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Journal of Danish Archaeology vol. 5, 1986, pp 7–13

New C-14 Datings of Late Palaeolithic Cultures from Northwestern Europe

by ANDERS FISCHER and HENRIK TAUBER

Abstract. New and more accurate C-14 dates of Alfred Rust's classical finds from Poggenwisch, Meiendorf, and Stellmoor have been carried out. At all three localities, find assemblages of the Hamburgian Culture is dated to the period c. 12500–12100 b.p. in C-14 years, whereas the industry of the Ahrensburgian Culture at Stellmoor gave ages within a narrow time interval at approximately 10100–9900 b.p. in C-14 years. Based on the C-14 datings, the time relations, and the possible genetic relations, between a number of Late Glacial and Post Glacial technocomplexes are discussed, i.e. the Magdalenian, the Hamburgian, the Federmesser, the Bromme, the Ahrensburgian and the Maglemosian complexes.

Previous attempts at C-14 dating of the Hamburgian and Ahrensburgian Cultures

The number of properly investigated settlements from the Late Glacial in northwestern Europe has increased considerably in recent years. Nevertheless, the excavations carried out by the late Alfred Rust in the Stellmoor tunnel valley, about half a century ago, are still of fundamental importance for understanding the chronological relations between the Palaeolithic cultures of the Late Glacial, as no other sites have furnished a more suitable material for pollen analysis or C-14 dating of the Hamburgian and Ahrensburgian Cultures.

In the early years of the C-14 method, a number of samples from the refuse layers in the Stellmoor tunnel valley were C-14 dated. These early age determinations of material from the Hamburgian and Ahrensburgian Cultures are listed in Table 1. As is seen, the dates of the Hamburgian Culture show a very large scatter. This is mainly due to the fact that at the early time of C-14 dating, it was not realized that calcareous gyttja and the carbonate fraction of bones and antler are highly unreliable materials for C-14 dating and may give dates that deviate some thousands of years from true ages.

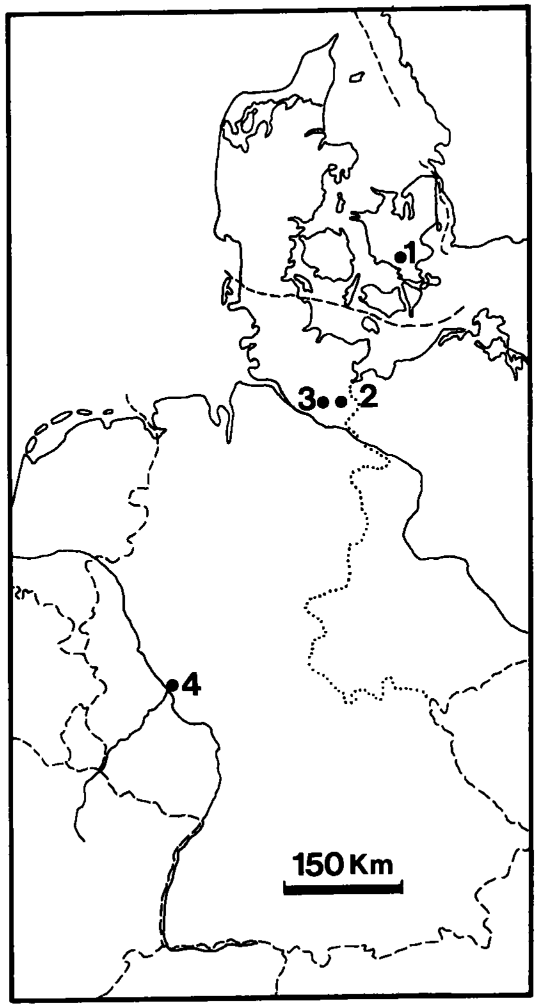

Fig. 1. C-14 dated Danish and German sites mentioned in the text. 1. Trollesgave, 2. Duvensee 8, 3. Stellmoor, Meiendorf and Poggenwisch, 4. Gönnersdorf.

Contributing to the scatter may also have been that at that time no common C-14 standard existed. Dates from different C-14 laboratories, therefore, may have been differently biased.

Locality *Sample no.*	*Wood*	*Antler or bone*	*Gyttja*	*Fraction of sample*
Stellmoor, upper layer				
W-262		9500 ± 200		Predominantly org. fraction
Stellmoor, lower layer				
W-261		12450 ± 200*		Predominantly org. fraction
Meiendorf				
W-264		11790 ± 200*		Predominantly org. fraction
W-281		11870 ± 200*		Organic fraction
H-38-121 A		12000 ± 300*		Organic fraction
H-38-121 B		12300 ± 300*		Organic fraction
H-38-121 C		6150 ± 500		Carbonate fraction
W-172			15750 ± 800	Org. fraction of gyttja
Poggenwisch				
W-271		11750 ± 200*		Predominantly org. fraction
H-31-67		13050 ± 200*		Organic fraction (bone)
H-136-116	12980 ± 370*			Twigs only
W-93			15150 ± 350	Organic fraction of gyttja
H-32-60			15700 ± 350	Organic fraction of gyttja
H-32-118 A			17100 ± 500	Carbonate fract. of gyttja
H-32-118 C			12850 ± 500	Organic fraction of gyttja

Table 1. Previous C-14 dates (b.p.) of samples from the Ahrensburgian and Hamburgian Cultures according to Suess (1954), Rubin and Suess (1956), and Münnich (1957).

However, if only the measurements of the organic fraction of bones and antlers, and of twigs, are considered (marked with an asterix in Table 1), a more consistent pattern emerges, especially if the large statistical errors are taken into consideration. The dates of the Hamburgian industries then range from c. 13050 ± 270 b.p. to 11750 ± 200 b.p. with a mean value close to 12300 b.p. Due to the large statistical errors of these dates, it is, however, difficult to draw any conclusions as to the likely duration of the habitation periods at the different sites, or to a possible time differentiation between them.

The previous C-14 dates of these industries have, therefore, given rise to a considerable uncertainty about the correct chronological position of the Hamburgian Culture. This can only be changed by new and more accurate C-14 dates of samples from the classical finds.

At the time of excavation, attempts were also made to date the Late Glacial sites in the Stellmoor valley by pollen analysis. In this way the sites representing the Hamburgian Culture were placed in the Oldest Dryas (Schütrumpf 1937, 1943, 1958). Later investigations (Usinger 1975) have shown that the habitation layers more likely belong to the Bølling period. However, the synchronism, and therefore the absolute age, of the early Late Glacial pollen zones in northwestern Europe is still under discussion, and correlation with C-14 dated pollen zone borders at other localities may therefore be somewhat uncertain.

Also the upper layer at Stellmoor, with artifacts of the Ahrensburgian Culture, has been pollen analysed. The layer was shown to belong to the Younger Dryas (Schütrumpf 1943; cp. Averdick 1975), which covers the time interval c. 11000 to 10000 b.p. (Mangerud *et al.* 1974; Berglund 1979). This is partly at variance with the only C-14 date of 9500 ± 200 b.p. (W 262, see Table 1), which has so far been obtained on material from this layer. Also a new and more accurate C-14 dating of the Ahrensburg layer is therefore required.

New samples for C-14 dating

Samples from the original excavations by Alfred Rust (1937, 1943, and 1958) were made available for new C-14 datings through the courtesy of the Schleswig-Holsteinisches Landesmuseum. The samples were selected in 1984 among the finds of Ahrensburgian industry found at Stellmoor, and from the finds of Hamburgian industry at Stellmoor, Meiendorf, and Poggenwisch.

The selection of samples were made in accordance with guidelines laid down by A.F. It was decided only to use unworked antler or bones (including marrow split bones) as dating material, and only to apply material from a single specimen in each sample. Great care was taken to secure samples with a well documented provenance. However, indications of the precise provenance did not exist. At best the origin of the samples was indicated by codes like Md2 (Meiendorf dead ice hole), AbH (Hamburgian layer at the Stellmoor dead ice hole), or AbA (Ahrensburgian layer at the Stellmoor dead ice hole). As a first choice, specimens of antler or bone with such a code painted on the sample itself, or indicated on a tag attached to the sample, were selected (provenance category 1). Because of a shortage of specimens of this kind, a number of samples were also chosen among specimens kept in small, closed cardboard boxes with a common label indicating the site and layer (provenance cat. 2). Specimens stored collectively in big open boxes, and without individual information, were avoided. Alltogether 17 samples were selected.

In order to estimate the necessary sample amounts, micro analyses of the nitrogen content of a number of bones and antlers were kindly carried out by Preben Hansen at the Chemical Institute, Univ. of Copenhagen. The analyses showed that approximately 100g of material of each sample would be sufficient for an accurate dating.

C-14 dating of the Ahrensburgian and Hamburgian Cultures

Only the collagen fraction of bones and antler was used for C-14 dating. It was separated by the method of Longin (1971) with an additional extraction for humic acids if indicated by the colour. The collagen was combusted to carbon dioxide, which was purified and counted in a proportional counter. A small portion of the carbon dioxide was used for assay of the C-13 content, which is expressed as $\delta^{13}C$ values, i.e. as per mil deviations from the isotope ratio in the PDB-standard. The $\delta^{13}C$ values were used for a correction for isotopic fractionation. Such a correction makes all C-14 dates of terrestrial materials (e.g. bone and antler) directly comparable. The final dating results are expressed in conventional C-14 years before 1950 (b.p.).

Stellmoor, Ahrensburgian Culture

K-4262	Antler of reindeer attached to cranial bone. Stellmoor, "AbA 8,0 167". Provenance cat. 1. $\delta^{13}C = -17,9‰$	10110 ± 105 b.p.
K-4323	Shed antler, possibly with marks of gnawing. Stellmoor, "AbA-162". Provenance cat. 1. $\delta^{13}C = -18,1‰$	9930 ± 100 b.p.
K-4324	Antler of reindeer attached to cranial bone. Stellmoor, „AbA 7,8 165". Provenance cat. 1. $\delta^{13}C = -18,0‰$	9900 ± 105 b.p.
K-4325	Marrow split bone (femur) of reindeer. Stellmoor, "1.F.". Provenance cat. 2. $\delta^{13}C = -17,9‰$	10010 ± 100 b.p.
K-4326	Marrow split long bone of reindeer. Stellmoor, "M.f". Provenance cat. 2. $\delta^{13}C = -17,4‰$	10140 ± 105 b.p.
K-4578	Marrow split bone of reindeer with possible marks of gnawing. Stellmoor, "... ju". Provenance cat. 2. $\delta^{13}C = -19,2‰$	10100 ± 100 b.p.
K-4579	Antler of reindeer. Stellmoor, "AbA 8,2 151". Provenance cat. 1. $\delta^{13}C = -17,5‰$	9980 ± 105 b.p.
K-4580	Antler of reindeer attached to cranial bone. Stellmoor, "AbA 8,4 138". Provenance cat. 1. $\delta^{13}C = -18,6‰$	9810 ± 100 b.p.
K-4581	Antler of reindeer attached to cranial bone. Stellmoor, "AbA 7,2 174". Provenance cat. 1. $\delta^{13}C = -19,2‰$	9990 ± 105 b.p.

Stellmoor, Hamburgian Culture

K-4261	Shed antler of reindeer. Stellmoor, "ABH". Provenance cat. 1. $\delta^{13}C = -18,6‰$	12190 ± 125 b.p.
K-4327	Antler of reindeer attached to cranial bone. Stellmoor, "Ab.H" Provenance cat. 1. $\delta^{13}C = -17,7‰$	10130 ± 105 b.p.
K-4328	Bone of reindeer (metacarpus). Stellmoor, "Ab.H M.mc.". Provenance cat. 1. $\delta^{13}C = -18,0‰$	12180 ± 130 b.p.

Meiendorf, Hamburgian Culture

K-4329	Antler of reindeer attached to cranial bone. Meiendorf, "Md.2. 34 U14". Provenance cat. 1. $\delta^{13}C = -18,3‰$	12360 ± 110 b.p.

K-4330	Marrow split bone (humerus) of reindeer. Meiendorf, "341 ~ humerus". Provenance cat. 2. $\delta^{13}C = -18,3‰$	10110 ± 85 b.p.

Poggenwisch, Hamburgian Culture

K-4331	Bone of reindeer (epistropheus). Poggenwisch, "J_2 H_2". Provenance cat. 2. $\delta^{13}C = -18,8‰$	12440 ± 115 b.p.
K-4332	Bone of reindeer (atlas). Poggenwisch, "J_1 H_1". Provenance cat. 2. $\delta^{13}C = -18,6‰$	12570 ± 115 b.p.
K-4577	Bone of reindeer (vertebra) with butchering traces and marks of gnawing by carnivore. Poggenwisch, "L". Provenance cat. 2. $\delta^{13}C = -17,4‰$	12440 ±115 b.p.

Evaluation of the C-14 dates

Two of the samples, which, according to the available information, were supposed to originate from the Hamburgian Culture, obviously have given ages that closely correspond to those of the Ahrensburgian layer at Stellmoor. Most likely they actually originate from the Ahrensburgian layer, but have got an erroneous provenance indication. Sample K-4330 belongs to provenance cat. 2, and an exchange may possibly have taken place during the long period of storage. Sample K-4327 from Stellmoor belongs to provenance cat. 1, and a mistake may here have arisen already during the excavation. If such mistakes are assumed, a very clear chronological pattern emerges (see Table 2).

The 11 samples of the Ahrensburgian Culture (including K-4327 and K-4330) have given dates which are so similar that the scatter only slightly exceeds what would be expected from a normal statistical distribution around a mean value close to 10020 b.p. in C-14 years. The dates therefore suggest that the investigated samples from the Ahrensburgian layer originate from animals which were killed within a very short time span around that date, i.e. just before the end of the Younger Dryas. A somewhat more extended period covering a few hundred years around 10000 b.p., however, cannot be excluded by the dates. This age of the Ahrensburgian Culture at Stellmoor is a little older than the only previous C-14 date from this layer (W-262, 9500 ± 200 b.p.), and somewhat younger than expected from the pollen analytical dating, although the new C-14 dates are not in disagreement with the pollen analytical evidence.

The approximate absolute age of the Ahrensburgian layer at Stellmoor may be derived from recent investigations of the absolute age of the Younger Dryas/Preboreal transition. By means of the revised varve chronology, and by ice core dating, this transition has been dated to c. 10700 b.p., or 8750 b.c., in calendar (solar) years (Strömberg 1985; Hammer *et al.* 1986). An absolute age very close to this also apply to the Ahrensburgian layer at Stellmoor.

It is usually assumed that the finds from the upper (Ahrensburgian) layer in the Stellmoor dead ice hole represent dump material and deliberate deposits of tools and raw materials from the settlement on the adjacent hill (the "Stellmoor Hügel"). The amount of flint artifacts from this site suggests a habitation density or frequency, which is quite unusual compared to other Late Palaeolithic sites of northern Europe. The plowed-up settlement area, which covers c. 250 by 120 m, is estimated to have contained c. 2000 tanged points (Tromnau 1975: 70). This number should be compared with the number of tanged points which was discovered in the fully excavated, individual flint concentrations of the Ahrensburgian Culture in the Stellmoor area. These flint scatters have been assumed to represent the refuse deposited during a single season by individual family units (cp. Rust 1958: 40; Fischer 1976: 106), and they contained on an average approximately 10 tanged points each (Tromnau 1975: 69).

The finds from the Ahrensburgian layer at Stellmoor may thus represent the remains from approximately 200 family visits (cp. Tromnau 1975: 71). On the basis of the available information on stratigraphy (Schütrumpf 1943: 10), and the wide typological variation within the assemblage of flint points, a rather long and discontinuous habitation period could have been expected. However, if the dated samples constitute a random selection representing the whole habitation period of the Ahrensburgian Culture at the Stellmoor hill, a comparatively short time span, and consequently a larger number of family units per year, is the most likely interpretation of the present C-14 dates.

Such an interpretation can be supported by ethnographic parallels. During the Younger Dryas the partly submerged Stellmoor tunnel valley must have acted as a barrier for the seasonal migrations of the main big game of the period, i.e. the reindeer, leaving a narrow passage at the foot of the Stellmoor hill (Rust 1958: Fig. 5; Tromnau 1975, Fig. 4,1). This topography have made this part of the tunnel valley a very suitable place for hunting reindeer by driving the migrating herds into the narrow passage. From ethnography several examples are known, where recent hunters of reindeer have gathered in considerable numbers at such localities in order to practise drive hunting on migrating herds (Gubser 1965: 65 and 104; Taylor 1974: 48; Binford 1978: 391 ff.). Ethnographic parallels from reindeer hunting at similar localities thus give no reason to doubt the new C-14 dates of the Ahrensburgian layer at Stellmoor.

The six C-14 dates of the Hamburgian Culture at Stellmoor, Meiendorf, and Poggenwisch cover a time interval from approximately 12500 to 12100 b.p., which corresponds to the first major warm period during the Late Glacial. The dates suggest a possible time differentiation between the three settlements with Poggenwisch the oldest, Meiendorf intermediate in age, and Stellmoor the youngest. It should, however, be kept in mind that the number of dates from each assemblage is very limited, and the suggested time differentiation could therefore be accidental.

Based on partly intuitive arguments, a time differentiation was also tentatively suggested by Rust (1958: 130), but Rust assumed that Poggenwisch was markedly younger than Meiendorf. However, it may as well be argued that the industries of the three sites are roughly contemporaneous and all belong to a fairly early part of the Hamburgian Culture (cp. Tromnau 1975: 34 and 79; Stapert 1984: 25, 1985: 83). The pollen analytical investigations of Schrütrumpf (1938, 1943, 1958), which formed part of the argument by Rust for a late chronological position of Poggenwisch, have also been questioned in a more recent investigation by Usinger (1975: 117 ff). Neither from a typological, nor from a pollen analytical point of view, should there be significant reasons to doubt the time sequence suggested by the new C-14 dates for the three habitations of the Hamburgian Culture at Poggenwisch, Meiendorf, and Stellmoor.

Locality *Sample no.*	*Age of Sample*	*Fraction of sample*
Stellmoor, upper layer		
K-4262	10110 ± 105	Collagen (antler)
K-4323	9930 ± 100	Collagen (antler)
K-4324	9900 ± 105	Collagen (antler)
K-4325	10010 ± 100	Collagen (bone)
K-4326	10140 ± 105	Collagen (bone)
K-4578	10100 ± 100	Collagen (bone)
K-4579	9980 ± 105	Collagen (antler)
K-4580	9810 ± 100	Collagen (antler)
K-4581	9990 ± 105	Collagen (antler)
Stellmoor, lower layer		
K-4261	12190 ± 125	Collagen (antler)
K-4327	10130 ± 105	Collagen (antler)
K-4328	12180 ± 130	Collagen (bone)
Meiendorf		
K-4329	12360 ± 110	Collagen (antler)
K-4330	10110 ± 85	Collagen (bone)
Poggenwisch		
K-4331	12440 ± 115	Collagen (bone)
K-4332	12570 ± 115	Collagen (bone)
K-4577	12440 ± 115	Collagen (bone)

Table 2. New C-14 dates (b.p.) of samples of bone and antler from Stellmoor, Meiendorf, and Poggenwisch.

Perspectives for cultural relations

The new C-14 dates of the Hamburgian Culture support the previously somewhat unsubstantiated assumption of a contemporaneity between this culture and the late parts of the Magdalenian Culture, which prevailed in Western and Central Europe south of the Hamburgian area (Bosinski 1978; Otte *et al.* 1984). The industry of the Hamburgian complex in the Stellmoor valley thus seems to be closely contemporaneous with the Magdalenian stage V industry from Gönnersdorf in the Middle Rhein area (Bosinski 1970; Brunnacker 1978: 44). A detailed comparison of the contemporaneity of the two cultures will, however, have to await new and more consistent C-14 dates of the Magdalenian Culture.

Though approximately contemporaneous, the tool traditions of the two cultures show considerable stylistic differences. The settlements of the Hamburgian Culture, therefore, can hardly be considered as summer hunting stations advanced from the more southern sites by the Magdalenian groups (cp. Bokelmann 1979: 22). If the Hamburgian Culture is derived from the Magdalenian Culture, the cultural and geographic differentiation therefore would be expcted to have taken place at a time earlier than Magdalenian V.

The new C-14 dates indicate that the Hamburgian

Culture is only separated by a relatively short time span from the subsequent Federmesser and Bromme complexes. Sites of the Federmesser complex have been C-14 dated as far back as c. 12000 b.p. in northwestern Germany (Bokelmann *et al.* 1983: 230), and back to c. 11500 b.p. in the Netherlands (Houtsma *et al.* 1984: 72), whereas the Bromme Culture in Denmark, at the site Trollesgave, has been C-14 dated to c. 11100 b.p. (Fischer and Mortensen 1977; Fischer *et al.* 1979). In this comparison it should be taken into account, that typologically the Trollesgave industry, which is the only C-14 dated assemblage of the Bromme Culture, does not appear to be the earliest phase of this Culture in Denmark (Fischer 1978); and that Poggenwisch, Meiendorf, and Stellmoor can hardly be the youngest settlements of the Hamburgian Culture as the Havelte group has a definitely younger appearance (cp. Stapert 1984, 1985).

The very short time interval between the C-14 dated assemblages of the Hamburgian Culture and of the Federmesser complex strengthens the typologicaly based assumption of a direct relationship between the two groups (Stapert 1985: 85 ff; cp. Houtsma *et al.* 1984: 68 ff). A similar relationship between the late Hamburgian Culture and the early Bromme Culture in Denmark is more uncertain. Typological similarities between the tool kits of the two cultures have been demonstrated (Madsen 1983: 29). They are, however, of a rather general character. Furthermore, a number of stray finds (Fugl Petersen 1974) and settlement assemblages containing elements characteristic of the Federmesser complex also exist in Denmark. As the age and the cultural context of these finds have not been clearly established, it is premature to decide whether the Hamburgian Culture, at its northernmost extension (Holm and Rieck 1983), developed directly into the Bromme Culture, or whether the cultural development passed via the Federmesser complex, and perhaps from this complex into the Bromme Culture.

Whereas the origin of the Bromme Culture is still somewhat uncertain, the close of the culture seems more certain. Typological resemblances thus suggest that the Bromme Culture gradually developed into the Ahrensburgian Culture. The find assemblage of the upper layer at Stellmoor may be considered as one of the latest steps in this succession (Fischer 1978).

The new C-14 dates of the Ahrensburgian layer at Stellmoor demonstrate that only a surprisingly short time interval separates this layer from the time of the oldest Post Glacial find assemblages in northwestern Europe, viz. the Maglemosian Culture. The oldest C-14 dated find association of the Maglemosian Culture in the vicinity of Stellmoor is Duvensee 8, which is only about 500 years younger than the Ahrensburgian layer of Stellmoor (Bokelmann *et al.* 1981: 35) from which it differs considerably in terms of typology. In spite of this typological difference, a continuity of tradition and population may be expected between the Ahrensburgian and Maglemosian Cultures (Fischer 1978, 1981). The comparatively large typological difference, within a short time interval, between the industry of the upper layer of Stellmoor and the Duvensee 8 assemblage may thus be considered as the result of an extraordinary rapid stylistic and technological evolution.

At the transition from the Late Glacial to the Post Glacial, the settlement pattern was probably changing as rapidly as the material culture. First of all, the climatic change at that time gave rise to considerable changes in the fauna, of which the human populations were highly dependent. The migrating herds of reindeer were thus replaced by scattered and more territorial big game. This must have favoured a development towards a smaller number of inhabitants, and possibly also shorter periods of habitation at the different settlements. In that case the settlements from the earliest part of the Post Glacial will be difficult to discover, because of the smaller and less dense deposits of cultural debris. These circumstances may be the main reasons for the well known lack of archaeological material from the centuries around the transition from the Late Glacial to the Post Glacial, which still exists throughout large parts of Europe.

The dating programme reported on in this paper was started in 1983 at the initiative of A.F., who is responsible for the selection of samples and for the archaeological evaluation and interpretations. H.T. is responsible for the C-14 measurements and for the statistical interpretations of C-14 results.

