c. 450–480 and brought by the Anglo-Saxons to England). It seems to document the early remarkable innovation in the English (and Frisian) runic alphabets, the occurrance of a new o-rune exemplifies the introduction of new vowel symbols necessitated by sound-changes. It is noteworthy that O. apparently is not aware of the possibility of a certain correlation and competition with the Roman letters due to the growing use of them for the vernacular, in this need for more signs or, for instance in the predominance of the closed "conservative" r-variant (p. 40). Only in the case of the s-variant on the Thames scramasax is an eventual influence from Roman bookhand mentioned (p. 135). It is remarkable that O. never comments on the main difference between the English-Frisian creation of new runes and the Scandinavian reduction from 24 to 16 more ambiguous symbols, no doubt also due to linguistic developments. According to O. the older futhark in England was still flourishing between 650 and 750, "while it was a dying script in Scandinavia and on the continent." (p. 136). This statement seems somewhat out-dated. In Scandinavia there was, due to many new finds, clearly a transitional period with continuity between the two systems. I shall not go further into particulars, though several other details could be discussed as well as some of the conclusions drawn on a rather unsafe basis, which also leaves the non-specialist reader with very little possibility of control.

Anyhow, with this attempt at a purely typological approach concentrated on the variants of the runic forms, Bengt Odenstedt has delivered a thought-provoking contribution to the discussion of the intricate questions of where, when and why runic writing started and how it developed. His comparison of runes with Roman capital letters in the final chapter (pp. 145–173) needs further consideration from an alphabetic-historical point of view, though the assumed original forms (p. 146) in my opinion are no more in accordance with what was actually found in the previous chapters than the "normal" forms usually given in runological handbooks (p. 11 – with a wrong s-variant compared with Krause-Jankuhn 1966), and the argumentation for the rounded forms as secondary to the angular tends towards arguing in a circle. However, considering the early inscriptions from the Danish area, evidently belonging in a cultural context which was strongly Roman-influenced but which do not really indicate practical purposes, O.s viewpoint (p. 173) ought to be discussed, that runic writing was created as an imitation of Roman epigraphy, poorly developed during the first centuries A.D. in a mainly oral community, and exercised chiefly epigraphically by a few "rune-masters", but also used for magical and decorative purposes.

Marie Stoklund

Book Chronicle 1991

CURT BECK & STEPHEN SHENNAN: *Amber in Prehistoric Britain.* With a foreword by Colin Renfrew. Oxbow Monograph 8. Oxbow Books, Oxford 1991. 232pp.

Besides containing a catalogue of prehistoric amber finds from Britain, the book treats a number of aspects such as the social context of amber, its sources and distribution. The results of infra-red spectroscopy lead to the identification of different varieties of amber. The results are discussed in a European context.

Sacred and Profane. Proceedings of a Conference on Archaeology, Ritual and Religion. Edited by P. GARWOOD, D. JENNINGS, R. SKEATES & J. TOMS. Oxford University Committee for Archaeology, Monograph No. 32. Oxford 1991. 171pp.

Fifteen papers dealing with rituals and their implications *i.a.* for social control, the function of centres, exchange and cultural transformation.

The Cultural Landscape during 6000 years in southern Sweden – the Ystad Project. Edited by B. E. BERGLUND. Ecological Bulletins No. 41. Munksgaard, Copenhagen 1991. 495pp, 1 folded map.

The volume reports on the results of the "Ystad Project", an interdisciplinary research programme carried out by the University of Lund in the period 1982–90. The combined efforts by scientists in the fields of prehistoric and medieval archaeology, palaeoecology, history and human geography have produced a reconstruction of landscape and settlement from the Late Mesolithic to the present time.

Regions and Reflections in Honour of Märta Strömberg. Edited by K. JENNBERT, L. LARSSON, R. PETRÉ & B. WYSZOMIRSKA-WERBART. Acta Archaeologica Lundensia, Series in 8° N° 20. Almquist & Wiksell International, Lund 1991. 408pp.

Thirty-nine scholars celebrate the 70th birthday of professor Märta Strömberg with this Festschrift, containing contributions on topics ranging from the Neolithic to the Medieval, as well as a bibliography of M. Strömberg's publications.