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Rude Mark
– A Maglemosian Settlement in East Jutland

by NIELS AXEL BOAS

The Maglemosian settlement of Rude Mark, near Odder in eastern Jutland, was completely excavated in the spring of 1978. The excavation was undertaken because of plans to build a by-pass round the town of Saksild (1). The settlement lay in the middle of the proposed route centred on the 18 m contour, near the top of the slope down towards the now-dry Kysing Fjord. During the period of settlement, the fiord was probably filled by a fresh-water lake with its surface near the 8 m contour (S.H. Andersen 1975, p. 33). The site was not on the lake shore, but lay some 200 m from it on the nearest more or less flat piece of ground to the south. In the absence of heavy tree growth to the north, the site would have had (just as it does today) a good view of much of the SW-NE oriented boreal lake basin (fig. 1).

The settlement was found during a survey by Jan Skamby Madsen, formerly of Odder Museum. A trial excavation of about 2 m^2 revealed a high concentration of flint of Maglemosian type (2). Surface collection indicated that the settlement extended about 15 m all round the trial excavation. The locality does not seem to have been known to private collectors or ever to have been exposed to systematic collection of artifacts.

During 1978 an area of 304 m^2 was examined. 125 m^2 of plough soil was removed by machine from zones about 3 m wide along the eastern side and 3.25 m wide along the south side of the area. The rest of the plough soil was excavated by shovel and sieved through a 4 mm mesh. The cultural deposits below the plough soil were also sieved in this way.

The relatively high lying site was noteworthy for several reasons. The limited extent of what was apparently a single occupation made complete excavation possible. A number of disturbances resulting from both human and natural causes could be distinguished, and their effects allowed for. Artifactually the find shows a near total specialisation on microlith production. Triangular microliths are particularly common, while all other tool types are rare.

THE NATURE OF THE SITE

The settlement was located on morainic sand with a low lime content. On the surface of this subsoil was the remains of a scatter of granite and flint nodules of various sizes. These stones were particularly concentrated in a 3 m broad zone running SW-NE, with a smaller concentration a little SE of the centre of the site. The terrain falls only about ½ m towards the N in the settlement area.

Most of the central part of the settlement was covered by a 0.1–0.2 m thick sand layer with a little humus, or a cultural deposit yielding finds (fig. 2 level 3). The level thinned out on all sides towards the edge of the excavated area. The fact that this remnant of a cultural layer was found at all may be because the site was originally located in a slight depression in the terrain. This could also have been created by human activity during the period of settlement. Intensive activity on the probably thin humus layer on the poor sand could have caused mixing and disturbances of this sort of depth below the surface of the ground. Most of the stones on the surface of the subsoil and in the thin cultural level were randomly distributed and lay in their original positions. A degree of clearance may be indicated by an area about 4 × 5 m, which was free of stones, in the centre of the site.

The only trace of a feature linked to the settlement was an irregular diffuse area of reddish sand and humic sand in the centre of the site, just to the north of the 1977 trial excavation. It measured about 2 × 3 m, and was up to 1 m deep. A tongue of humic sand with a patch of charcoal up to 0.5 m across extended from the south into the previously mentioned feature. The southern part of the reddish feature was disturbed by the largest tree fall on the site, measuring some 4 × 5 m. The patch of charcoal and the red colour of the feature could result from a hearth or hazelnut roasting area ploughed away when a system of ridge and furrow cultivation was established during the historical period. The bottom of a furrow between two strip fields ran right over the central part of the red feature. The lack of burnt stones can be explained by the fact that the original hearths have been ploughed away. The next furrow in the medieval field system was visible in the northernmost part of the excavated area. This one had also cut at least 0.2 m down, so that all traces of the cultural level had vanished (fig. 2, level 2).

A total of 18 treefall holes were observed, all very uniform. They varied from 1.5 to 5 m in diameter, and from 0.3 to 1.2 m in depth. They were usually regularly oval in shape. They contained a characteristic tripartite deposit consisting of a 0.1–0.2 m thick, sloping or vertical humic sand level with finds. On one side of this was the remains of a layer of the bright yellow basal sand, broken up by root holes, and on the other a sandy humic layer, grey in colour and with no stones. The lastnamed rarely contained finds, and consisted mainly of leached sand which originally lay around the bole of the tree, and also of material naturally deposited on the contemporary forest floor. The cultural deposits in the treefall holes in the central part of the site had a very high frequency of finds. These holes therefore give a fairly good idea of the density of finds on the settlement at a time presumed to precede the later cultivation.

Various points on the old surface and in the treefall holes produced collections of charcoal, which can not, however, be definitely linked to the occupation. Some scattered Early Neolithic material was found in the western part of the excavated area, but none was found in the treefall holes, which suggests that the trees in question had fallen before the Neolithic period.

FINDS

Soil conditions mean that only charred organic materials survive. Flint and stone, on the other hand, probably present an almost representative picture. The flint nodules from the scatter of stones on the subsoil surface seem to be immediately usable for tool manu-

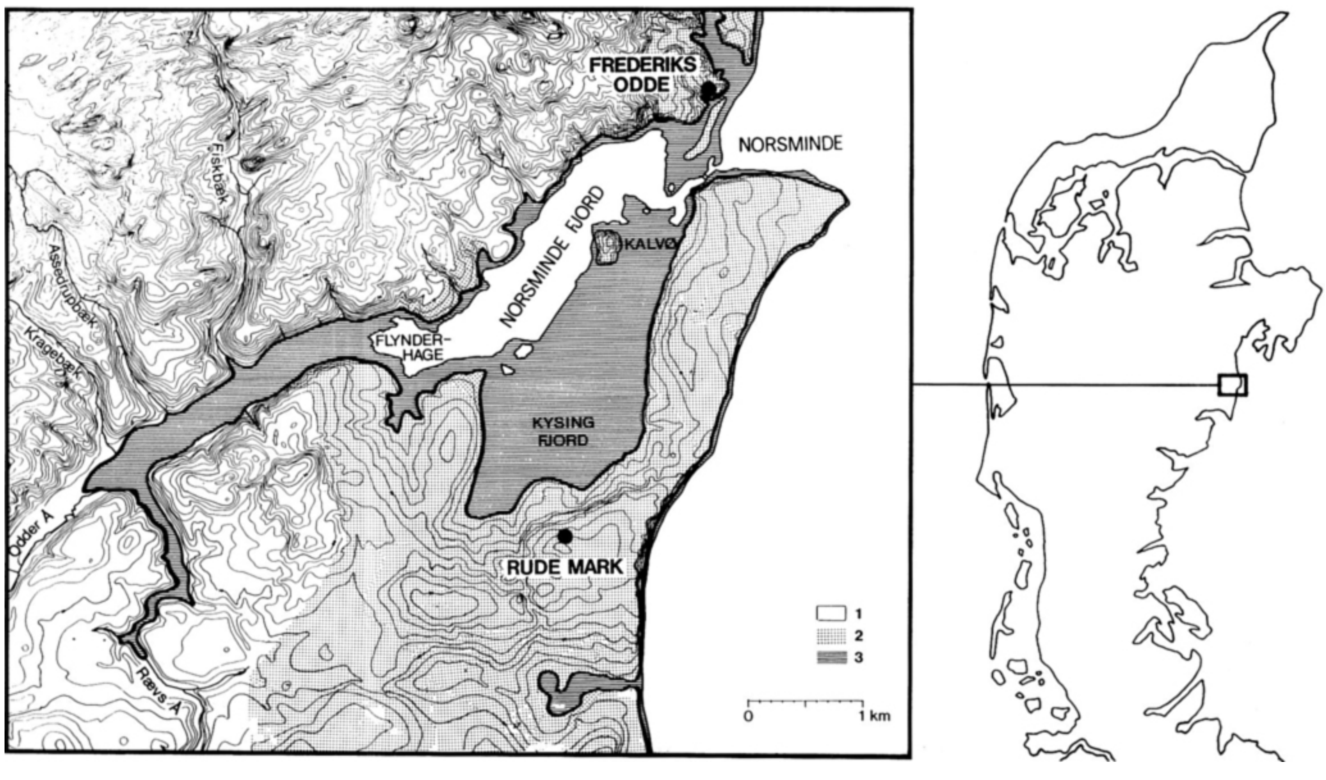

Fig. 1. The location of the Rude Mark settlement and the only other known Maglemosian site, Frederiks Odde, in the Kysing- and Norsminde Fjord region. Orohydrographic map based on 4 cm map sheet by Geodætisk Institut (reproduced with permission of the G.I. no. A.404/85. Courtesy S.H. Andersen). – 1, clay. 2, sand. 3, raised sea-floor.

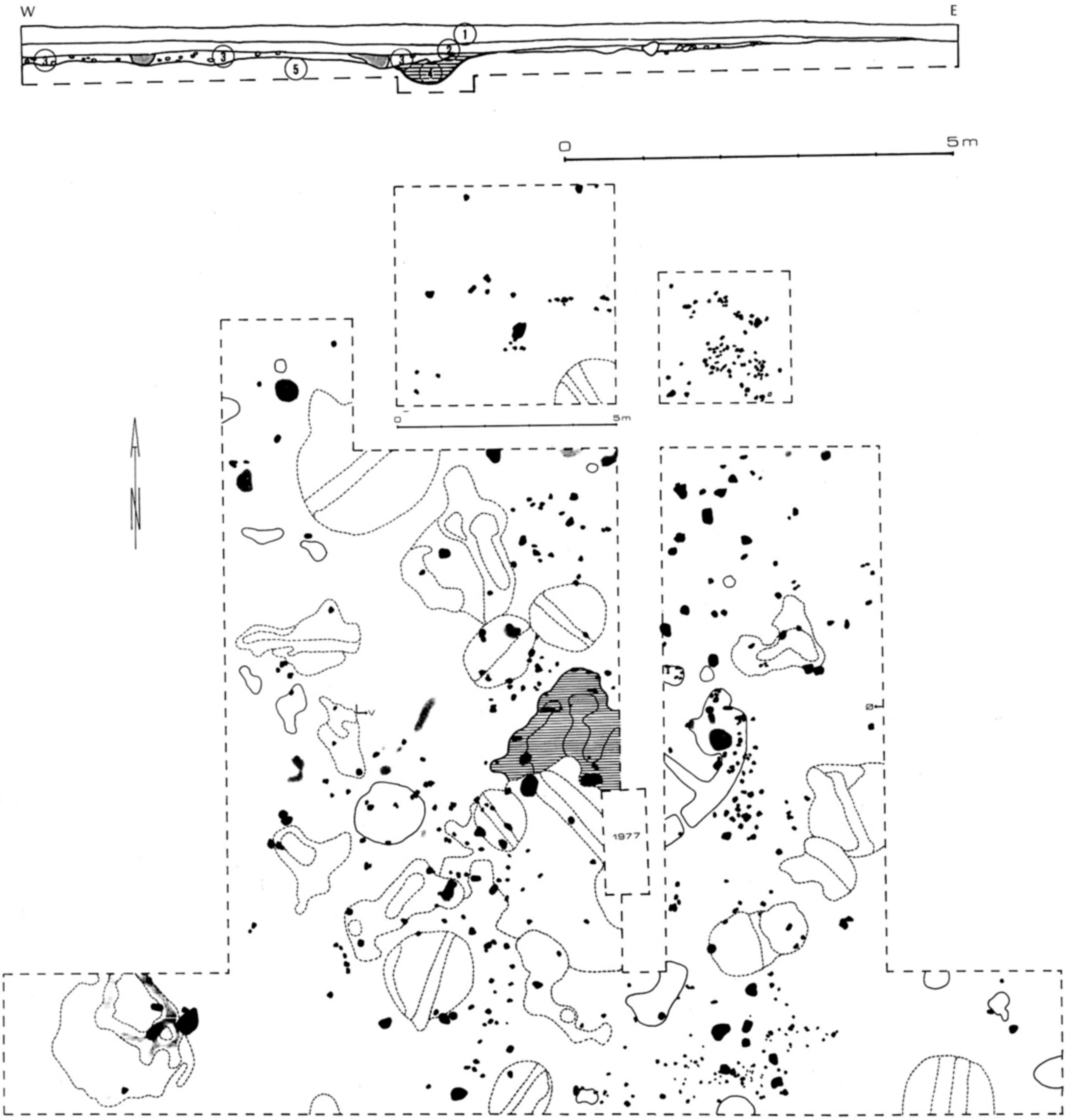

Fig. 2. W-E section and plan of the settlement.

facture. Tools were mainly produced from local morainic flint, using nodules of small size. 49% of the blade cores, for example, have some cortex remaining. Use of frost shattered surface flint is also common, as 66% of the blade cores have at least one frost shattered primary working surface.

The total flint waste and worked pieces amounts to 22,579 items. 723 (3.2%) are artifacts. Total weight of the flint material is 36,430 grams, the artifacts weighing 1,920 grams or 5.3%. Only 2% of the flint is shattered by heat. The distribution of burnt flint (fig. 3) supports the interpretation of the central reddish sand area as a hearth or roasting area, because the highest concentration of burnt flint is in this area. The low frequency in the north part of the red sand area is because this is the position of the furrow between two strip fields. Only ⅓ of the burnt pieces are burnt white with heat fracturing; the rest are less fractured, are burnt black, or have irregular, shining shatter surfaces.

The distributions of flakes, blades (fig. 11), blade cores and removals (fig. 10) form a regular, oval concentration 12 m SW-NE and 8 m SE-NW, and also a weak 4 × 4 m flake and blade concentration about 3 m N of this. It will be shown below that the distributions of microburins (fig. 13) and microliths (fig. 14) also show a roughly similar double concentration. Microliths comprise 77% of all the tools below the plough layer.

Most of the flint is light to dark bluish grey in colour. There are, however, a few pieces of white, milky, opaque flint. A couple of flaked flint nodules have traces of a surface patina which was originally reddish brown. These must have been brought to the site from an area with damper soils. Just under half the flint from the plough soil and a few pieces under it have a faint whitening of the surface, similar to that seen on sites in a marine environment. This alteration could be recent.

7,611 pieces of flint were sieved from the ploughsoil over the settlement, forming 33.7% of the total flint. In the ploughsoil there was a decrease in frequency away from the central area that was roughly proportional with that visible under the ploughsoil. As the site seems to form a single unit, and as there is no admixture of flint from any other mesolithic occupation, the flint from the ploughsoil is included in the following analysis (3). The distribution maps only include finds from below the plough soil (4). For the sake of comparison with other sites, previously established typologies are used for classifying the finds (see e.g. Brinch Petersen 1966: 77–185). A general summary is given in table I.

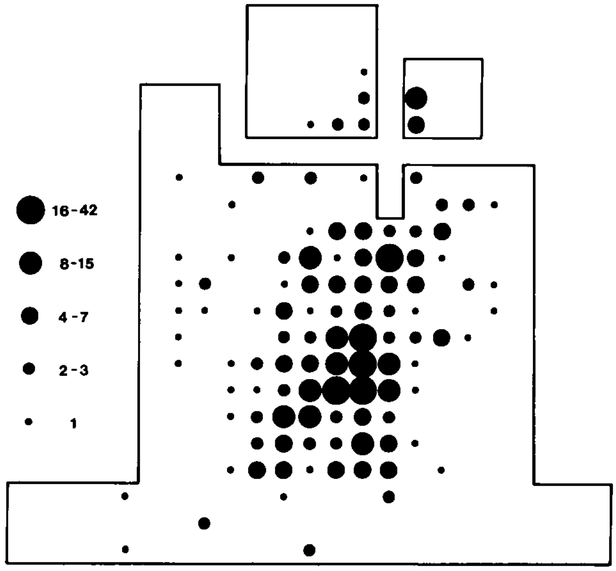

Fig. 3. The burnt flint distribution of Rude Mark.

Waste products

Cores

The microblade cores and flake cores from the site divide up as follows (cf S.H. Andersen 1973: 25):

A. monopolar cores	72
B. bipolar cores	59
C. polyhedric cores	7
D. disc cores	3
E. fragmentary, indeterminate	12
Total	153

None of the cores can be described as completely regular, prismatic microblade cores. A-cores are often conical and heavily flaked. 47% of the cores have only one striking surface. The cores are generally irregular, and only 10 have regular blades. Preparation by means of carinated blades did not occur. 61% have trimming or preparing of the core edge. Mean height of the A-cores is 5 cm, diameter of the striking surface 3.2 cm; of the B-cores, 4.6 cm and 3 cm respectively; and of the C-cores, 4.7 cm and 2.3 cm respectively. Three cores have strong crushing marks on their edges, resulting from subsequent use as hammer stones. 5 A-cores could be re-united with removals, all of which seem to be the results of mistakes, with the cores being struck too far from the edge and then discarded (fig. 4: 13–14). In one case attempts were made to continue blade production, however (fig. 4: 15). The D- and E-cores were mainly used for the production of short, broad flakes and have no edge trimming (fig. 4: 12). Two A-cores have faint scratchings in the remnants of cortex.

Core removals

Core removals divide up as follows (cf S.H. Andersen 1973: 25):

WASTE PRODUCTS		%
blade cores	153	0.70
core base removals	21	0.10
core side and edge removals	92	0.42
core point removals	10	0.05
blades	3643	16.64
flakes	17584	80.34
burin spalls	8	0.04
microburins	367	1.64
scalar pieces	3	0.01
flakes and blades with scratched cortex	6	0.02
total	21889	100.00
IMPLEMENTS		
flake scrapers	19	2.63
blade scrapers	5	0.69
borers	8	1.11
dihedral burins	4	0.55
angled burins	30	4.55
transverse burins	4	0.55
knives	36	4.98
denticulated flakes and blades	13	1.80
waisted flakes and blades	4	0.55
transversally retouched blades	18	2.49
notched blades	18	2.49
flakes with partial edge retouch proximally	20	2.77
flakes with partial or full retouch on side	30	4.15
A-lanceolates	126	17.43
B-lanceolates	28	3.87
C-lanceolates	9	1.24
segments	22	3.04
microliths, broken	147	20.33
triangles, isosceles	60	8.3
triangles, not isosceles (slightly scalene)	108	14.94
core axes (including fragments)	8	1.11
flake axes	1	0.14
pressure stones	3	0.41
hammer stones	2	0.28
total	723	100.00

Table I.

Core base removals, platform complete or partial	19
Central parts of cores	4
Core side removals from B-cores (pole-pole or pole-point)	47
Core side removals	30
Core point removals	10
Core edge removals	15
Thick flakes (over 1 cm), indeterminate core fragments	42
Total	167

The core base removals result from the flintworker's attempts to create a striking surface and angle enabling further blade production from the core. On the dorsal surfaces are visible traces of the trimmed core edge. 5 core base removals have the striking point placed immediately above the previous one. The core side removals are a heterogeneous group, differentiated from thick flakes by having blade scars on their dorsal surfaces. The core edge removals have a triangular cross section, with the edge of the core forming the dorsal side. 10 core removals have burin spalls or spall-like pieces detached, 10 have clear, partial use wear, 3 were used as scrapers and 1 is denticulate. 3 of the core removals could be edge removals from core axes with edge angles of 56–57° (cf Skaarup 1979: 49).

Blades

This group comprises 16% of the flint waste products. By definition their length is equal to or greater than twice the breadth. Microblades have lengths of under 5 cm, breadths of under 1.2 cm. Division into regular A-blades and less regular B-blades (cf Skaarup 1979: 45 and Blankholm et al. 1968: 69) is as follows:

A-microblades	489
A-blades	500
B-microblades	917
B-blades	1742
Total	3648

Fragmentary blades are only included when they satisfy the definitions put forward above. The striking platforms of the A-microblades are often so small that they can scarcely be seen. The striking angle is usually between 75 and 78°, which corresponds to the striking angle of the cores. There are traces of powerful trimming followed by the use of a striking point on the edge of the core. Lips or platform overhangs over the bulb of percussion are only rarely present. This indicates the use of hard hammer technique or of a soft hammer stone (Madsen 1981: 16–20). ¼ of the A-blades and ⅓ of the A-microblades have only a single dorsal ridge and are gently curved towards the distal end. Mean length of the A-blades is 4.7 cm, and about 5% have use wear. About 30% of the A-microblades are unbroken, while the corresponding total for A-blades is 56%. Proximal ends predominate among the broken fragments, suggesting that the distal ends were used as flint insets /microliths. The B-blades also have a 5% level of use wear.

The total number of A-microblades is less than that of microliths, which shows the high degree of utilisation of microblades for artifacts.

Waste flakes, flakes, and burin spalls

Flakes and waste flakes form 80% of the flint material. About 6% of the artifacts are produced on flakes. 4 flakes have scratches on the cortex, whether human or natural in origin cannot be determined with certainty. Most of the flakes are small trimming or retouching removals. This is mainly due to the fact that almost all the soil was sieved.

The small number of burin spalls corresponds to the low number of burins. 2 are secondary, i.e. they result from the resharpening of an old burin (fig. 5:22). 6 are primary spalls with triangular cross section (fig. 5: 23).

Microburins

About 90% of the 367 microburins are on microblades. When orientated with the dorsal side and retouched end upwards, they divide up as follows (cf Skaarup 1979: 51):

A. proximal end microburins	275
B. distal end microburins	42
C. microburins on medial pieces	34
D. microburins truncating microliths	11
E. crescentic microburins	5
Total	367

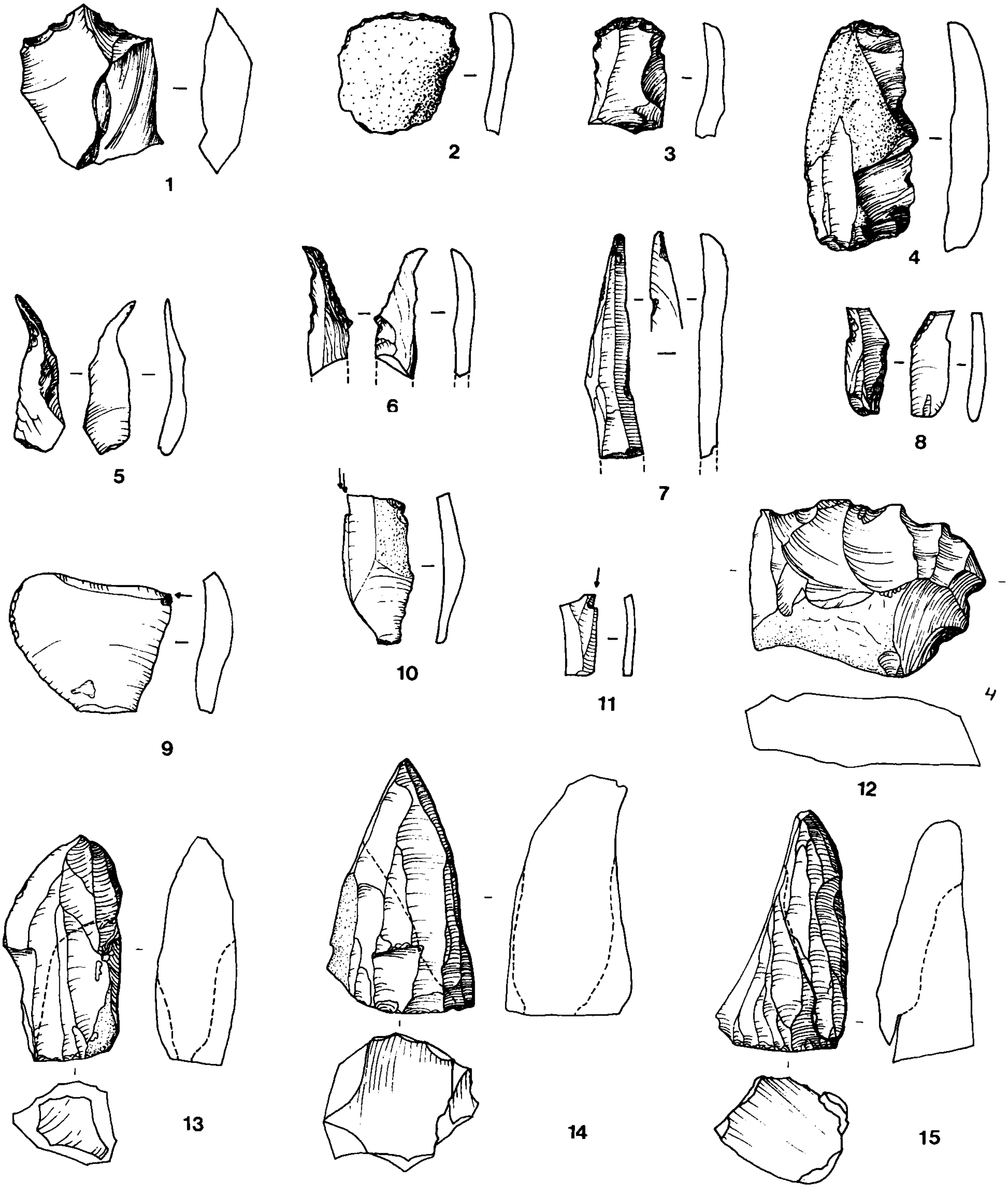

Fig. 4. Scrapers (1 – 4), borers (5 – 8), burins (9 – 11), and cores (conjoined cores and removals) (12 – 15). N.A. Boas del. 2:3.

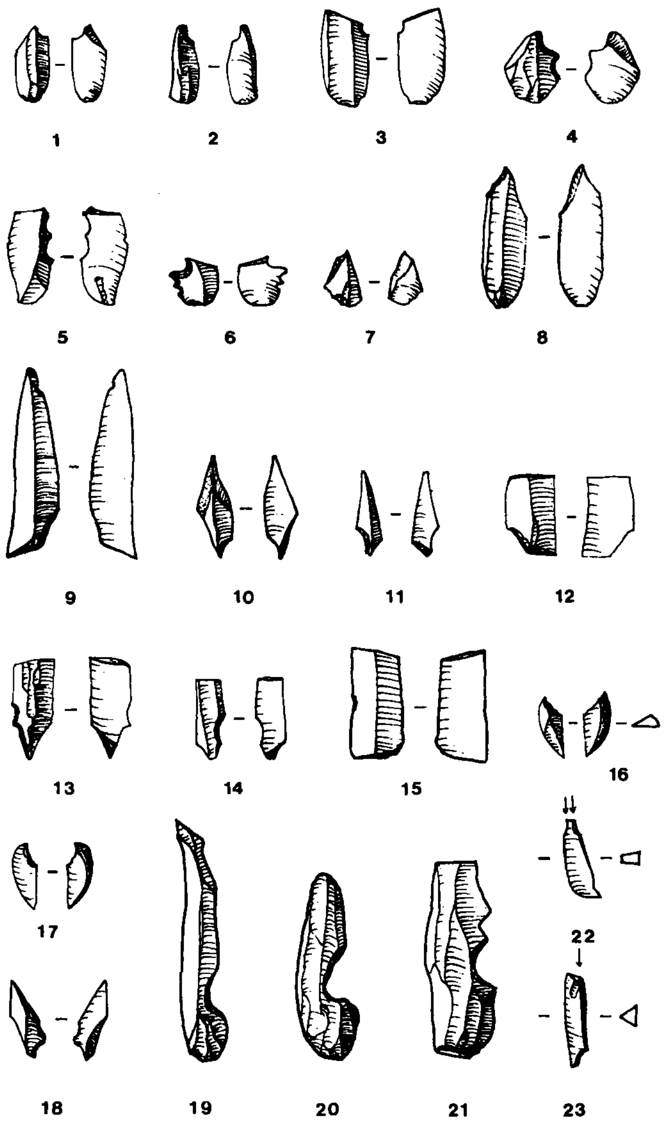

Fig. 5. Microburins (1 – 15), cresent microburins (16 – 17), truncated microburins (18), notched flakes (19 – 21) and burin spalls (22 – 23). N.A. Boas del. 2:3.

No fewer than 204 A-microburins have the notch on the right side, and 17 B-, 23 C- and 7 D-microburins do too. ¾ of the microburins are on proximal ends. Mean thickness is 0.2 cm. The distal end microburins are longest, having a mean length of 3.7 cm. This is similar to that of the lanceolate microliths, so that these microburins can be seen as unfinished or discarded lanceolates. Mean burin angle is 35°. The D-microburins are formed at notches just above and parallel with diagonal retouch on a blade or a microlith (fig. 5: 18). They show the method of producing triangular microliths, and can be regarded as waste products resulting from the shortening of the length of triangles (Larsson 1978: 80). D-microburins are only about 1.5 cm long and 0.5 cm broad. The roughly 1 cm large crescentic microburins (fig. 5: 16–17) are the result of mistakes where the fracture has progressed in an even curve back to the same side of the blade as the notch. The distribution of microburins (fig. 13) corresponds to that of blades, waste flint and microliths – particularly lanceolates! (cf fig. 11, 12 and 14).

Artifacts

Scrapers

Only 3.5% of the artifacts are scrapers. It is a very heterogeneous group. They divide up as follows (cf Skaarup 1979: 53–55):

Blade scrapers (breadth under 50%)	6
Oval scrapers (breadth 50–75%)	10
Discoid scrapers (breadth over 75%)	5
Toothed scrapers	1
Side scrapers, oval	2
Total	24

5 scrapers are doubtful, however, in that their edge retouch is under 0.2 cm in height. 3 are produced on plain cortex-covered flakes, and 7 have partial cortex on the dorsal surface (fig. 4: 2 and 4). 3 blade scrapers, 2 oval and 1 side scraper have clear use wear on the ventral surface near the edge. Mean length of the blade scrapers is 5.7 cm, of the oval scrapers 3.9 cm and of the discoid scrapers 2.9 cm. One blade scraper is on a microblade, the rest on macroblades with the scraping edge at the distal end. All have convex edges, which for the blade and oval scrapers have a maximum extent of 2.5 cm. One blade scraper has two notches in the right long edge (fig. 4: 4). Edge angle varies between 50 and 110°. One oval, one side and one blade scraper are on core trimming pieces. There are no double scrapers.

Borers

The group consists of:

Bore points	1
Blade borers	5
Flake borers	2
Total	8

The two flake borers were found in the ploughsoil and could be neolithic. The bore point and 3 of the blade borers have points turned to the left, while the rest have straight points (fig. 4: 5, 6, 8). All points are on distal ends. Mean length of the blade borers is 5.3 cm and length 1.4 cm. 3 of the borers with bent points are very similar to the Late Palaeolithic "zinken" (Holm and Rieck 1983: 8 and fig. 2, 3–8).

Burins

These are produced on blades, flakes, and core removals and may be divided as follows (cf Skaarup 1979: 57–63):

Dihedral burins	4
Simple angled burins on breaks	16
Double burins	2
Transverse burins	4
Angled burins on convex scraper edge	2
Plane burins on platform remains	10
Total	38

Towards ⅓ of the burins have an uncharacteristic appearance, and may

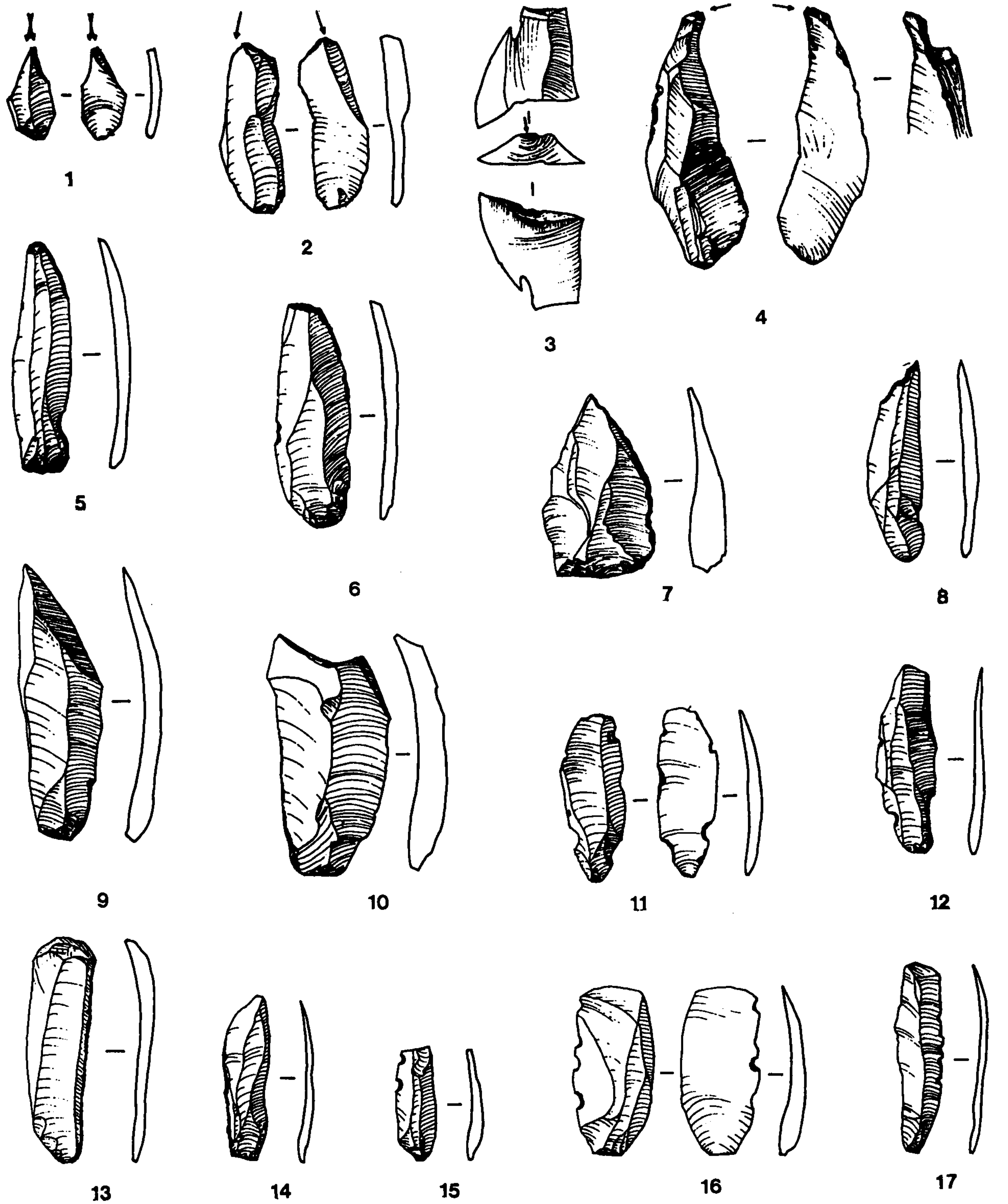

Fig. 6. Burins (1 – 4), knives (5 – 7), waisted blades (11 – 12), blades with edge retouch (9 – 10, 13 – 14) and denticulated flakes (15 – 17), N.A. Boas del. 2:3.

have been produced by chance. This is mainly the case for the plane burins, all of which are made on platform remnants of flakes. 1 transverse burin, 1 angled burin on a break and 3 plane burins are made on core removals. One transverse burin on a broken flake nearly forms a right angle on the ventral surface, in the middle of which there are powerful traces of use wear at right angles to the ventrally turned side of the edge (fig. 6: 31). 8 simple angled burins are angled to the left and 8 to the right, while 12 of the rest are angled to the left. One double burin is on a macroblade (fig. 6: 10). There are no burin blows on transverse retouch (fig. 4: 9–11 and 6: 1–4).

Knives

Flakes with edge or end retouch (Skaarup 1979: 63–67) comprise 36 items, which can be divided into the following groups:

Flakes with crescentic end retouch	13
Flakes with crescentic edge and end retouch	5
Flakes with straight or oblique end retouch	11
Flakes with concave end retouch	7
Total	36

They can be regarded as knives, as shown by the fact that more than half have clear use wear on the unretouched long edge. 12 pieces are turned to the left, the rest to the right. 2 blade knives have a notch near the proximal end's »dorsal« side (fig. 6: 5). Mean length of the flakes with crescentic end retouch is 5.8 cm, of the flakes with straight or oblique end retouch 5 cm, and of the last group 5.5 cm. Retouch is always carried out from the ventral surface except on two flakes with straight/oblique retouch. The latter group is always on blades (fig. 6: 8). One piece with diagonal concave end retouch is fully retouched along the shorter side, and has a notch opposite this. Two other knives have notches on the shorter side. They could both be roughouts for triangles with concave sides. One flake has deep concave end retouch.

Notched removals/microlith roughouts

The group with notches, sometimes finely retouched, is heterogeneous. Under half are indubitably microlith roughouts. Apart from one, all are on blades, and are subdivided as follows:

A-microblades with notch	6
A-blades with notch	5
B-microblades with notch	3
B-blades with notch	3

6 of the blades are broken 0.1–1.2 cm above the notch. 2 blades have only ½ a notch; these could be microburins on breaks. On 5 blades the relatively deep notch is assymetrically V-shaped, with the longest arm oriented towards the distal end (fig. 5: 19). 2 blades have 2 notches, the one furthest from the distal end being the deepest (fig. 5: 20). One blade has a crooked notch and is denticulate on the left side. 6 blades have notches on the left, 11 on the right. V-shaped notches are more commonly near the proximal end, while U-shaped notches are more randomly dispersed (fig. 5: 21). Length of whole blades is up to 7.2 cm, breadth 0.8–2.1 cm.

Waisted blades

This group comprises 3 blades with notches on both sides of the basal end, and 1 which is waisted in the middle. One blade has, apart from the notches, sporadic retouch on both long edges and the distal end. Another has two other small notches on the right long edge, and fine convex retouch on the distal end (fig. 6: 11–12).

Denticulated flakes

This heterogeneous group divides up as follows:

A-microblades with denticulation	5
A-blades with denticulation	4
B-microblades with denticulation	1
B-blades with denticulation	3
flakes with denticulation	2
Total	15

The denticulation occurs either as saw- or sickleblades and flakes with series of closely spaced notches under ½ mm in size (5 pieces), or as 2–3 U- or V-shaped notches over ½ mm (10 pieces). Two blades combine both (fig. 6: 17). 4 have more or less straight breaks at one end, 4 others at both ends (fig. 6: 15). 5 examples have denticulations combined with use wear on the same edge, and 3 have gloss. 3 are on the left side, 9 on the right side, of blades. The denticulation is always produced from the ventral side (fig. 6: 17).

Removals with full or partial retouch on a long edge

Apart from blades with full retouch along one side, this is a heterogeneous group comprising 30 pieces. The retouch may be of almost all types and different placements. It may be applied to either complete or fragmentary flakes and blades. One blade has fully retouched long sides. 2 have full retouch on one side, one left and one right (fig. 6: 13–14). Retouching is always carried out on the dorsal surface.

Microliths

The 500 microliths can be classified as follows (cf Brinch Petersen 1966: 93–98, Skaarup 1979: 71–80):

lanceolates with partial retouch on a long edge	126
lanceolates with full retouch on a long edge	28
lanceolates with oblique basal retouch	7
lanceolates with convex or straight basal retouch	2
segments	16
segments with chord retouch	6
fragments of indeterminate lanceolates and segments	34
triangles, isosceles	39
triangles, slightly scalene	10
triangles, isosceles, one side concave	15
triangles, isosceles, two sides concave	6
triangles, slightly scalene, one side concave	65
triangles, slightly scalene, two sides concave	33
triangle fragments, indeterminate	43
microlith fragments, unclassifiable	70

Lanceolates. Most of the lanceolates may be produced of waste products from the manufacture of segments and triangles. Triangles are usually made from the medial portions of blades using the microburin technique, but 99% of the lanceolates are distal ends. 37% of the lanceolates are broken, there being twice as many basal than point breakages. The fact that so many have similar more or less straightly broken bases indicate that blades with the distal end broken were, despite this, used for lanceolate production. This breakage often occurs during blade manufacture, and need not be the result of use or conscious preparation. 12% have 1–3 small notches or removals resulting from use, and 27 lanceolates have broken tips (cf Brinch Petersen 1984: 178). The retouch is always carried out on the dorsal side (fig. 7: 1–5 and 8:5). Point retouch

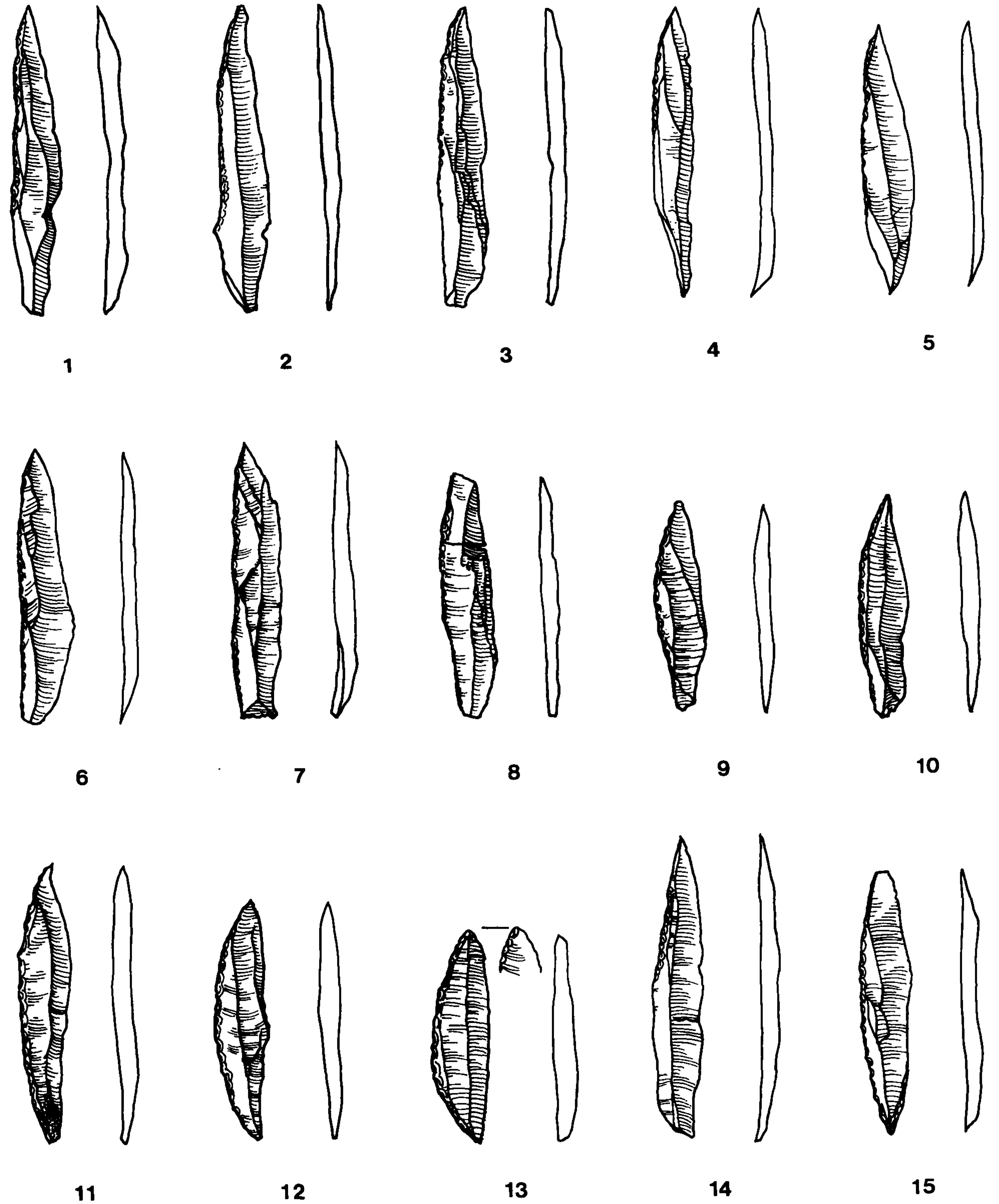

Fig. 7. Lanceolate microliths (1 – 10), segments (11 – 13 and 15) and a lanceolate with basal retouch (14). The proximal blade end of the illustrated lanceolates and segments are upwards, triangels downwards. J. Bacher del. 1:1.

is straight (40% of cases), convex (35%), concave (5%) or weakly convex-concave (7%).

Fig. 16 a shows great variation in length of lanceolates with partial retouch along a long edge. There is a tendency towards bimodality, with peaks at around 2.9 cm and 3.5 cm. Breadth is ideally around 0.8 cm. Mean length is around 3.3 cm, breadth 0.9 cm and thickness 0.2 cm (cf fig. 16 b).

Lanceolates with full edge retouch all have the retouch on the left. There are equal numbers with broken points and bases. 5 fragments have small, unretouched basal tongues, and are thus transitional between this and the previous group. Over ¼ of this group (like ⅓ of the previous one) has a facet at the point resulting from microburin removal. Mean length is 3.6 cm, breadth 0.9 cm, and thickness 0.2 cm (fig. 7: 6–10).

5 of the 7 lanceolates with oblique basal retouch have uniform basal retouch on the right. One has left handed point and basal retouch, ending on a microburin facet (fig. 7: 14). Two have full side retouch, which at one point angles in towards the middle of the piece. The last short-broad lanceolate has almost straight basal retouch (fig. 8: 4). It resembles a Horsham point (Brinch Petersen 1966: 95 fig. 47), but could also be classified as an atypical triangle.

Segments. 7 segments are damaged. All have steep, left-hand retouch, which is continuous except in one case. 4 have unretouched microburin facets, one of them at both ends. This shows a production method similar to that of the triangles, with two closely spaced, asymmetrical notches, from the bottom of which the burin scars run out towards the ends of the blade. One piece (fig. 7: 15) closely resembles a Sauveterrian point. One segment has chord retouch on the ventral surface (fig. 7: 3), 5 have it starting from the proximal end. Their mean length is 3.8 cm, breadth 0.8 cm and thickness 0.3 cm. They are thus definitely thicker than either the triangles or the lanceolates (cf. fig. 7: 11–13).

Fragments of indeterminate lanceolates and segments. This group comprises 16 proximal point ends, 4 distal point ends and 14 medial pieces. 26 have left hand, 8 right hand retouch. 4 point ends have preserved microburin facets.

Triangles. 19 of the isosceles triangles with straight sides (fig. 8: 9, 12–15) are damaged. 31 have left handed and 8 right handed retouch, when oriented with the distal end of the blade pointing away. All retouch is on the dorsal side, and is finest at the distal end. Most are medial sections of blades; only 6 have the lower short side retouched on the side of the blade's distal end, and 7 have a microburin facet preserved on one or both ends. In 5 cases the hypotenuse is damaged with 1–3 notches. The angle between the short sides varies between 105–158°. Mean length of the isosceles triangles is 2.6 cm, breadth 0.8 cm and thickness (for all the triangles) 0.2 cm.

Of the slightly scalene triangles with straight sides, 8 have the shortest side at the proximal end, 2 at the distal end (fig. 8: 1–3). 3 are left handed, 7 right handed; 6 are on distal fragments, 4 on medial fragments. 2 have unretouched facets from microburins. The angle between the two short sides varies between 122–152°. Mean length is 3.3 cm, breadth 0.7 cm.

8 isosceles triangles with one concave side are right handed (fig. 8: 20), 7 are left handed (fig. 8: 21–23). With one exception, the concave side is at the proximal end. The concavity is strongest on the last ½ cm leading up to the angle between the two short sides, so that a hook may be formed by the extension of these two sides. The concave retouched side always becomes concave-convex towards the point. One is retouched on the hypotenuse at the distal point. The angle between the short sides (measured relative to the two points of the microlith) varies between 110–159°. Mean length is 2.6 cm, breadth 0.8 cm.

The 6 isosceles triangles with two concave sides are all right handed (fig. 8: 7). They are very uniform and regular, with an angle between the short sides of 110–125°. The 2 concave sides are definitely the remains of the 2 notches from near the bottom of which the burin blows were directed towards the distal and proximal ends. Mean length is 2 cm, breadth 0.7 cm.

The most common group consists of slightly scalene triangles with one concave side (fig. 8: 17–19, 24–25). Of the 65 examples, 59 have the concave side towards the proximal end, 33 are left handed, in 24 cases the raw material is the distal end of the blade, and 42 are slightly imperfect. 2 right handed examples have a small unretouched section next to the junction of the two short sides (fig. 8: 25). Mean length is 2.9 cm, breadth 0.7 cm, and angle between the 2 short sides 129°. Most of the thin microliths are in this group, with a mean thickness of 0.2 mm.

Of the slightly scalene triangles with both sides concave (fig. 8: 6, 10–11 and 16), 24 are left handed and 9 right handed. With one exception, the shortest side is at the proximal end. 3 have microburin facets at the proximal point, while 2 have them at both ends. 12 are on distal ends; three of the left handed ones have retouch on the hypotenuse at the distal point, while two of the right handers have hypotenuse retouch at the distal point – in one case this is exceptionally carried out from the dorsal surface. The third longest microlith from the site belongs to this group, of which the mean length is 3.1 cm, breadth 0.7 cm, and the angle between the short sides 146°.