BERIT VALENTIN ERIKSEN: *Change and Continuity in a Prehistoric Hunter-Gatherer Society: a study of cultural adaptation in late glacial – early Postglacial southwestern Germany.* Archaeologica Venatoria 12. Tübingen 1991. 232pp.

The author seeks explanation for the cultural changes which occurred during the Pleistocene – Holocene transition within the study area, The Swabian Alb in South-West Germany. Attention is focused on the natural environment, settlement continuity and technological innovations.

JULIAN THOMAS: *Rethinking the Neolithic.* New Studies in Archaeology. Cambridge University Press, 1991. 212pp.

The focus in on South-West Britain, the classic scene for research on the British Neolithic. The author challenges traditional views about neolithic societies and offers new possibilities of interpretation.

BERNHARD STAPEL: *Die geschlagenen Steingeräte der Siedlung Hüde I am Dümmer.* Veröffentlichungen der urgeschichtlichen Sammlungen des Landesmuseums zu Hannover. Verlag August Lax, Hildelheim, 1991. 209pp., 152 distribution plans and 43 plates.

The settlement complex at Dümmer-See in Lower Saxonia has been regarded as one of the important sites for research on the Early Neolithic in North-Western Europe since the discoveries by Reinerth (from 1938) and the excavations by Deichmüller (since 1961). The finds include Rössen, Ertebølle and early TRB elements. Bernhard Stapel presents an analysis of the lithic material from the site of Hüde I in an attempt to establish a sequence of industries belonging to successive occupations.

SØREN DIETZ: *The Argolid at the Transition to the Mycenaean Age. Studies in the Chronology and Cultural Developments in the Shaft Grave Period.* The National Museum of Denmark, Department of Classical Antiquities. Copenhagen 1991. 336pp.

This dissertation presents a study of the material culture of the Argine Plain, Peloponnese, during Middle Helladic times. A detailed classification of settlement pottery leads to a description of the chronology, settlement patterns, cultural development and external relations during this important formative stage.

FLEMMING KAUL, IVAN MARAZOV, JAN BEST & NANNY DE VRIES: *Thracian Tales on the Gundestrup Cauldron.* Publications of the Holland Travelling University, Volume One. Najade Press, Amsterdam, 1991. 114pp., 53 figs.

The centennial of the discovery of the Gundestrup Cauldron was celebrated on the 28th of May 1991. In this small publication, four scholars, each with a different background, present new evidence for the origin of the cauldron and discuss its iconography.

SØREN H. ANDERSEN, BIRGIT LIND & OLE CRUMLIN-PEDERSEN: *Slusegårdgravpladsen III, Gravformer og gravskikke. Bådgravene.* Jysk Arkæologisk Selskabs Skrifter XIV,3. Aarhus Universitetsforlag, 1991. 266pp. With summaries in English.

The first two volumes of the publication about the important Roman Iron Age cemetery at Slusegård on Bornholm were published in 1978 by Ole Klindt-Jensen, who died in 1980. This is the first of three volumes based on the records left by the excavator. It contains contributions on the geology and topography, grave types and burial customs, and on the boat-graves, which are especially characteristic of this cemetery.

Høvdingesamfund og Kongemagt. Fra Stamme til Stat i Danmark 2. Edited by PEDER MORTENSEN & BIRGIT M. RASMUSSEN. Jysk Arkæologisk Selskabs Skrifter XXII:2. Aarhus Universitetsforlag 1991. 296pp. With summaries in English.

The second report from the research programme *Fra Stamme til Stat,* initiated by the Danish Research Council for the Humanities in 1984. The aim of the programme is to promote research conserning the economic, social and political development from the Roman Iron Age to the Viking Age in Denmark.

Samfundsorganisation og Regional Variation. Norden i romersk jernalder og folkevandringstid. Beretning fra 1. nordiske jernaldersymposium på Sandbjerg Slot 11–15 april 1989. Edited by CHARLOTTE FABECH & JYTTE RINGTVED. Jysk Arkæologisk Selskabs Skrifter XXVII. Aarhus Universitetsforlag, 1991. 352pp. With summaries in English.