The fragmentary triangles include 25 proximal ends (20 right handed), 16 distal ends (10 left handed) and 2 medial fragments. 5 have microburin facets at the proximal point, 3 at the distal point.

The large number of microlith fragments reflects the careful methods of excavation. Of the total, 50 are point fragments, 30 are medial fragments, 6 are burnt, 5 points have traces of microburin facets, 33 have straight and the rest oblique breaks.

Of the triangles, 108 were determinable as left handed, 79 as right handed.

Axes

The best preserved of the 8 core axe fragments is a small symmetrical axe (not an adze); it is made on a powerful flake, the ventral side of which is partially preserved (fig. 9: 3). It has convex, trimmed broad surfaces, and a pointed butt. The edge has been partly removed by a transverse blow. Another blow was then made towards the most convex of the broad surfaces. Length is 8.7 cm, breadth 4.3 cm and thickness 2.1 cm. Butt width is 2.7 cm, butt thickness 1.1 cm, edge breadth 2.7 cm and weight 60 g. An edge flake of a presumed symmetrical axe is about 3.4 cm wide, and has an edge angle of 53°. A fragment 2.7 cm long, 3.3 cm wide and 2.7 cm thick derived from a symmetrical adze. A butt fragment with trimmed sides (fig. 9:2) could derive from an (a)symmetrical adze. Length is 7.3 cm, butt breadth 2.7 cm and butt thickness 1.4 cm. A fragment of the body of a symmetrical adze with trimmed sides measures 5.8 cm in length, 4.2 cm in breadth and 2.2 cm in thickness. An edge flake from an adze has an edge breadth of 3.2 cm and an edge angle of 57°. An edge and side fragment of an adze measures 5.7 cm in

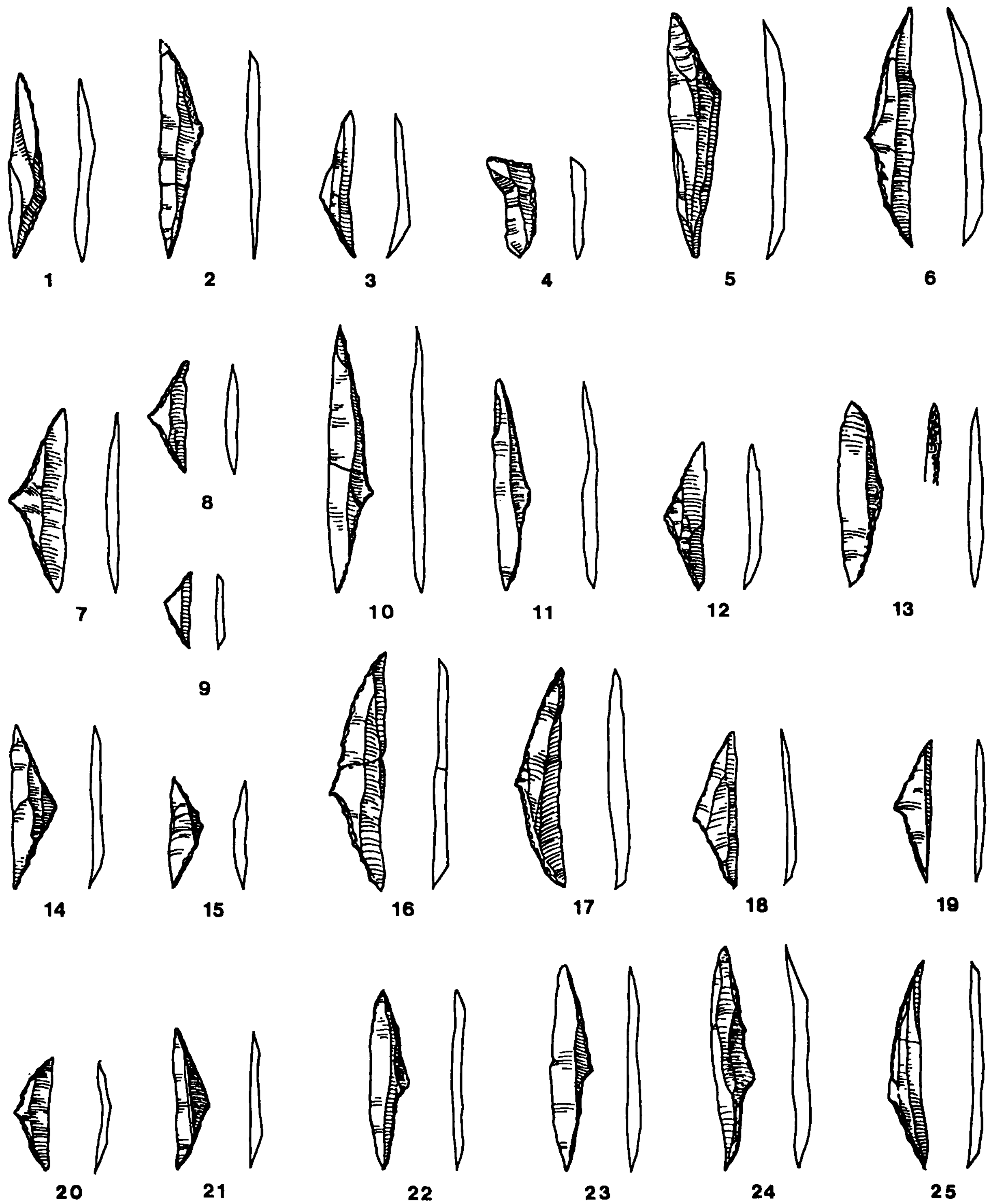

Fig. 8. Lanceolate microliths (4 – 5) and triangels (1 – 3, 6 – 25). J. Bacher del. 1:1.

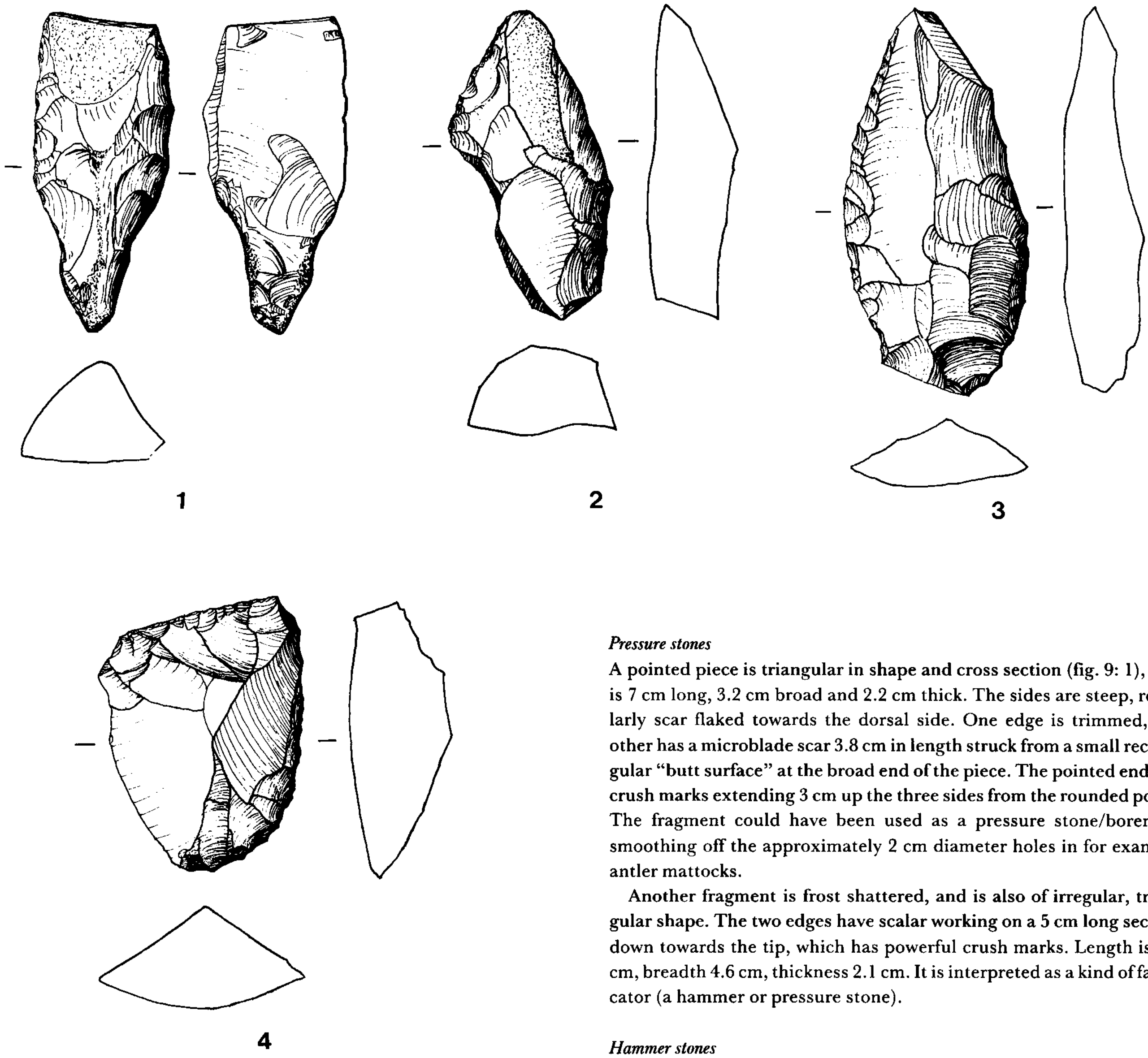

Fig. 9. Pressure stone (1), core axes (2 – 3) and an edge resharping flake (4). N.A. Boas del. 2:3.

length, and has an edge angle of 67°. A fragment 5.7 cm in length, 4.6 cm in breadth and 2.4 cm in thickness has the character of an adze, with an angle of 68°. Edge and sides are trimmed, and the butt is formed by a small irregular cortex area 3.6 × 1.1 cm.

A symmetrical flake axe with flat flaking from the central cultural level of the site has unfortunately been lost. It was very similar to one from Flaadet (Skaarup 1979: 83, fig. 24, 4).

Pressure stones

A pointed piece is triangular in shape and cross section (fig. 9: 1), and is 7 cm long, 3.2 cm broad and 2.2 cm thick. The sides are steep, regularly scar flaked towards the dorsal side. One edge is trimmed, the other has a microblade scar 3.8 cm in length struck from a small rectangular "butt surface" at the broad end of the piece. The pointed end has crush marks extending 3 cm up the three sides from the rounded point. The fragment could have been used as a pressure stone/borer for smoothing off the approximately 2 cm diameter holes in for example antler mattocks.

Another fragment is frost shattered, and is also of irregular, triangular shape. The two edges have scalar working on a 5 cm long section down towards the tip, which has powerful crush marks. Length is 8.8 cm, breadth 4.6 cm, thickness 2.1 cm. It is interpreted as a kind of fabricator (a hammer or pressure stone).

Hammer stones

An irregularly round hammer stone has 3 areas of powerful crush marks, and 2 cortex covered areas. Maximum diameter is 6.1 cm, minimum 5.3 cm. The other hammerstone is a triangular, foursided and lightly worked piece of natural flint with crush marks at both ends. One hitting surface is about 2.4 cm across, the other about 3.3 cm, and shaped as a ridge about 1 cm across.

Floral and Faunal remains

About 100 g charcoal were collected from various places on the site. Charcoal from the east side of the area of reddish sand, and about 7 g hazelnut shells from the same place and the immediate surroundings, have been used for radiocarbon dates (see below).

Two fragments of burnt bone, about 1 cm across, were also found.

CULTURAL AFFINITY AND DATING

The settlement at Rude Mark fits into the centre of the Danish Maglemosian Culture, near the transition from the earlier to the later part. Specialised microlith production is a characteristic of the find, and the quantity of triangles is greater than from any other site from the early Maglemosian. Classic scalene triangles of Sværdborg type are scarcely represented, while the slightly scalene pieces with concave sides appear in numbers never before seen. The latter type appears only rarely in Scandinavian and North German finds from the early Maglemosian Culture (Blankholm et al. 1968: 95, and Skaarup 1979: 68 and 99).

The presence of waisted blades, the presence of only a few primitive burins on breaks, and the relatively large number of slightly scalene triangles as in Sønder Hadsund and Duvensee 2, shows the affinities between Rude Mark and the early Maglemosian.

The small number of artifacts in most categories makes comparisons with other sites difficult. The proportions of the various types of microliths must therefore be used to show the chronological position of the site. The percentages of the various microliths place Rude Mark in the lanceolate seriation between Sønder Hadsund and Stallerupholm. In a seriation of slightly scalene triangles the site would fall between Sønder Hadsund and Linnebjär (cf Skaarup 1979: 100 diagr. 3). The number of triangles relative to lanceolates shows, however, that the site should in fact be moved down towards the transition between the earlier and later Maglemosian Culture. Similarly, both lanceolates and triangles are longer and narrower than the examples at for example Flaadet (fig. 16, a–b). The blade cores from Rude Mark also have a smaller striking area and are higher than those from Flaadet.

The mean width of the Rude Mark triangles is 7.5 mm. When compared to the Maglemosian settlements in east Zealand, this puts Rude Mark between Orelund Vest with a value of 8.6 mm and Ulkestrup I with 7.2 mm (K. Andersen 1983: table VII). The latter is C14 dated on hazel nuts to 6190 + 100 bc (Andersen, Jørgensen and Richter 1982: 77). C14 dates from the central fireplace/roasting area at Rude Mark are:

K 4217, hazel nuts	6240 + 130 bc
K 4218, charcoal	6150 + 85 bc
K 4219, charcoal	6110 + 120 bc

The hazelnuts are in closest context with the settlement material and should give the most reliable date. The dates of the charcoal samples, however, seem to be too late compared to the archaeological datings. Contemporaneity between Rude Mark and Ulkestrup I gains further support from the relative proportions of lanceolates and triangles; at Rude Mark this is 1:3, very close to that at Ulkestrup I. Lanceolates predominate on sites of the earlier Maglemosian Culture, while triangles are extremely predominant in the later Maglemosian. The characteristic keeled and handled cores of the later Maglemosian do not appear at Rude Mark (Henriksen 1976: 22).

THE CHARACTER OF THE SETTLEMENT

The cultural level preserved under the plough soil was not very deep. In the furrow between 2 of the strip fields running E–W over the site the cultural level had been almost completely removed from a zone about 1.5 m wide. Another furrow runs partly along the north edge of the excavation, and partly 12 m further south, through the central reddish area or hazel nut roasting location. All the distribution maps show a drop in the frequency of finds connected with these furrows. The ploughing of the earth up onto the fields to form ridges has on the other hand protected the cultural level in the approximately 10 m wide area between the furrows.

Treefalls disturbed about ⅙ of the settlement. The holes were evenly spread, and so provide chance areas where the original distribution of finds can be checked. In the distribution maps, this is plotted by m^2. The m^2 areas which include treefalls in the central part of the settlement are particularly rich. Against this, the m^2 areas with treefalls at the edge of the site have few finds. The isorithmic distribution map of flakes (fig. 13) shows a N-S oriented rectangular concentration of 11 × 8 m at most. The mean value of 54 pieces/m^2 covers an area of about the same shape and orientation of about 9 × 6 m. A physical barrier in the form of a hut wall might be responsible for the latter concentration, because the centre of the area is made up of the hazel nut roasting area with concentrations of nut shells and burnt flint; and because a partial clearance of the stone scatter was undertaken from this area. The distribution of different categories of waste, flakes, and blades (fig. 11), cores and core removals (fig. 10), microburins (fig.

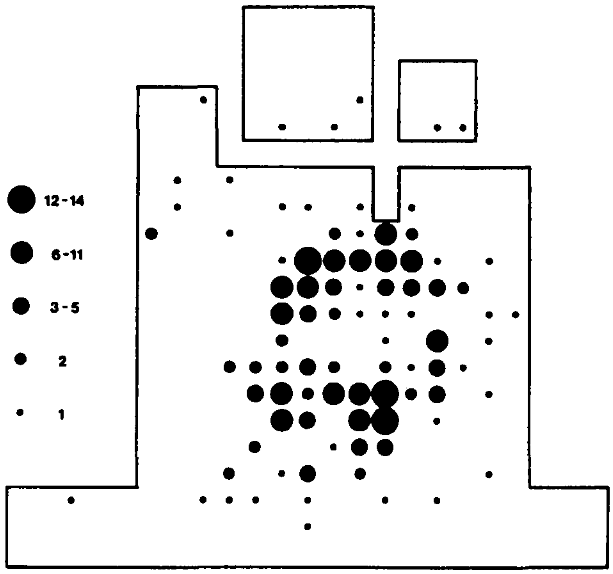

Fig. 10. Distribution of cores and removals.

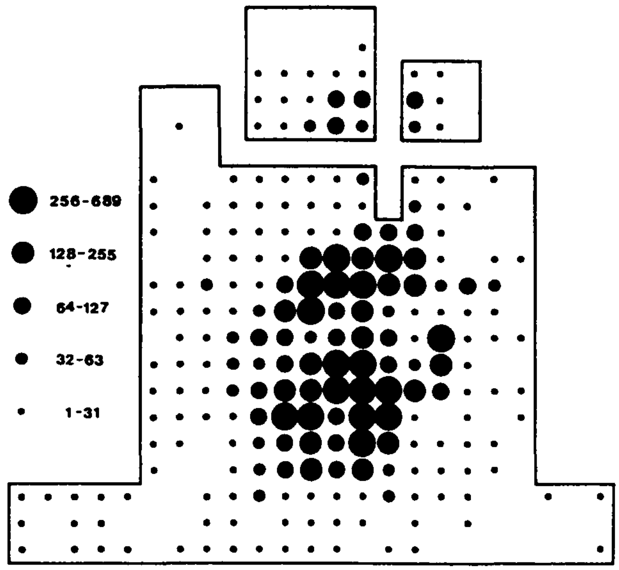

Fig. 11. Distribution of flakes and blades.

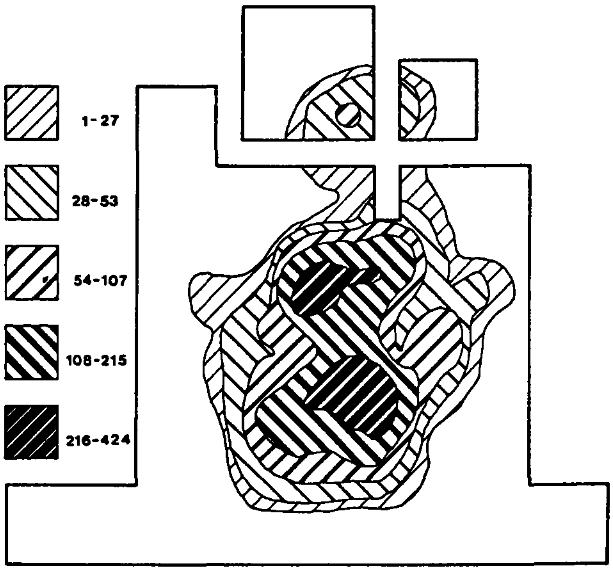

Fig. 12. Distribution of waste flakes.

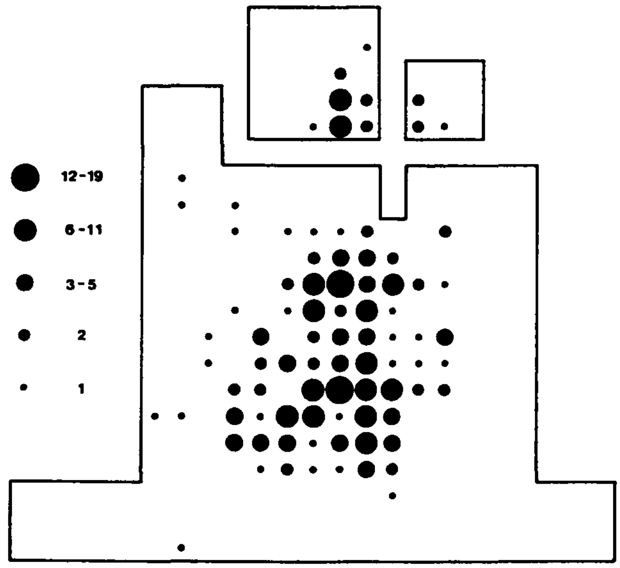

Fig. 13. Distribution of microburins.

13) and the predominant artifact group, namely the microliths, show a similar picture with only a small deviation.

Regarding the smaller, northern concentration of flint, it can be seen that the division of the large concentration into two parts is artificial, caused by the later field system. The furrow has created the tongue-shaped extension of the finds to east and west, with a corresponding reduction of finds in the central area (cf fig. 12). The lower frequency between the large southerly and small northerly flint concentrations is on the other hand genuine. This area is in fact directly between two furrows, where the heaped earth of the ancient field has provided some protection for the remains of the settlement.

Comparing the distributions (fig. 10–14), it is clear

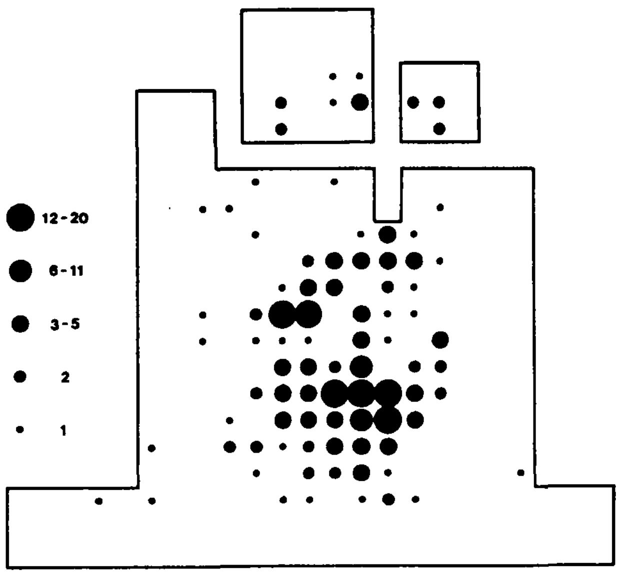

Fig. 14. Distributions of microliths.

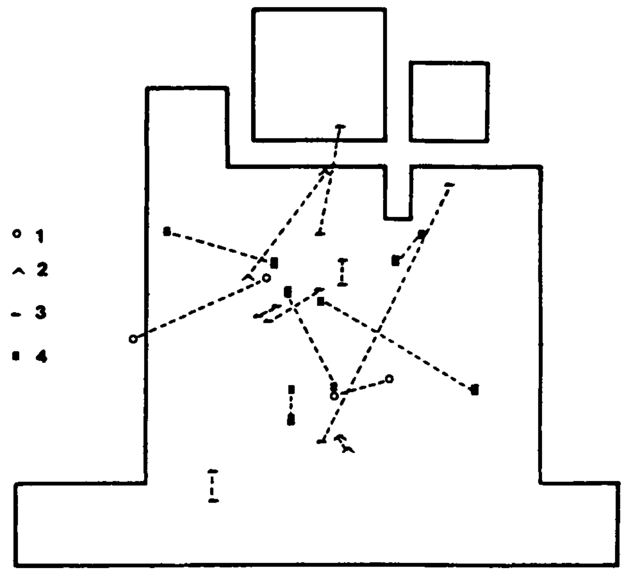

Fig. 15. Distribution of conjoined pieces. 1, lanceolate. 2, segment. 3, triangle. 4, core.

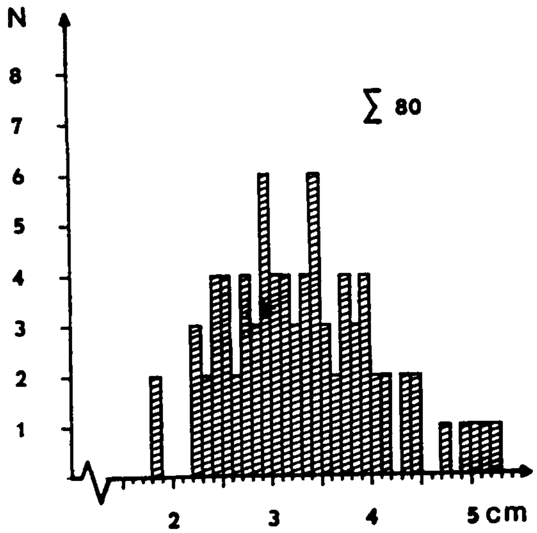

Fig. 16 a. Diagram. Length of lanceolate microliths.

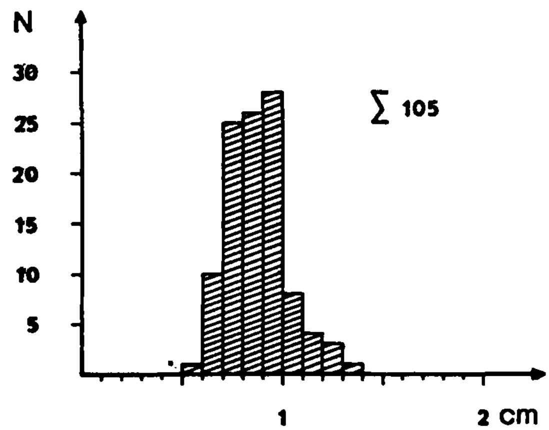

Fig. 16 b. Diagram. Width of lanceolate microliths.

that the small northern concentration must be regarded as a secondary "flint working area", as opposed to the larger southern "flint preparation area" where primary working of the flint cores took place. Cores and core removals are remarkably rare in the small concentration (fig. 10), while blades, microburins and microliths are well represented (figs. 11 and 13–14). The northern concentration can thus be viewed as a microlith production locus, using blades and flakes brought there for the purpose. ⅔ of the microliths here are isosceles triangles.

The larger find concentration tends to show a circular distribution of cores and core removals (fig. 10) around the "roasting location", but has a more even distribution of flakes and removals (fig. 11–12). Burins are exactly similar, while microliths concentrate south of the "roasting location" (fig. 14). Microburins distribute themselves similarly to flakes and blades (figs. 11 and 14).

It has been possible to reunite broken fragments of the following objects: 5 cores with core removals; 2

broken lanceolates; 2 segments; and 6 triangles. The distribution map of re-united tools shows (fig. 15) that transport of the separated fragments was considerable. One triangle was re-united from 2 fragments found 11 m apart, NE and S of the large flint concentration. Fragments of one lanceolate and one core were each found one in the small northern and one in the large southern concentration, which emphasises the links between the two. Transport of separated pieces seems to have taken place mainly N-S.

In conclusion, it can be said that Rude Mark forms a well-delimited unit, when the find and its conditions are considered. Distribution divides into a large, oval flint working area round a hearth or hazel nut roasting site, and a smaller flint concentration. The same picture emerges from 10 other Maglemosian settlements in southern Scandinavia and northern Germany (Grøn 1983, 32–42). It is tempting to regard the small patch as the site of a possible hut, south of which the various activities took place. These activities were centred on microlith production. There are few scrapers, burins and axes. The preparation of hunting equipment was the main activity; apparently, processing the prey did not take place to any great degree.

The aurochs from Prejlerup, C14 dated to 6460 bc, was shot with a combination of microliths similar to that found at Rude Mark (Aaris-Sørensen 1984: 178; Petersen and Brinch Petersen 1984: 178), including the characteristic scalene triangles with concave sides. This is a type which qualitatively and quantitatively form an important part of the inventory from Rude Mark.

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NOTES

1. The work was carried out by the author as director of excavation, one temporarily employed assistant, and 4 young unemployed people from Odder.
2. OOM j. nr. 22. Rude Mark, Saksild Parish, Hads Herred.
3. Intrusive materials, which mainly derived from the plough soil: Late glacial: 1 tanged point. Kongemose culture: 1 trapeze, 1 rhombic arrowhead, 1 handled core. Norslund culture: 1 oblique transverse arrowhead. Early Neolithic B material: 39 flakes, 9 flake scrapers, 7 axe fragments (polished thinbutted), 1 axe fragment (stone, thinbutted), 2 transverse arrowheads (on flakes), 39 potsherds (including a fragment of a lugged beaker), 1 blade knife. Late Neolithic/ Early Bronze Age: 2 heart shaped arrowheads, flat flaked, 1 dagger fragment, flat flaked, 1 potsherd. Iron Age: 16 potsherds. Viking Period: 1 potsherd with "Slavic" wavy line decoration. Medieval/ Recent: 25 potsherds, 1 sherd of stone ware.
4. This work uses the statistical mean, i.e. the middle number when the values are arranged in sequence. This must not be confused with the average, which is sometimes used as the mean by others (Skaarup 1979: 73, table 24 compared with diagram 10, according to which the mean lanceolate breadth is 0.9, and not (as stated in table 24) 1.1 cm.)

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Ertebølle Revisited

by SØREN H. ANDERSEN and ERIK JOHANSEN

INTRODUCTION

A series of excavations were undertaken during 1979–84 to re-evaluate the classic kitchenmidden at Ertebølle, a late Mesolithic coastal site, which defines a whole "culture" in Denmark and Southern Scandinavia (Clark 1975, 181–199) (1).

The following is a survey of the preliminary results of these new investigations.

HISTORY OF RESEARCH

Denmark is one of the classic areas for prehistoric studies of shell middens and has a long archaeological tradition for investigations of kitchenmiddens or "Køkkenmøddinger".

In 1837, we find the first reports in the National Museum concerning digs on Danish shell middens (2). Later in 1850–51, the excavations at the large shell midden of Meilgård (done by Worsaae), clearly demonstrated that these accumulations truly were a unique type of stone age site and not – as had been proposed – natural shell banks with artefacts intermixed (3). Also in 1851, the term "Køkkenmødding" was introduced. In the following years these sites played a dominant role in the discussion among Danish archaeologists about the existence of an older phase of the stone age. Chronologically, technologically, and economically these sites differed from the stone age which was characterized by the big megalithic tombs with their polished flint axes and bones of domesticated animals.

To solve this problem, a series of new excavations were started in one of the largest shell middens in Denmark – at Ertebølle near the Limfjord in Northern Jutland (figs 1–2). The site, which later became the type site for this culture, was excavated in 1893–1897 (Madsen et al. 1900).

Under the direction of the archaeologist S. Müller, a group of archaeologists and scientists (2nd kitchenmidden committé) was established in order to cast new light on the shell middens from one well documented and thoroughly investigated site. It was the intention to obtain a large sample of artefacts to describe, define, and date this prehistoric phase in relation to the megalithic monuments, and by that, once and for all divide the stone age into an older and a younger phase.

After achieving these goals through the excavation of a large part of the Ertebølle midden proper (fig. 4), the results were published. The remaining (southern) part of the Ertebølle køkkenmødding was put under government protection (Madsen et al. 1900, 1–90) (fig. 4).

During the excavation, a 2×1 m column of the central part of the midden was brought to the National Museum for exhibition (fig. 8).

Large scale excavations of Danish kitchenmiddens were not resumed until the 1970's. Despite this, however, our knowledge of the Ertebølle culture has been vastly expanded, mainly through research on other types of Ertebølle sites. The information obtained by the excavations of sites such as Dyrholmen (Mathiassen et al. 1942), Ringkloster (S.H. Andersen 1975), Brabrand (Troels-Smith 1937, 1966), and Sølager (Skaarup 1973) formed the basis for a new evaluation of the Ertebølle type site.

This, however, is not the case with the Ertebølle type site itself. Since the end of the excavations in 1897, only on two occasions were new information on this site published. The first was a small article describing the remains of what was supposed to be a hut structure (Simonsen 1951, 222–223, Clark 1975, 194) (see also below). Later in 1970, a series of eight C-14 dates taken from the midden sample in the National Museum were published (Petersen 1970, 7 and 36). Unfortunately, these dates were without any correlation to stratigraphy and/or type inventory (4).

Despite the fact that Ertebølle is the classic type site, Danish archaeologists have not been able to answer a series of questions which today are closely connected with the description, understanding, and interpretation of this Northern European Mesolithic site (e.g. the

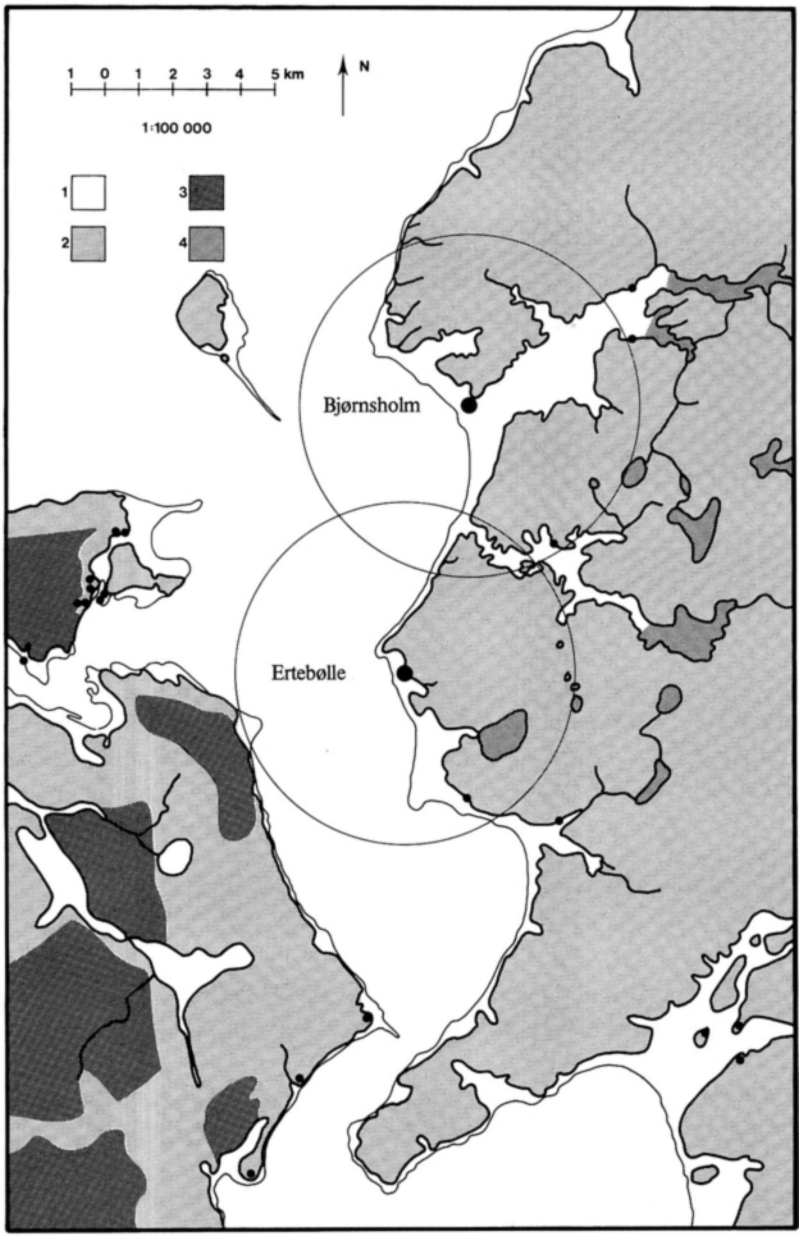


Fig. 1. The position of the Ertebølle and Bjørnsholm shell middens at the Limfjord in Northern Jutland. The distribution of various resource types are indicated. A distance of 5 km from the two "big sites" is indicated by circles. Also the modern and Mesolithic coastline are marked by a thin and wide line respectively
1. Sea
2. Sandy and gravelly soils.
3. Morainic clay
4. Freshwater lakes and marshy areas.
Small black dots mark other Ertebølle-culture sites.
Hanne Stenz and Orla Svendsen del.

character, artefact content, function, accumulation, and chronology of such a settlement).

Since the 1970's, this type of prehistoric research has resumed again and a series of new kitchenmidden excavations at Meilgård (Bailey 1978, 45 fig. 3), Norsminde (S.H. Andersen 1987), Ertebølle (S.H. Andersen 1983), Bjørnsholm (5), and several other locations have been undertaken by the first of the authours (SHA).

Because of lack of up-to-date information, in 1979 it was decided to start a new series of excavations at Ertebølle – a project which continued until 1984 (S.H. Andersen 1983) (6).

As was the case with the 'old' excavations, the new investigations were performed by a group of archaeologists and scientists (i.e. Quarternary geologists, a botanist, palynologists, zoologists, ichthyologists, and a specialist in marine molluscs and foraminiferas) (7).

Before the project started, a series of questions were formulated as a guide. Several problems were closely connected with the site itself, such as:

1. What was the exact size of the midden?
2. Was the midden a chronological unit or not? If not,
3. what was the rate of accumulation?
4. How long a time span did the site cover?
5. Was the Ertebølle midden identical to the other Danish middens?
6. What type of site was the midden?
7. Was it a settlement proper or just an area of waste?
8. Was there a drop zone or waste dump in front of the site as is well known from many other Danish Late Paleolithic and Mesolithic sites (i.e. Tybrind Vig (S.H. Andersen 1975, 15–23))?
9. What was the relationship between the Ertebølle midden and the Littorina sea?

Last, but not least, we wanted to obtain an up-to-date sample of the artefact assemblage in association with a well defined stratigraphy, as well as the possibility for obtaining new samples for C-14 and scientific analysis (see above).

Many of these problems could be solved if we excavated large sqares to the rear and in front of the midden, delineated the site area, and opened a new section or trench through the preserved part of the Køkkenmødding.

ERTEBØLLE REVISITED

The Ertebølle site is located in the northwestern part of Jutland in the central Limfjord area (fig. 1). The Køkkenmødding today lies on the western side of a hilly projection facing the sea of Livø Bredning (fig. 1–2).

Ertebølle sites in the Westhimmerland (fig. 1)

Seen in a larger perspective, the Ertebølle type site is not the only one in this area. A few kilometres to the north in the present day Trend river valley, which during the Mesolithic was a large fjord, several smaller Late Mesolithic coastal sites were found. Finally, approximately 8 km to the north we have another large Køkkenmødding at Bjørnsholm, which is probably the largest Danish shell midden of all (fig. 1) (5).

In this area we have the two largest Danish kitchenmiddens. They are contemporary in an archaeological sense, but differ in artefact style and also to some degree in their economies. Such a situation poses some very interesting questions of settlement patterns, population density, and environmental productivity within this part of the Limfjord.

Unfortunately, this area has never been subjected to any intense or large scale reconnaissance of Ertebølle sites. For this reason, our knowledge of the Late Mesolithic settlement patterns are very limited (e.g. we do not know of any inland sites at all in this part of Jutland).

Site territory

For a geological description of this area, see K. Strand Petersen in this volume.

It is very difficult to tell what the region looked like in the Mesolithic. However, new geological investigations seem to indicate a habitat completely different from today (fig. 2).

The area must have been a large sheltered bay well protected by the "Ertebølle head" to the north and by a small island to the south. This small island – which was later completely eroded away – has been the basis for a large system of beach ridges going in a SW-NE direction, and by that sheltering the area adjacent to the kitchenmidden (fig. 3).

Further to the north, there was an access through the Hanherred out into the Skagerak and North Sea. Just 10 km to the west is the large island Fur and 11 km to the northwest, the small island Livø (fig. 2). The vicinity of the site is dominated by a low hilly terrain which does not exceed more than 30 m in height. The subsoil is glacial meltwater sand and gravel. Along the coastline there are some small river outlets, and just at the site there is a little spring. To the southeast – only 2–3 km from the midden – there was a large freshwater lake connected to the sea through a narrow river channel (fig. 2).

Two to three hundred meters to the west of the site, on what today is raised seabottom, traces of a natural shell bank was discovered. The C-14 dates of this shell bank indicate that it was contemporaneous with a part of the midden itself 4050 ± 100, 3890 ± 95, 3840 ± 95 (K-4340, 4341, and 4342). This bank may very well be where (or one of them) the inhabitants collected their shellfood (see Kaj Strand Petersen this volume).

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, higher than today (Iversen 1979, 407).

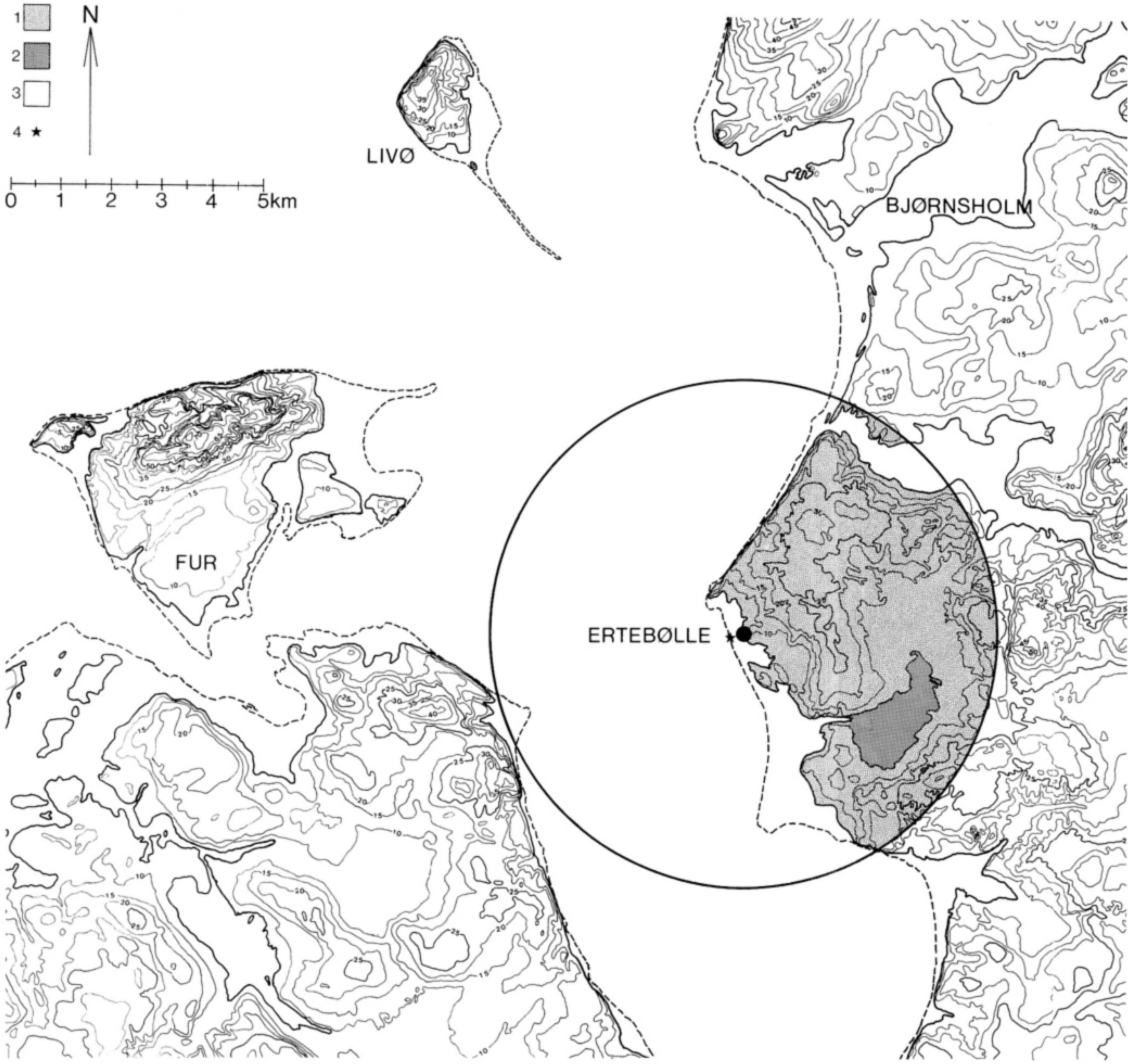


Fig. 2. Topography and geology of the "catchment area" around the Ertebølle site in the Mesolithic.
1. Sandy and gravelly soils.
2. Freshwater lake.
3. Sea.
4. Natural shellbank.
Modern coastline is marked by a dotted line. Contour map. Reproduced with permission of the *Geodætisk Institut* no. A.404/85.

The higher temperature and salinity of the seawater due to stronger tides created very favourable living conditions for the marine food chain.

The local wind conditions may also have played a role. The area around Ertebølle is exposed to the Limfjord and the North Sea. Despite an outer chain of islands, this area must have been more exposed to storm conditions and wind than the east Jutland coast.

As for the vegetation, our pollen analysis has not been completed. However, the earlier analyses of charcoal from the midden suggest a landscape covered by oak (Quercus), elm (Ulmus), birch (Betula), aspen (Populus), alder (Alnus), hazel (Corylus), and willow (Salix) (Madsen et al. 1900, 89–90). This combination reflects an environment and climate which may have been similar to the modern assemblage seen today around the Limfjord.

Animal life is also well represented, as documented by the list of species from the old excavations (Madsen et al. 1900, 81–89), and by the new one given in this article (see p. 59) (8).

Site area

The new investigations have shown that this famous shell midden is not the only Mesolithic site along the prehistoric coastline in this area. Just 40–50 m south of the type site, a small shell midden (measuring 10×10 m) was recorded, 90 m further to the south, another one (measuring 10×15 m) was found (fig. 3).

On the plateau bordering the old coastline to the east-southeast, a large elongated area (measuring 200–250×30–40 m) containing several partially overlapping concentrations of Ertebølle flint tools and debris were found.

The position of these flint concentrations along the prehistoric beach indicates that they all originally must have been coastal sites. Based on the finds, these areas all seem to belong to the Late Mesolithic Ertebølle culture. It is also worth noting, that these flints are found c. 150 m further to the south along the old coastline than the kitchenmidden itself (fig. 3). These observations tell us that an Ertebølle coastal site is not always a kitchenmidden. Even within small areas, one may find contemporary coastal settlements with an associated Køkkenmødding and/or without.

It should be noticed that the various sites within this defined area manifest themselves *both* as kitchenmiddens as well as coastal settlement sites without shell accumulations. The detailed relationship between these various types of sites are still to be determined (fig. 3).

The kitchenmidden itself is narrow and oblong in shape. It stretches approximately in a N-S direction along the foot of and partially upon the side of a low bank (2–3 m high) which borders a flat plateau gradually rising to the east (figs 3 and 4). The largest dimensions were at the northern end where the 1890 excavations took place. Gradually, the midden becomes thinner and more narrow to the south (the preserved area).

The minimum length was c. 140 m, the width c. 20 m, and the thickness c. 1.9 m (Madsen et al. 1900, 12–20). Today the site is positioned between 5.4–3.7 m above sea level.

The narrow elongated shape is characteristic for most Danish kitchenmiddens. The immediate surrounding areas to the west, north, and south of the location are today low, marshy grasslands – raised sea-bottom. In this part of Denmark, the postglacial uplift is about 6 m (K. Strand Petersen 1975, 1981 and this volume. S.H. Andersen 1979a, 10).

The bank on which the site is located, is a coastal cliff older than the midden (9). In front of the site is an extensive system of marine deposits in the form of beach ridges (fig. 3) which stretch from the southwest to the northeast up to the kitchenmidden. These ridges are contemporary with the midden. In the field, east of the site, a small spring rises, and from there, runs across the bank and out into the sea. Our investigations indicate that this spring existed during the Mesolithic and must have passed through the midden area, therefore, dividing it into a northern and southern area. It is reasonable to suppose that this small spring was one of the determining factors for the location of the site during the Mesolithic.

INVESTIGATIONS BEHIND THE KITCHENMIDDEN

Due to the large numbers of artefacts recovered, earlier Danish kitchenmidden excavations concentrated exclusively on the shell deposits themselves, while the surrounding areas were not investigated. It has not, therefore, been possible to determine whether the middens were actual settlement sites or simply part of a settlement (i.e. the waste area or "midden").

In order to cast new light on this question, it was decided that the area behind the Ertebøllle midden should be investigated. This area was chosen for several reasons: the flat plateau just behind the midden (see fig. 3) would seem to 1) be the most well suited area for habitation, 2) our surface reconnaissance showed a clear scatter of Mesolithic flints in this area – demonstrating that activities *had* taken place, and, 3) the Ertebølle graves at the Bøgebakken and Skateholm sites in Southeast Scandinvia are all positioned on higher ground *behind* the settlement and their associated waste areas (Albrethsen and Petersen 1977, Larsson 1984).