Twenty-four papers on the Roman Iron Age and Migration Period, dealing with imports, interpretation of grave finds, iron production, gold, and the nature of power.

Aspects of Maritime Scandinavia AD 200–1200. Proceedings of the Nordic Seminar on Maritime Aspects of Archaeology, Roskilde, 13th-15th March 1989. Edited by OLE CRUMLIN-PEDERSEN. Vikingeskibshallen, Roskilde 1991. 291pp.

Twenty-three contributions on ships, ports and trading stations, including discussions about the methods used in present research concerning the reconstruction of the coastal environment and maritime traffic in later Prehistory and the early Medieval Age.

ELSE ROESDAHL: *The Vikings.* Allen Lane, The Penquin Press, London 1991. 323pp.

An English translation of the authoritative work in Danish from 1987, *Vikingernes Verden.* It presents a comprehensive and up-to-date survey of the archaeology and history of the Vikings, in Scandinavia and abroad.

Social Approaches to Viking Studies. Edited by ROSS SAMSON. Cruithne Press, Glasgow, 1991. 240pp.

Twenty-one papers presented at the seminar, New Perspectives on Viking Studies, Glasgow 1988. Historians, archaeologists and anthropologists discuss Viking Age societies, deriving their inspiration from structuralism, feminism, economic anthropology, and Marxism, among others.

Mammen. Grav, kunst og samfund i vikingetid. Edited by METTE IVERSEN, ULF NÄSMAN & JENS VELLEV. Jysk Arkæologisk Selskabs Skrifter XXVIII (Viborg Stiftsmuseums række bind 1). Aarhus Universitetsforlag 1991. 343pp. With summaries in English and German.

This monumental report from a seminar held in 1987 presents a number of studies on the princely burial (dendro-dated to 970/71 AD) and the treasure find at Mammen, Central Jutland, of which the former is the eponymous site of the Viking Age Mammen Style. The Mammen grave promts discussions about the transition from paganism to Christianity in Scandinavia.

TORSTEN KEMPKE: *Starigard/Oldenburg. Hauptburg der Slawen in Wagrien. III, Die Waffen des 8.–13. Jahrhunderts.* Offa-Bücher Band 73. Karl Wachholtz Verlag, Neumünster 1991. 103pp. including 7 maps.

An analysis of the weapons found at the Old Slavonic castle of Starigard/Oldenburg, excavated in the period 1953–1986. With contributions to the history of weaponry in the Baltic region from the Viking (or early Medieval) Age to the 14th Century.

DIRK HEINRICH: *Untersuchungen an Skelettresten wildlebender Saugetiere aus dem mittelalterlichen Schleswig. Ausgrabung Schild 1971–1975.* Ausgrabungen in Schleswig, Berichte und Studien 9. Karl Wachholtz Verlag, Neumünster, 1991. 203pp.

The author continues the work on the animal bones from Schleswig (the analyses of the domestic animals were published in 1990 by Heidemarie Hüster in the same series). The material dealt with is compared with the wild fauna at a number of North German sites.

GÜNTER P. FEHRING: *The Archaeology of Medieval Germany – an introduction.* Studies in Archaeology. Routledge, London & New York 1991. 266pp.

Translation of *Einführung in die Archäologie des Mittelalters* (1987). Students in Medieval archaeology are priviledged in having access to this and a number of other recently published, national surveys (earlier H. Clarke, *The Archaeology of Medieval England,* 1984; S. Tabaczynski, *Archaeologia sredniowieczna* (Poland), 1987; N.-K. Liebgott, *Dansk Middelalderarkæologi,* 1989).

Eksperimentel Arkæologi. Studier i teknologi og kultur nr. 1, 1991. Edited by BO MADSEN. Historisk-Arkæologisk Forsøgscenter, Lejre, 1991. 176pp. (with summaries in English)

The first of a new series of reports on experimental archaeology, a discipline exercised at the Lejre Experimental Centre since 1964. The volume includes reports on: The use of mesolithic antler axes, pollarding of trees, Bronze Age ornamentation, cremation burial, pattern welded swords, cultivation of Iron Age cereàls, rotary querns, Iron Age house construction, shooting with Iron Age bows, loom weaving, and the manufacture of glass beads.