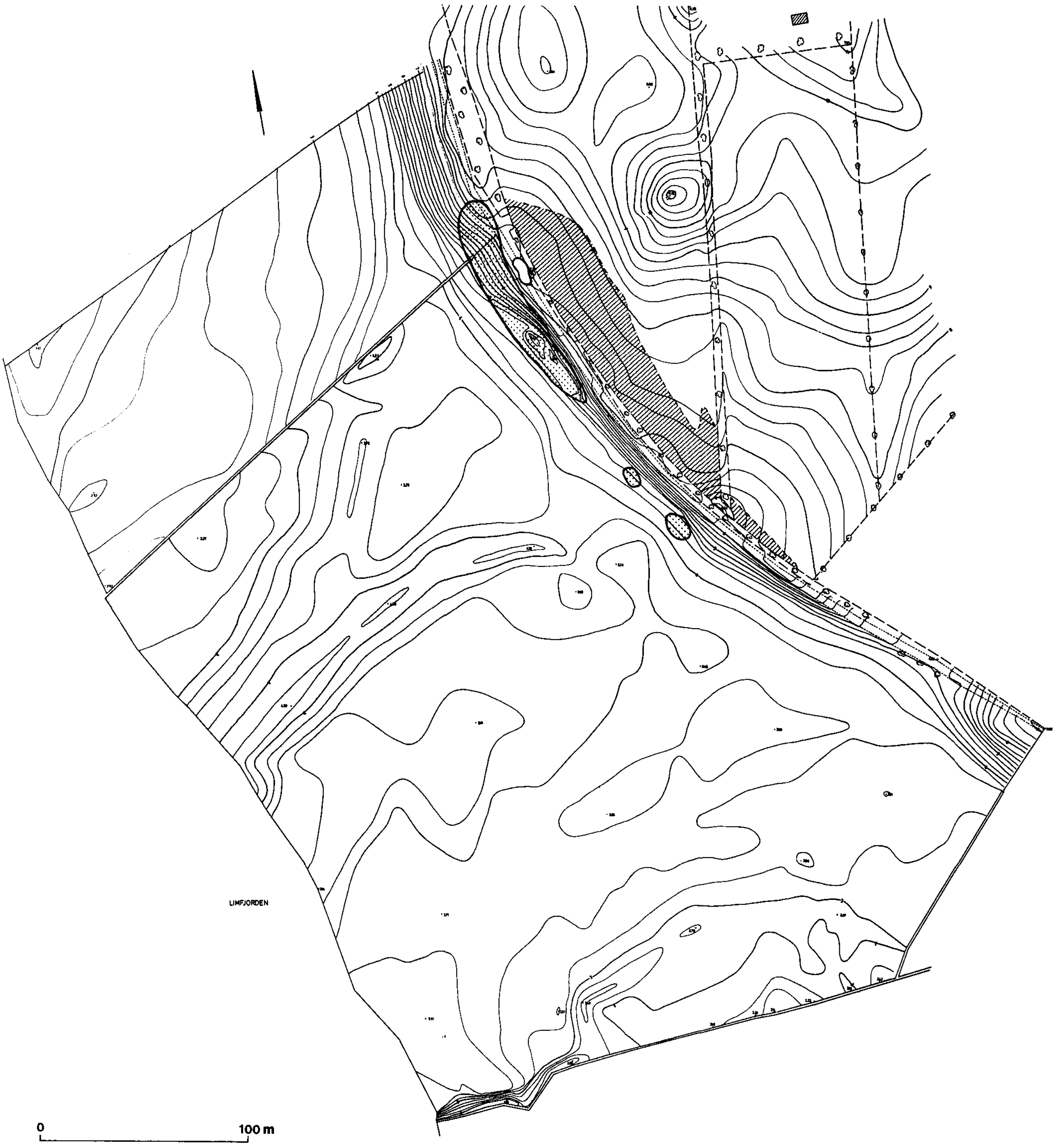


Fig. 3. The position of the kitchenmiddens (dotted) along the prehistoric coastline and the extension of the areas on dry land where flints are found – "activity areas" (shaded). Observe the system of beach ridges running from SW to NE. Distance between the contours is 25 cm. Jan Sloth Carlsen and Orla Svendsen del.

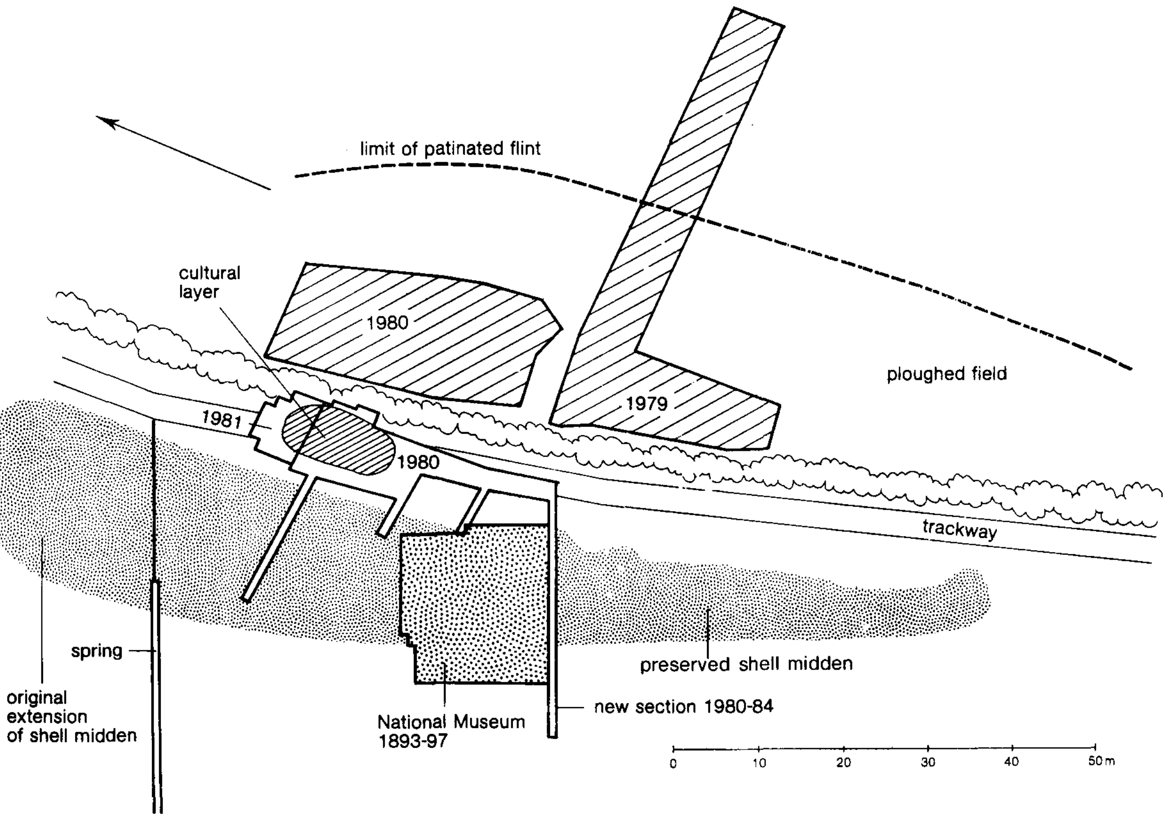


Fig. 4. Plan of the midden (shaded) and its immediate surroundings. Excavated areas are indicated. Jan Sloth Carlsen del.

The distribution of Mesolithic flints behind the kitchenmidden follows the old coastline. The intensity of artefacts is especially dense behind the central and southern part of the kitchenmidden. East of the northern part of the midden, there are very few traces of occupation. The frequency of flints is not very high in this area. No more than 10–100 pieces have been excavated pr. m^2, substantially lower than in the midden itself.

After scraping away the plough horizon from two large areas (a total of 910 m^2 (fig. 4 top)), it was clear that no primary cultural layer was present. With increasing distance from the midden, the finds in this top horizon gradually became fewer and disappeared at around 30–40 m – as observed after the surface reconnaissance. Furthermore, the area under investigation was extended to 90 m from the kitchenmidden – but no finds or structures were observed at all (fig. 4).

Scattered flints and artefacts were found throughout the plough horizon, but apart from a small oval pit (c. 100×60×30 cm) containing Ertebølle artefacts, the whole area was found to be completely void of all different types of structures normally associated with settlements.

On top of the bank, just 4–5 m east of the National Museums excavations, the subsoil forms a shallow depression filled with a fine grey sand. In this depression was a thin primary cultural layer, oval in shape (measuring 15×6 m), which contained flint waste and other typical Ertebølle artefacts (figs 5–6). This layer (just 15 cm thick) must reflect a very short occupation episode. Stratigraphic observations here clearly indicate that the top level of the sand horizon has been subjected to marine erosion, an indication that the midden has been flooded by the sea.

Although no ceramics or organic materials were preserved in this area, very high concentrations of flint were found. The artefact density was especially high in an area several meters wide around a large stone (70× 60×40 cm) with a particular concentration to the east (figs. 5–6). Close to this stone, the flint debris was

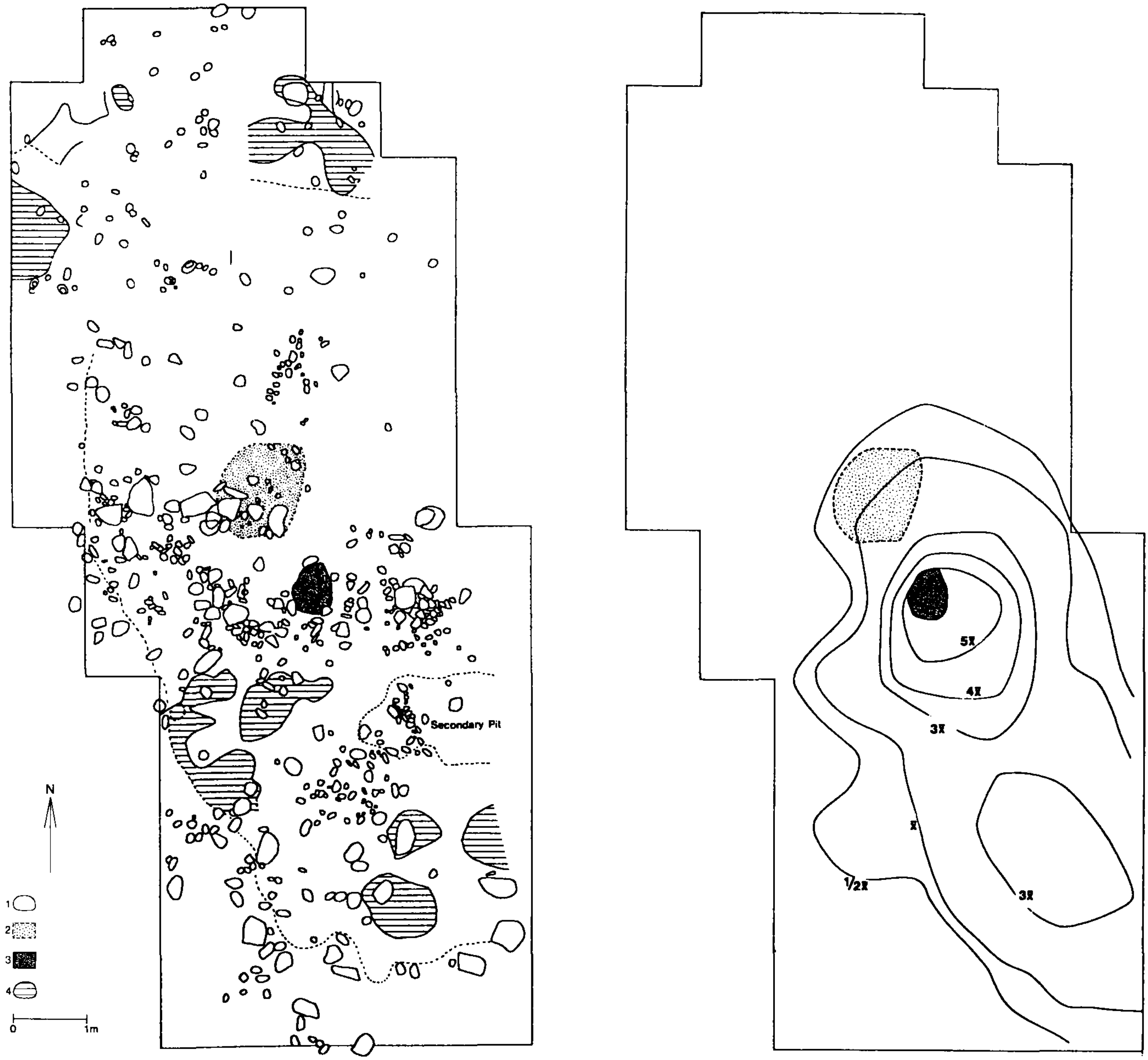


Fig. 5. (Left) Plan of the small flint-knapping area on top of the slope – just behind the central part of the midden, cf. fig. 4.
1. Stones.
2. Fireplace.
3. Big stone.
4. Pits.
Dotted line = Limit of grey sand layer.
(Right) Distribution of flint debris in the deepest horizon (layer 4) in relation to fireplace and the big stone. – The contours are based on the mean weight pr. m^2; ½x = 123 g, x = 246 g, 2x = 492 g, 3x = 738 g, 4x = 984 g, and 5x = 1230 g. Orla Svendsen del.

comprised of very small splinters and chips, while the bigger flakes – often with cortex – were found further away. As well as the debris, several broken tools and many unfinished transverse arrowheads were recorded.

Analysis on this material demonstrated that many of the flints, even when found several meters apart, could be refitted giving further support to the idea that this layer represents an undisturbed activity area.

Fig. 6. View of the flint-knapping area on dry land with the big stone. Cortical flakes from the initial preparation stage of the flint working are seen lying on the old surface around the stone. Erik Johansen photo.

One meter to the north of this flint knapping area a pit shaped fireplace (1.2 m in diameter) was found. It was filled with sand and contained firecracked stone and burned flint debris (fig. 5).

Such a distribution of flint debris has been frequently recorded not only at modern excavations of small single occupation sites, but also, from experimental archaeological tests and ethnoarchaeological investigations (Fischer et al. 1977, 93. Fischer et al. 1979, 12. Binford 1983, 152).

These lines of evidence indicate that this area was possibly a working area inwhich the large stone was used either for sitting or as an anvil during flint knapping. The presence of a fireplace in the immediate vicinity of the "working area" is also well known from ethnoarchaeological studies (Binford 1983, 149–150).

In accordance with the modern experiments and the ethnoarchaeological information, the "flint knapper" must have sat on the large stone or have been supported by it with his left side to the fireplace (Hansen et al. 1983).

All the flint types found in this area belong to the Ertebølle culture. Closer chronological analysis indicates that this "working area" is contemporary with the middle phase of the midden. However, contemporanity cannot be proved – just rendered a possibility.

Due to factors such as the topography, marine erosion, ploughing, and excavations, it is impossible to establish any stratigraphic relationship between this area and the midden only 3–4 meters away. It is, however, highly probable that they were both part of the same large settlement.

During the excavation, it was observed that all flints found up to c. 7 m above present sea level were waterrolled and patinated, indicating that this must have been the highest level of the stone age (Littorina) sea in the region. This observation corresponds well with the earlier and more recent geological investigations along the shores of the Limfjord (K. Strand Petersen 1975). This demonstrates that the kitchenmidden (which lies between 3.7–5.4 m above D.N.N.) and an extensive part of the flat plateau behind it, must have been flooded at least once – and possibly twice.

Marine erosion, therefore, could be an explanation for the lack of settlement structures to the rear of the midden. If this is the case, the erosion must have been extremely extensive, washing away even the deepest pits, postholes, and graves. However, it is interesting to

Fig. 7. (Left) Photograph of the "old excavation" in 1893–97. The work was performed within a square meter grid and in 20 cm thick layers. For the digging, local farmers were employed and equipped with small garden rakes. The older man supervising the work is Captain A.P. Madsen. The younger man is Georg F.L. Sarauw.
(Right) Excavation of the new trench in 1983. The south profile is exposed and being measured and photographed. See how the midden is positioned upon the surface of the marine sand. Photo Jan Sloth Carlsen.

note at this point, that the graves at Bøgebakken and Skateholm lie between 10 and 70 cm below the surface (Albrethsen and Petersen 1977, Larsson 1984). These measurements give an idea of the extent of sea erosion which could have taken place at Ertebølle if graves of a similar depth were present at this site.

Such heavy erosion is possible, but this does not fit the observations of the Ertebølle midden, which has an undulating surface and is not covered by any marine sediments, despite the fact that it was c. 2–3 m lower than the plateau behind it.

The explanation for the lack of structural remains, however, is more likely to be found in the types of habitations themselves. Either there was no settlement in this area, or it was of a type that left no traces remaining today (i.e. graves, deeper depressions or pits cut into the subsoil).

Conclusion

Our excavations on the plateau behind the kitchenmidden have only revealed few sporadic traces of habitation; one of which was a flint knapping area. The lack of structural remains in this area may be caused by marine erosion, but may just as well reflect either: that no large scale activity took place there or that they simply have been of a type which has not been preserved in the archaeological record.

Given the long time span during which the kitchenmidden was in use, the small number of flint artefacts and structural remains are striking.

Information from other Danish shell middens, where no marine erosion has taken place, support the Ertebølle results.

At these sites (e.g. Norsminde), traces of habitation to the rear of the midden (S.H. Andersen 1987) were also lacking.

INVESTIGATIONS IN THE KITCHENMIDDEN

In connection with the new investigations at Ertebølle, a 1 m wide by 29 m long trench was excavated through the kitchenmidden (fig. 8). This new trench was positioned immediately to the south of the square excavated by the National Museum (in the 1890's) and runs from the "old" coastal bank in the east, through the midden, and out into the marine deposits to the west. Our trench, therefore, is to be considered as a sample of the southern part of the kitchenmidden.

During our work (1980–84), the edges and corners of the old excavation were found, so that the exact position of the two excavations could be established in relation to each other (fig. 8).

This trench was excavated very meticulously, recording everything both on plans and with three dimensional coordinates. A large series of bulk samples were taken for scientific analysis, the sections were drawn and photographed, and finally, two column samples J and N (on fig. 8) were removed for future analysis.

After excavation and cleaning of the south section of the trench, the Ertebølle kitchenmidden again manifested itself in an impressive way, similar to the photographs in A.P. Madsen's book (Madsen et al. 1900) (fig. 9).

Stratigraphy of the kitchenmidden

In the trench, the maximum thickness of this in situ midden is c. 1.2 m by c. 15 m. The base of the midden is relatively flat, the surface is domed, so the cross section of the midden is semicircular (figs. 10–11).

A sharp delineation of the western end of the midden could not be established, because it fades out into the marine deposits.

The subsoil (consists of morainic clayey sand with stones) slopes gradually from the bank westwards. The bank has been eroded by the sea at a level of 4.5 m above modern sea level (Early Atlantic Transgression).

Above this moraine, there is a marine sand horizon (up to 4.3 m above modern sealevel) where both layers of fine and more coarse grained sand were deposited. This layer begins c. 5 m from the foot of the bank gradually sloping and becoming thicker to the west. Intermixed in this layer are 2–5 cm horizons with flint tools, debitage, animal bone, wood, pices of bark, many shells and shell fragments of predominantly oysters (Ostrea sp.), cockles (Cerastoderma sp.), and mussels (Mytilus sp.). This material shows that these layers are either part of a redeposited kitchenmidden or "waste" from a site. Geological investigations of this sand layer indicate that it was thicker. The erosion of this layer must have been caused by the sea – probably during the High Atlantic Transgression.

Our observations of the square excavated by the National Museum in the 1890's demonstrated with certainty that they had only dug as far as the sand layer,

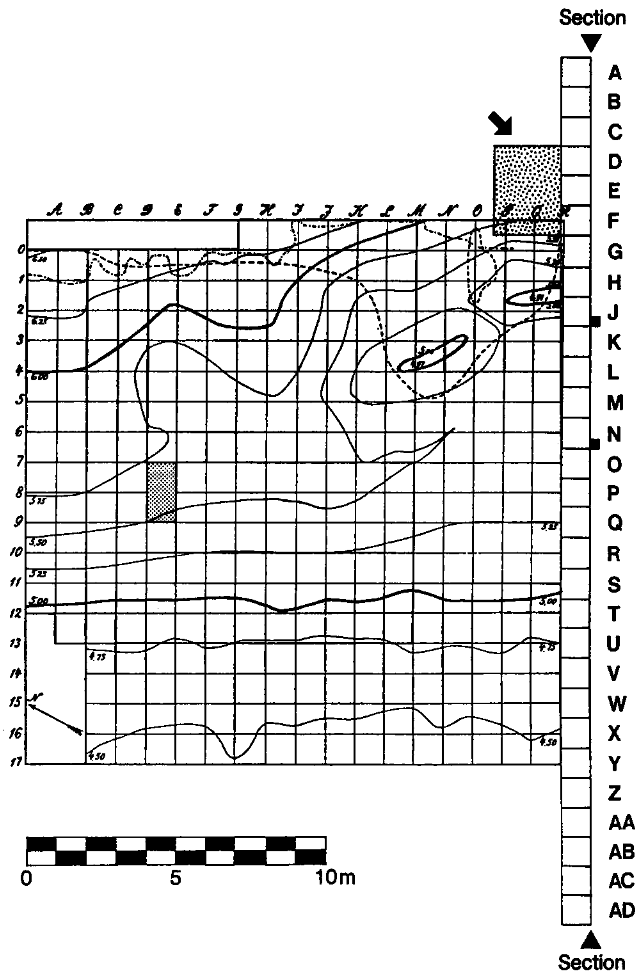


Fig. 8. Map of the position of the "old" and "new" excavation; position of the two column samples, J and N and the small excavated area of the black culture layer at the foot of the slope (arrow). Shading indicates the position of the 2×1 m column taken out of the central part of the Køkkenmødding during the excavation of the National Museum in 1895. Hanne Stenz del.

but not into it. Therefore, the artefacts we excavated within this sand horizon are most probably not represented in the material from the 1890 investigation.

Between the foot of the cliff and the beginning of the sand layer, there is a c. 5 m wide area which slopes gently down to the west (fig. 10). Here a c. 10 cm thick black cultural layer was found, containing large quantities of charcoal, flint tools, flint debitage, bones, and "cooking stones". At the bottom of the slope, this layer has been deposited directly upon the subsoil. To the west, it gradually divides into 2–4 thinner blackish layers which can be followed out into the top part of the sand horizon where they then disappear. In order to increase the number of artefacts from this black cultural layer, a square (3×2 m) just north of our original trench was excavated (fig. 8). In this area a scatter of hearth stones were found, together with another in situ fireplace. It represents a habitation on the beach down to a level of 4.3 m. The contemporaneous sea level must have been c. 4.3–3.8 m above the present.

The stratigraphic context demonstrates that the black layer is contemporary with the youngest part of the sand layer and older than the midden. This layer provides new information concerning the formation of the site. Repeated occupation took place here several hundred years before the accumulation of the midden.

The black horizon was covered by a series of 30–40 cm thick layers of narrow gravel beach ridges running along the foot of the cliff (figs. 10 and 12) thereby demonstrating that this area was still at that time very close to the sea. Within these beach ridges, cultural material was found showing that the site was still inhabited. There was a further regression of the sea and a larger part of the sand horizon was exposed thereby, making it accessible for habitation. From then on, the deposition of the midden took place. Even then, however, the sea could not have been far away, as the lowest layers of the midden show many unmistakable signs of redeposition with thin horizons of marine sand and gravel.

The upper part of the shell midden is characterized by several secondary pits filled with crushed shells. Since they contain no datable material it is impossible to tell exactly how old they are.

At the foot of the cliff, the kitchenmidden is situated directly upon the system of beach ridges as mentioned above, while further to the west, it lies on top of the sand layer (fig. 10).

In this direction, the midden becomes thinner and the sand content increases. Also, traces of marine activity become more pronounced. Here, there is no primary in situ shell midden. Instead, a layer of crushed shells mixed with many waterrolled artefacts are found. It is clear that the content of this horizon is redeposited material from other parts of the midden. Looking at the topography, this material was probably eroded from the north-northwestern part of the midden and then washed along the coast and later deposited at the southern end. This 'outwash' layer continues at least 25 m further to the west.

The lowest part of the midden is covered by a layer of freshwater peat, indicating that this area – after the retreat of the sea – became a brackish or freshwater lake/marshy area.

Our investigations proved that a 'dump' or 'waste layer' outside (to the west) the kitchenmidden – a pnenomenon known from Danish Mesolithic sites i.e. Tybrind Vig (S.H. Andersen 1985, 55–56) was not present in front of the Ertebølle midden.

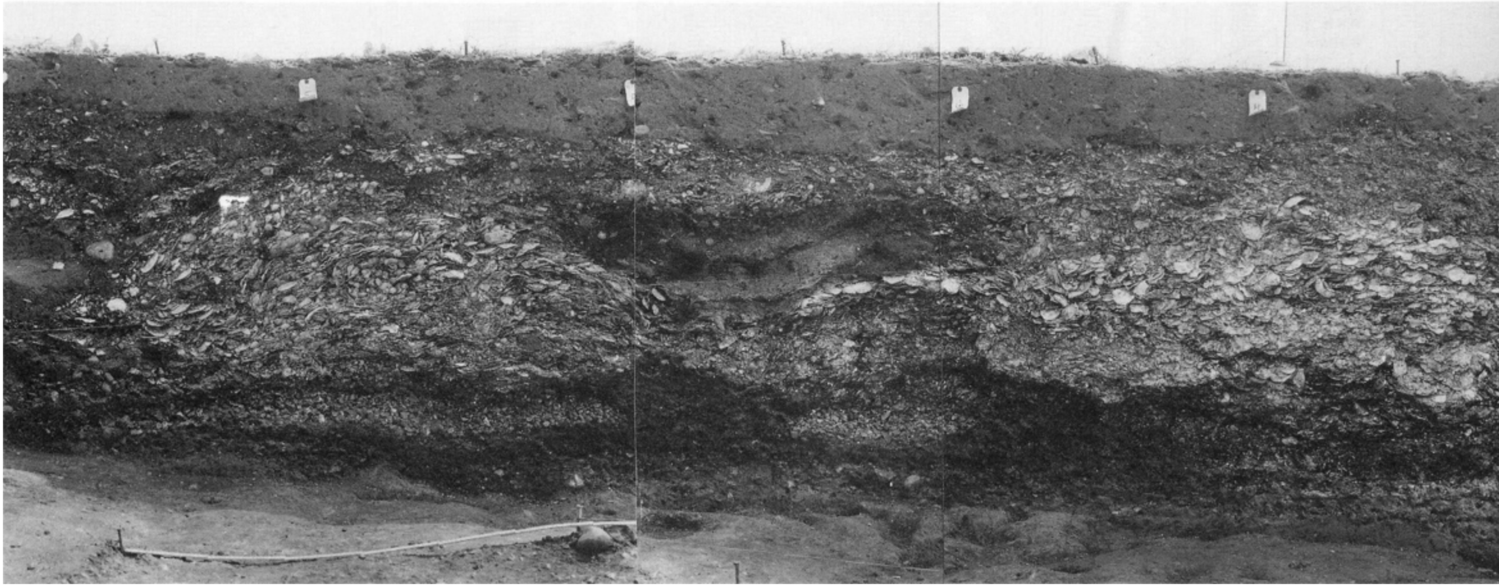
The area between the midden and the sloping bank is characterized by alternating layers of sand and shellfish. The position of these layers and their stratigraphic relationship with the midden clearly demonstrate that they derive from the plateau behind the midden – probably eroded by the sea. The presence of shell horizons here shows that in the stone age there also must have been smaller shell deposits (Køkkenmøddinger) on the plateau to the rear of the midden.

Since we have no dates of these layers at the moment, it is only possible to say that they must be older than the transgression(s) which flooded the plateau and eroded the deposits down the bank.

Interpretation of stratigraphy

After the erosion of the bank during the Early Atlantic Transgression, the sea withdrew.

Contemporary with or later than the retreat of the sea, the marine sand horizon was deposited. At the same time we find the oldest traces of habitation at Ertebølle, a small settlement on top of the bank. This settlement c. 4020–4060 b.c. must have consisted of a small kitchenmidden such as the ones seen in Brovst layer 11 (S.H. Andersen 1970) and the Norslund layer 4 (S.H. Andersen and C. Malmros 1966). During the High Atlantic Transgression the sea eroded the top of the sand layer. The sea then receded and the slope at the foot of the bank was exposed and became a dry beach well suited for habitation (the black layer 3,850 b.c.). Shortly after, the beach and the sand layer were exposed enough for the accumulation of the large Køkkenmødding where the oldest part c. 3,800 b.c. is found close to the slope. Several small beach ridges intermixed with cultural material and shells document that the sea still was not far away. Our investigations indicate that the midden was deposited in the regression between the High and Late Atlantic Transgression. About 3,500 b.c., the midden at this spot started to inc-



rease rapidly in a horizontal and vertical way. Contemporary to this accumulation we find indications of a gradual rise in sea level (see K. Strand Petersen, this volume). After 3500 b.c. there is a lapse in the accumulation of shell for some period. Finally, we see the last traces of shell deposits belonging to the youngest Ertebølle c. 3,200 b.c.

Later the sea flooded (once, possibly twice) the Ertebølle midden thereby causing erosion to occur both on the plateau behind the midden and along the coastline. One of these transgressions must have taken place after c. 3,000 b.c. and before 2,800 b.c. (11).

Finally, the sea withdrew and the sea bottom in front of the site gradually became transformed into a brackish marshy or bog area.

The Ertebølle midden displays many traces of marine activity in the form of small beach ridges – layers of gravel and fragmented shell. This means that the midden, in contrast with most Danish kitchenmiddens, was always in the intertidal zone exposed to wave action, high tides, and storms.

A large part of the southern end of the Ertebølle midden is an accumulation of secondary material. This conclusion has, of course, consequences for the material from the old excavation – of which a substantial part must stem from this 'secondary' accumulation. This new information tells us also, that calculations should not be based on midden size alone.

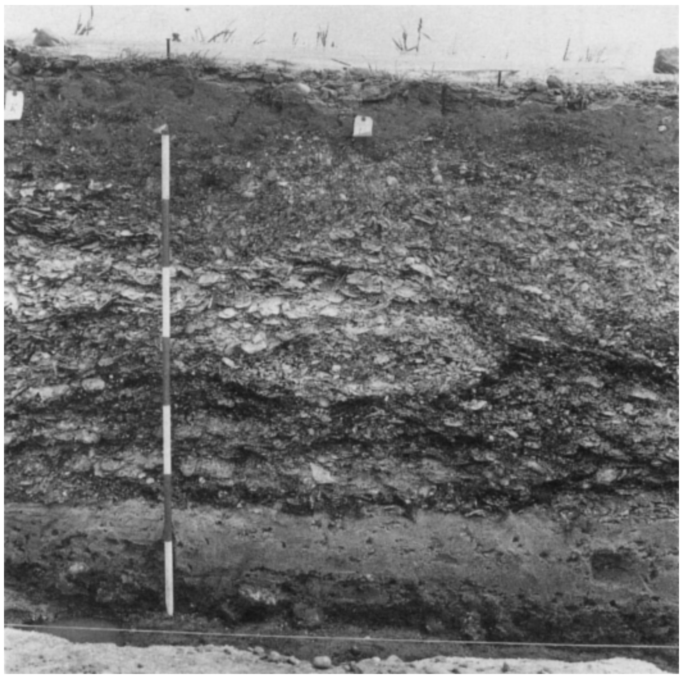


Fig. 9. (Top) Square "D-H" in the eastern part of the Køkkenmødding. In this area the midden is characterized by rather steep-sided shell heaps reflecting a fast accumulation. In the centre of the shell heaps is a large hearth or firepit with three superimposed layers of clay and charcoal. Jan Sloth Carlsen photo.
(Bottom) Square "L" in the central part of the midden. This area is characterized by more horizontal layers reflecting a slow accumulation rate. The lens in the centre is a local heap of cockles.

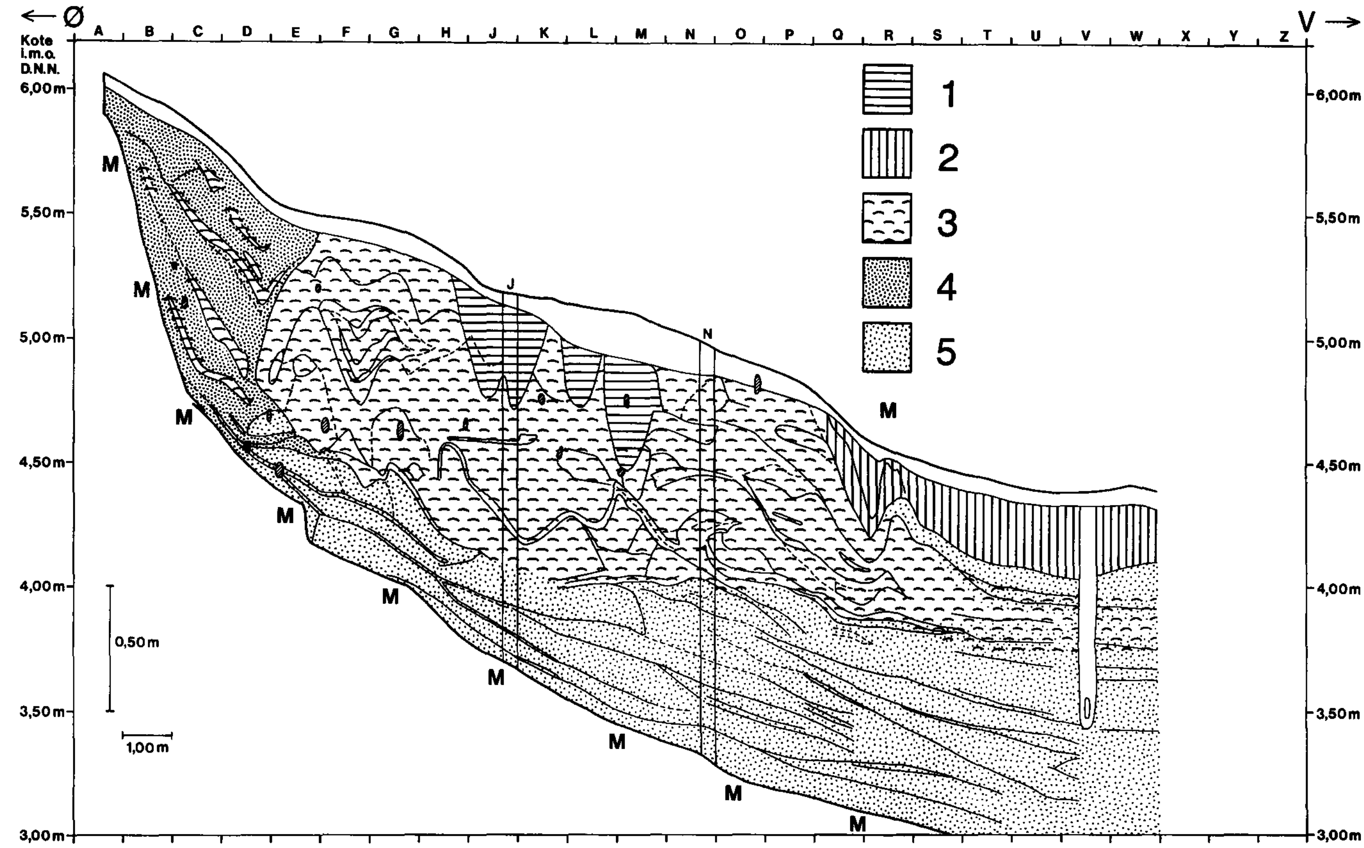


Fig. 10. South section (E-W) through the Ertebølle Køkkenmødding, cf. fig. 9.
1. Secondary pits.
2. Peat.
3. In situ shell midden.
4. Sand and shell layers.
5. Marine sand.
M. Morainic clay.
The two column samples "J" and "N" are indicated. The profile is exaggerated 5x.

Midden composition

The shell midden consists of a mixture of marine molluscs, charcoal, flint debitage, animal bone, ceramics, and stones of varying size. Fireplaces of different types, layers of ash, fishbones, and a few larger stones were also found. The shell composition of the deposits vary, oysters (Ostrea sp.) always dominate (up to 80%), followed by cockles (Cerastodorma sp.), mussels (Mytilus sp.), and periwinkle (Littorina littorea).

In smaller areas, any of these species may dominate completely – most probably representing waste from individual meals of a single species (fig. 9 bottom).

A more detailed survey of the mollusc content and composition is given by K. Strand Petersen in his article (this volume).

The distribution of cultural remains also vary. Some horizons are characterized by a particular dominance of artefacts. The areas around the fireplaces are sometimes extremely rich in finds.

The content of artefact material in these shell heaps is very uniform throughout the midden, suggesting that their types of activities remained constant through the long occupation period.

Around the fireplaces are horizons of ash and charcoal (fig. 14). In some areas it has been possible to follow such layers up to 7 meters from the fireplace. These layers enable us to establish contemporary surfaces within the midden. Furthermore, the extension of such ash horizons clearly prove that these fireplaces were open-air. If they had been in huts, the ash would have been more confined.

The stratigraphy of the midden (figs. 10–11) shows that the excavated part could be divided into two areas,

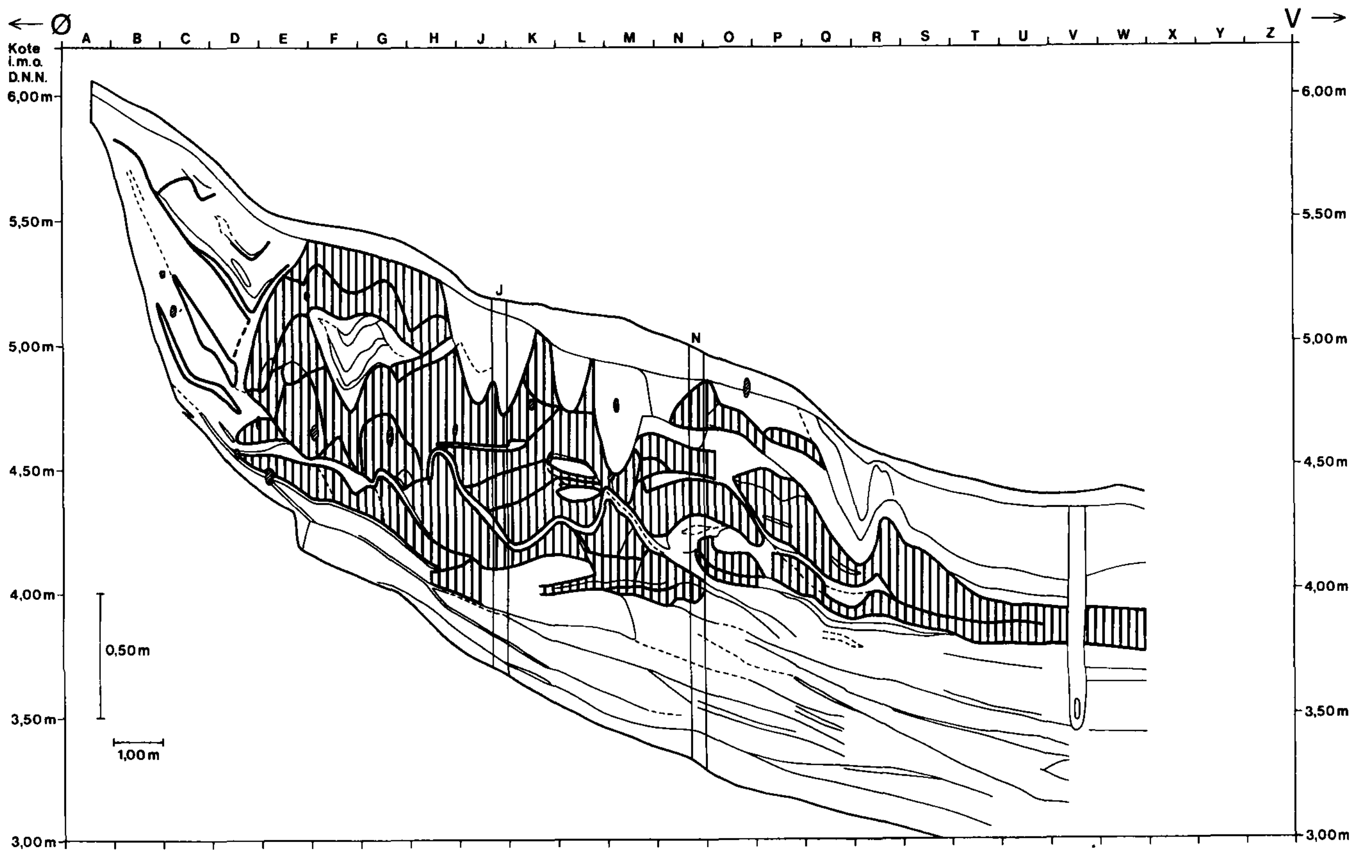


Fig. 11. Section of the Ertebølle Køkkenmødding. All well defined and localized stratigraphic units are indicated by the hatching. Orla Svendsen del.

each characterized by its layers of shellfish. Firstly, the midden area close to the sloping bank is characterized by loose, steepsided shell heaps, few artefacts, and a very homogeneous composition of shellfish species. Secondly, the western part of the midden is comprised of more horizontal horizons (compressed shell) of mixed shellfish containing many artefacts.

This observation probably reflects different activity areas within the midden: 1) an area frequently used for dumping of shell and 2) one with a much slower rate of accumulation.

The positioning of the fireplaces each in the center of these two areas (fig. 12) lends support to this observation.

As can be seen in the section (figs. 9–10), it is obvious that the midden does not represent one regular and continuous accumulation. Quite the contrary, a great number of finer and thicker layers or "heaps" can be defined – either widespread through a large part of the midden or more locally distributed (fig. 11).

The sections (figs. 9–11) exemplify a typical Danish kitchenmidden. By differences in composition, colour, density, and degree of decomposition, it is possible to separate the individual layers. Although the number of layers vary at different points along the section, the general number is relatively constant around 6–10 horizons through the midden (fig. 11).

These individual heaps measure 2–7 m in an E-W direction and 30–50 cm in thickness.

Such heaps of shell debris must represent occupational episodes, stressing that there is not necessarily a relationship between depositional episodes and occupational episodes (Binford 1982, 16). An occupation may cause several shell heaps or none at all. Therefore, it is also impossible to tell how large the individual habitation units were.

A solution to this problem, may be in an analysis of refitting flint debitage and bone, but this has not been tested so far.

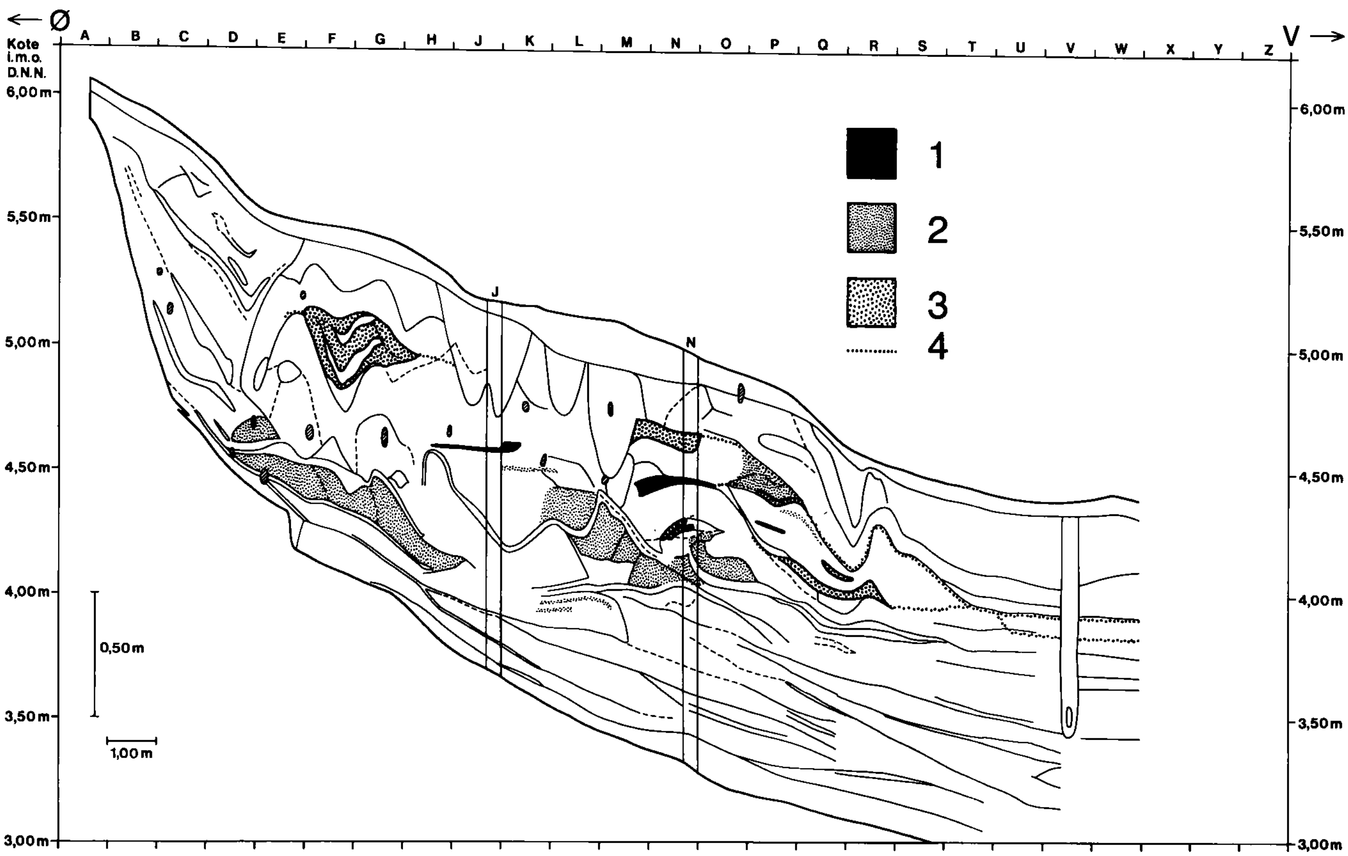


Fig. 12. Section of the Køkkenmødding. The positioning of the fireplaces, ash layers, fishbone horizons and layers reflecting marine activity are marked. Orla Svendsen del.

1. Fishbone layer
2. Marine sediments within the midden
3. Fireplace
4. Ash layer

Activity areas

Around the fireplaces there are concentrations of flint debitage, flint tools, bone, and pottery – clear indications that these areas have been centers of activity such as, production of tool types and consumption of food.

An analysis of the occurence and size of the flint debitage indicate high frequencies near the fireplaces (fig. 14).

The intensity of flint debitage increases towards the fireplace, but drops at a distance of c. ¾–1 m from the periphery (see fig. 14).

A substantial part of this flint waste is microdebitage (less than 1 cm in length) which proves that flint knapping took place on the midden (Binford 1983, 156, Fischer et al. 1979, 17).

In squares N-O (just 1 meter from the fireplace), a large stone (measuring 25×10×10 cm) was found surrounded by flint debitage – most probably a flint knapping area (fig. 14 top). A similar situation was observed in square S. A stone (c. 40×30 cm and 20 cm high) was found surrounded by many flakes. These stones may have functioned as anvils (fig. 14 bottom).

The usewear analysis on the blades found around the fireplace in square N (see fig. 14 top) demonstrates that a high percentage of these were used for shaving and whittling plant stems, probably for the production of baskets and/or fishtraps (see later).

Even though animal bones were found throughout the midden, they display similar distribution patterns as the other types of artefacts. Like the flint tools, there is a clear concentration of bone near the fireplaces (fig. 14 top). It is interesting to note that the number of bones becomes more frequent 3–4 m from the hearth and then increases towards the fireplaces, but suddenly

Fig. 13. Types of fireplaces. 1) horizontal layer of burned shell powder and charcoal (left), and 2) pit-shaped layers of clay, burned shells and charcoal (right). Jan Sloth Carlsen photo.

drops at a distance of c. 1 m from the periphery. These observations are best interpreted as a result of food preparation and consumption around the fireplaces – probably "drop zones" as described by L. Binford (Binford 1983, 151–153).

There are three distinct horizons (5–10 cm thick) of concentrated fishbones (fig. 12). Two of these layers are found in the western part of the midden, while the third is in the central part. These horizons are localized, their diameters are 80 cm, 120, and 170 cm respectively (in an E-W direction), and are found in the middle layers of the midden. The two fishbone layers in the western part of the midden seem to be connected with the nearby fireplaces (fig. 12). Such concentrations may reflect periods of intense fishing or a systematic use of specific areas of the midden for fish processing.

All these observations show that the Køkkenmøddinger – in contrast to general opinion – were divided into different activity areas (flintknapping, cooking, production of tools, and disposal of shellfish) and that especially the fireplaces have been essential as locations for activities over long periods of time.

Fireplaces

In this section of the midden we have documented at least 5 fireplaces of two types. The most common type is round with layers of light grey burned shell material and charcoal. The diameter of this type of hearth ranged from 60–120 cm (fig. 13). The other type of fireplace was comprised of a steepsided pit with three successive layers of charcoal, lightbrown clay, and burned shell (fig. 9). The size (2,5–3 m in diameter) and its pit-like shape clearly make this fireplace unique. Although it may be interpreted as a fireplace, the form and size of this feature may suggest other interpretations, such as "cooking pits" or "firepits" as described by M. Klinge (Klinge 1931). The fact that this feature is found amongst the shell heaps, may also be taken as an indication that its function has some connection with them.

Stone fireplaces were not found during the new excavation, however, traces of such a fireplace were found in the black cultural layer under the midden. In connection with the old excavation, two similar stonelined fireplaces were also recorded underneath the midden (Madsen et al. 1900, 25–28).

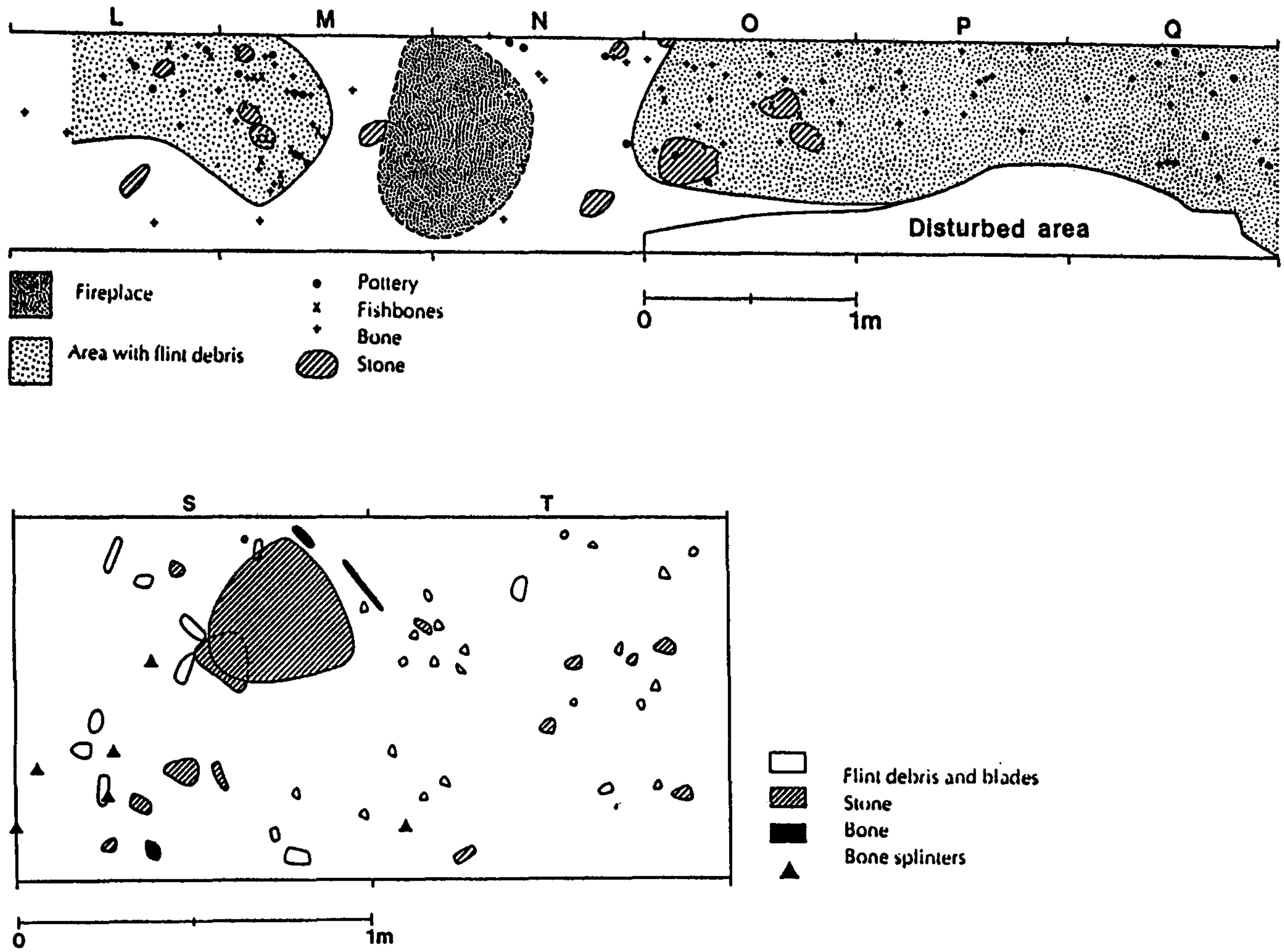


Fig. 14. (Top) Horizontal distribution of flint debris, stones, bones, fishbone concentrations, and pottery around the fireplace in square "N" (see fig. 13 left) Younger Ertebølle culture.
(Bottom) Distribution of flint debris, blades, flake axe, stones, and bones around the stone in square "S" in the marine sand under the Køkkenmødding. Older Ertebølle culture. Orla Svendsen del.

The fireplaces are – with one exception – all found in groups within the same area of the midden and very often superimposed. This observation must indicate that the position of the fireplaces have been fixed through time (in some cases through 2–300 years).

The fact that we only have the stone fireplaces in the bottom layer of the Ertebølle midden is also a fact observed at other middens. This is interpreted as remains of old living floors outside the shell heaps which have been covered by younger shell debris.

The difference in type may also indicate differences in function or state of permanency, but this problem has not yet been analysed.

Other features

No pits, house floors, or graves were recorded within the midden during our excavation, but from the old investigations, at least two (probably Mesolithic) graves were found (Madsen et al. 1900, 77–80).

It was not possible to observe features in the sand under the midden because the trench was too narrow.

The new excavation also proved that what previously was supposed to be a part of a house floor – and published as such (Simonsen 1951, 222–223) was not a house, but the S-E corner of the old excavation.

Fig. 15. Section of square "S" with the stone in the marine sand, cf. (fig. 16 bottom).

Chronology

Twenty-six C-14 dates have been analysed in connection with the new investigations at Ertebølle. Of these, 25 are based on oyster shells (Ostrea sp.) and one on charcoal (see the list p. 60 and fig. 16). The position of each C-14 sample was taken in stratigraphic context in order to date the different sections and layers in this part of the midden.

The C-14 analysis supports the stratigraphic observations. The oldest dates come from the marine sand under the midden, 4,020 ± 95 b.c. and 4,060 ± 95 b.c. (K-4317 and 4318) The black cultural layer at the foot of the bank dates to 3,850 ± 95 b.c. (K-4366). After this time, the accumulation of the midden began. The oldest part of the midden, the area closest to the bank, dates to 3,800 ± 95, 3,750 ± 95 and 3,760 ± 95 b.c. (K-4309, 4312, and 4313). From the start, the growth of the midden seems to have been slow and gradual. However, after 200–300 years (around 3,500 b.c.) the rate of accumulation became faster and the dates demonstrate that the main part of the shell midden (both in a horizontal and vertical way) was deposited within a hundred years. Again, the rate of deposition became slow and the shell heaps close to the bank were accumulated within the years 3,300–3,100 b.c. (K-4307, 4308, and 4305).

The youngest C-14 date is 3,120 ± 90 (K-4307), which is in nice accordance with its stratigraphic position as this sample comes from the uppermost undisturbed layer.

In our trench these dates clearly demonstrate that the Ertebølle Køkkenmødding at this spot is not a chronological unit but rather, an accumulation over 700 years. Neither is it a gradual and continuous one, but rather, a series of more or less intense depositions (figs. 17a–b).

It is essential to stress that all the dates are of a Mesolithic age. No Neolithic levels were observed in this section of the midden.

Finally, it is interesting to compare the new dates with the results from the National Museum's column, which was just 14 m to the north of the new profile (fig. 8). If we compare the two groups of dates (all made on oyster shells) it is evident that a substantial part of the midden deposit of the National Museum's excavation belongs to a period which is barely represented in our section. The majority of the National Museum's C-14 dates fall in a period c. 3,600 b.c. from which we have just a few dates in our series (fig. 16). Again, an emphasis of the fact that such a Køkkenmødding is a result of both a horizontal and vertical accumulation.

It is also worth mentioning, that the topmost and lowest levels in these two areas have given identical C-14 dates respectively c. 3,800 b.c. and 3,100 b.c. This, indicates that these habitations must have been of a rather large horizontal extension.

These observations combined with analyses of the artefact material all suggest that the northern part of the Ertebølle midden is the oldest and that it has been growing along the coastline from the north to the south.

This is probably the explanation for the oblong outline of this midden as well as for other Danish kitchenmiddens.

The above measurements (length, width, and thickness) of the Ertebølle midden are, therefore, not a reflection of one single unit, but a cumulative deposit during a 700–800 year period (see below).

The new investigations show that the kitchenmid-

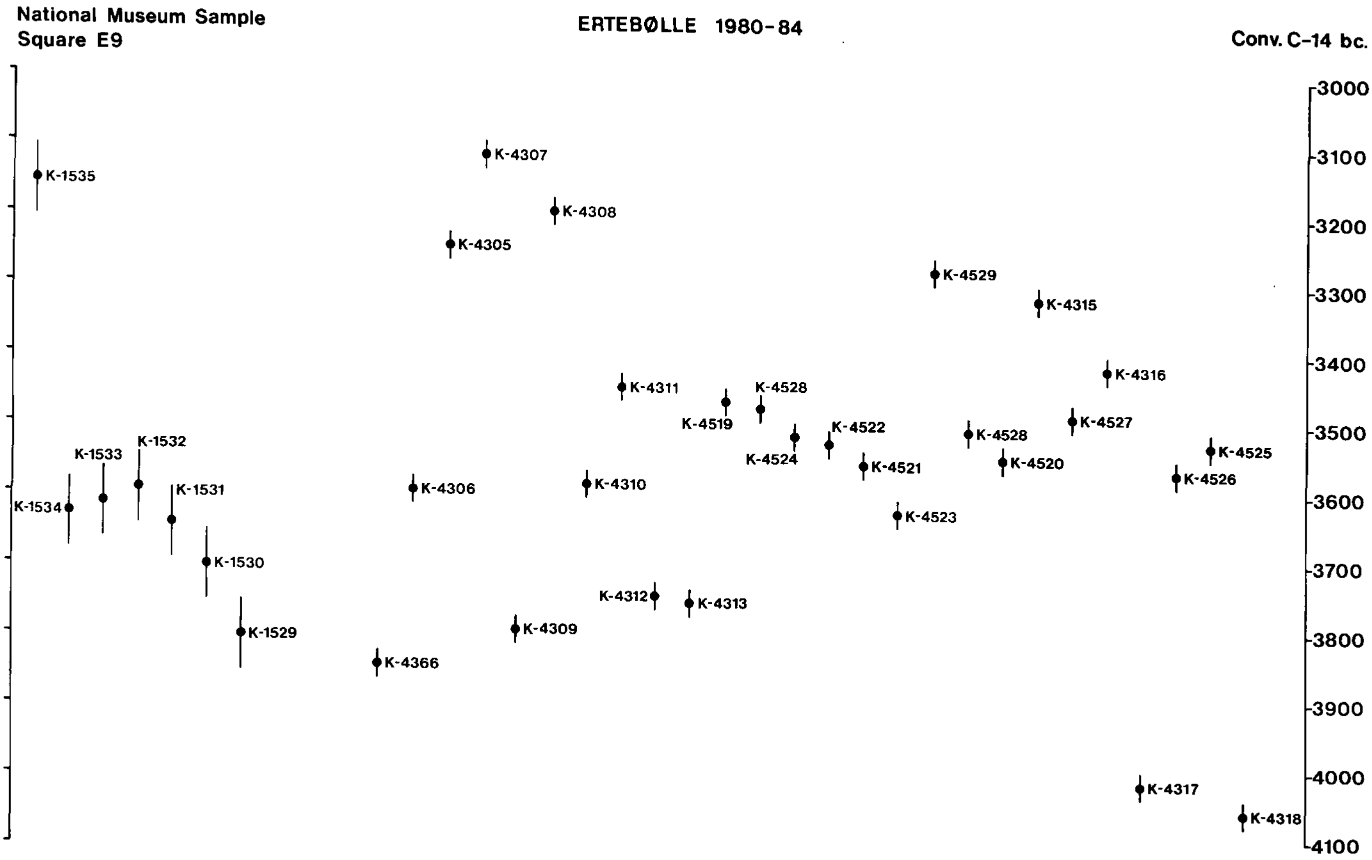


Fig. 16. Diagram of all C-14 datings from Ertebølle. The datings from the National Museum sample are arranged in their stratigraphic sequence; the datings from the 1980–84 excavation are depicted as they occur in the section of the midden.

dens must not be considered as chronological and functional units. They represent a process during which the focus of activities gradually moved along the prehistoric coastline. How large the individual units were seems to vary considerably.

The repetition in the use of such sites like Ertebølle, Meilgård and Norsminde, as demonstrated by the stratigraphy and the C-14 dates, is a clear indication of a rather (if not completely) sedentary settlement system in the later Ertebølle culture.

The finds

Several implements of flint, bone, antler, and pottery of Ertebølle tradition were found.

The abundant artefact material and bone shows that a large number of different activities have taken place. Artefacts occur throughout the midden. Both the horizontal and vertical distribution of artefacts reflect areas of concentrations. In terms of the horizontal distribution, the material around the fireplaces is highly concentrated – not only tools, but also, debris and animal bone. At Ertebølle, the densest concentrations are found within the midden itself.

The vertical distribution of finds are depicted in fig. 18. If we compare figs. 12 and 18, it is evident that the majority of artefacts correspond with the ash layer(s) from the fireplaces. This indicates that these layers reflect long occupations in open air conditions.

Due to the long occupation, the well documented stratigraphy, and the C-14 sequence (see p. 60), we can observe changes in the artefact inventory. Some changes are gradual and minor while others, like the occurrence of ceramics, are more abrupt.

The tools are made on two different types of flint: 1) small flint nodules with a grey hard cortex probably coming from the morainic deposits and 2) flint nodules

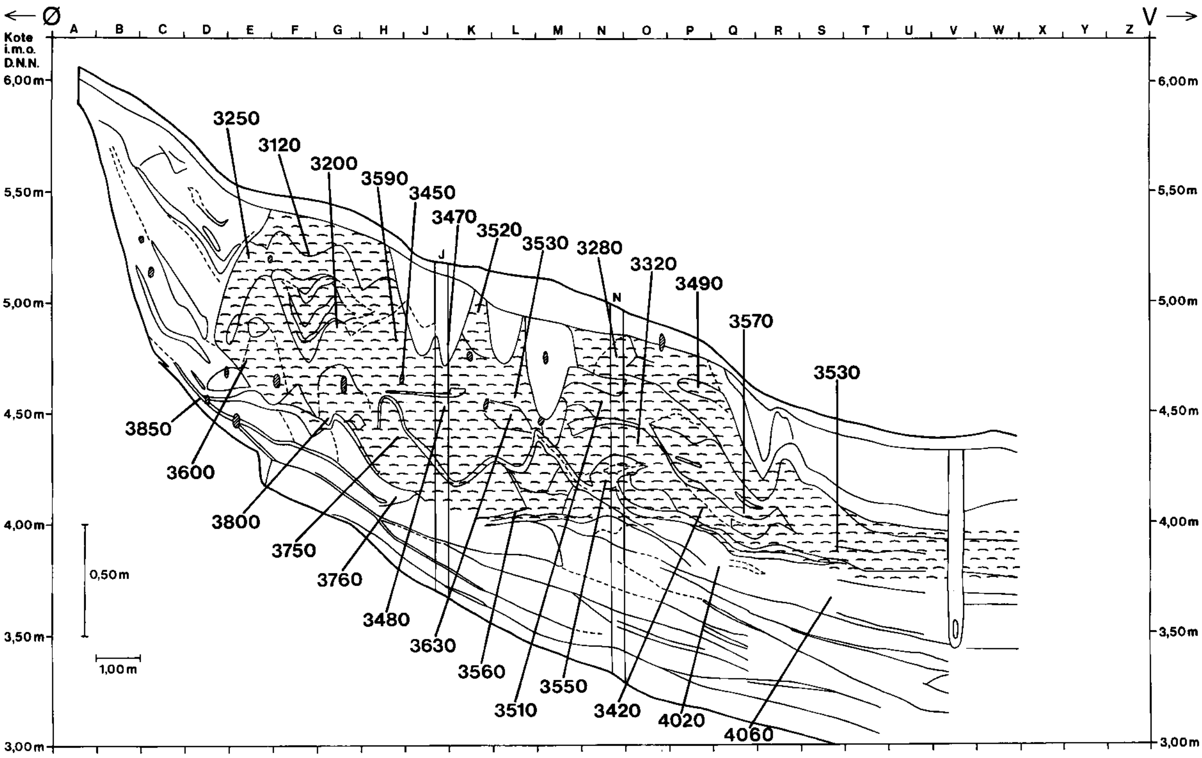


Fig. 17a. The positioning of the individual C-14 samples in the section. Orla Svendsen del.

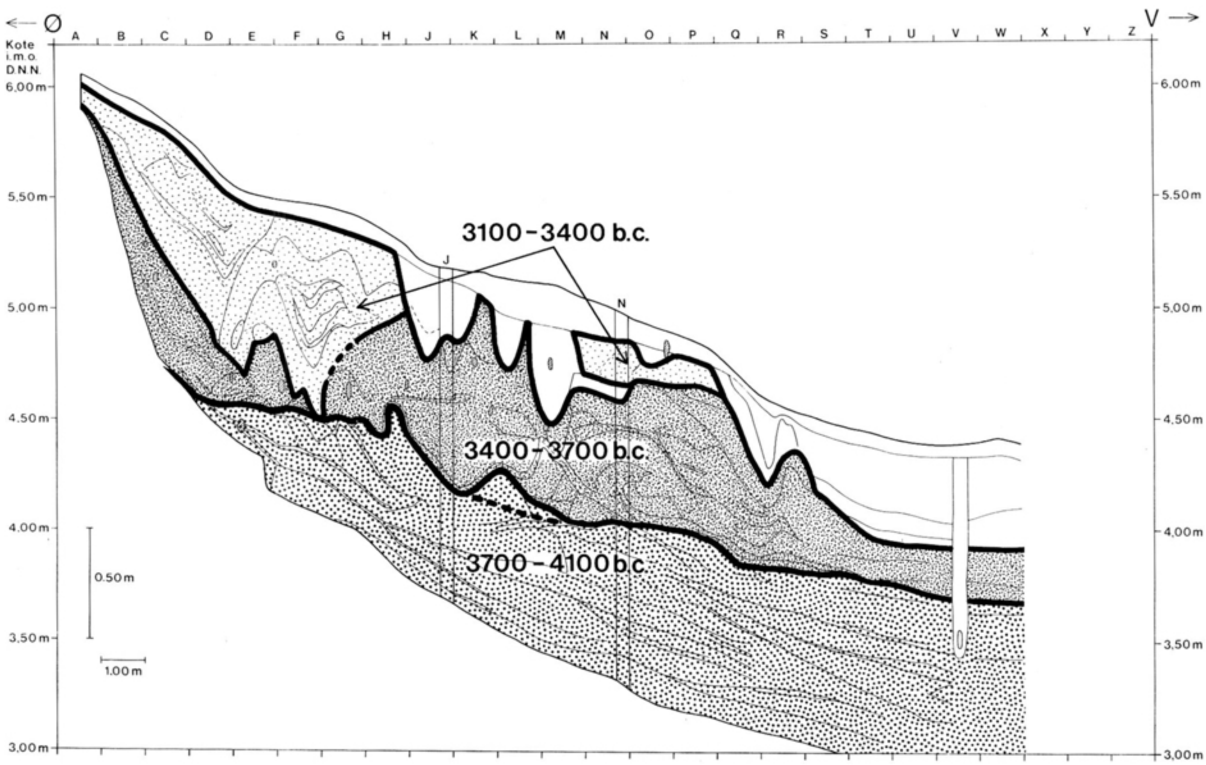


Fig. 17b. Section of the midden showing generalized sequence based on C-14 datings. Orla Svendsen del.

with a chalky soft primary cortex. This type of raw material must have come from areas where there is direct access to limestone or chalk bedrock. Such stone outcrops are not found in the area of Ertebølle, but c. 15 km to the north-northwest in the area around Aggersund.

The flint tools are relatively small, irregular, and simple compared to other contemporary Ertebølle sites. These characteristics seem to be constant throughout the habitation period at this site.

The contemporary nearby sites like Bjørnsholm (fig. 1), had access to the same types of raw material, but their tools differed stylistically. These observations may very well indicate two groups of people with different flint tool traditions.

Besides the flint tools already known from the old excavations at Ertebølle, we have also found types which were not known at the end of the previous century. This applies especially to the burin group, edge rejuvenating flakes from axes, burin spalls, and so on. The number of transverse arrowheads has been greatly increased due to the modern techniques of excavation.

The flint inventory is characterized by many tools on blades, such as scrapers, borers, burins, and truncated pieces (fig. 19).

The occurrence of composite tool types (fig. 19,11) is also a very characteristic regional aspect of the Ertebølle culture in North Jutland.

Also, with these types of tools are transverse arrowheads and both flake and core axes (figs. 20–21). In the Danish Late Mesolithic, the core axe dominates in the older phases, while the flake axe dominates in the younger. In Ertebølle, the flake axe dominates in the top layers, while the two forms are evenly represented within the rest of the midden. In the vertical distribution of the subtypes of the flake axe, we also find chronological differences. In the top layers, there is a dominance of flat flaked flake axes, while the edge trimmed variant is common in the deeper layers of the midden. No axes on greenstone (diabase) were found.

From the sand horizon under the midden, we find the same flint tool types, but we can observe slight differences in technique and relative proportions. For instance, there is an increase in the number of burins and a decrease in scrapers and borers. A greater number of blade knives are also found in this horizon (fig. 19,13) This a characteristic of the older Ertebølle in Jutland (S.H. Andersen & C. Malmros 1966, 76–77, 88, and 92).

Among the tools on flakes, it is worth mentioning a few scale worked flakes (S.H. Andersen 1979). These flakes are found in the secondary marine outwash to the west of the midden. This type is significant to the oldest Ertebølle phase in Jutland. They are also indications that other (probably more northern) parts of the midden must be older than that of the area where the new trench was placed.

A sample of 98 blades have been analysed for traces of usewear (Juel Jensen 1986, 22). Of these, 57 displayed traces of plant polish (figs. 20,4–8). The direction of wear is perpendicular to the edge, and the polish is restricted to a few centimeters along the edgeline. These types were probably used for the splitting and shaving of plant stems, and have been interpreted as waste from the production of baskets or fish traps (Juel Jensen 1986, 25).

Tools of antler and bone of the Ertebølle tradition are also found: 1) one red deer antler axe with the shafthole near the burr of the antler (fig. 22,3), 2) several sawed tines for pressure flaking (fig. 22,4–6), 3) many simple roundt sectioned bone points (fig. 23,1–7), and 4) a small fishhook (fig. 23,8).

The abrupt appearance of pottery occurs in the layers of the midden later than c. 3,700 b.c. (fig. 21). Apart from one rimsherd found in the top layer of the sand under the midden, no pottery was discovered here or in the black cultural layer at the foot of the slope. Also, pottery is found in small concentrations around the fireplaces (fig. 21). The pottery is from a very thick ware – clearly thicker than what was found at contemporary sites further to the south in Jutland (S.H. Andersen 1975, 56–64).

Cultural context

All finds from the new excavation belong to the Ertebølle culture. The artefact inventory from the marine sand under the midden, the black cultural layer at the foot of the bank, and the deepest part of the midden itself is similiar to what is known and described from the sites Dyrholmen I (Mathiassen et al. 1942), Norslund layer 3–4 (S.H. Andersen & C. Malmros 1966), and Brovst layer 8 (S.H. Andersen 1970). These horizons all define the older Ertebølle culture (the aceramic Ertebølle) of western Denmark. The Norslund layer 3–4 are dated to c. 4,400 b.c. (S.H. Andersen & C. Malmros 1981, 60–61) and Brovst layer 8 has a chronological po-

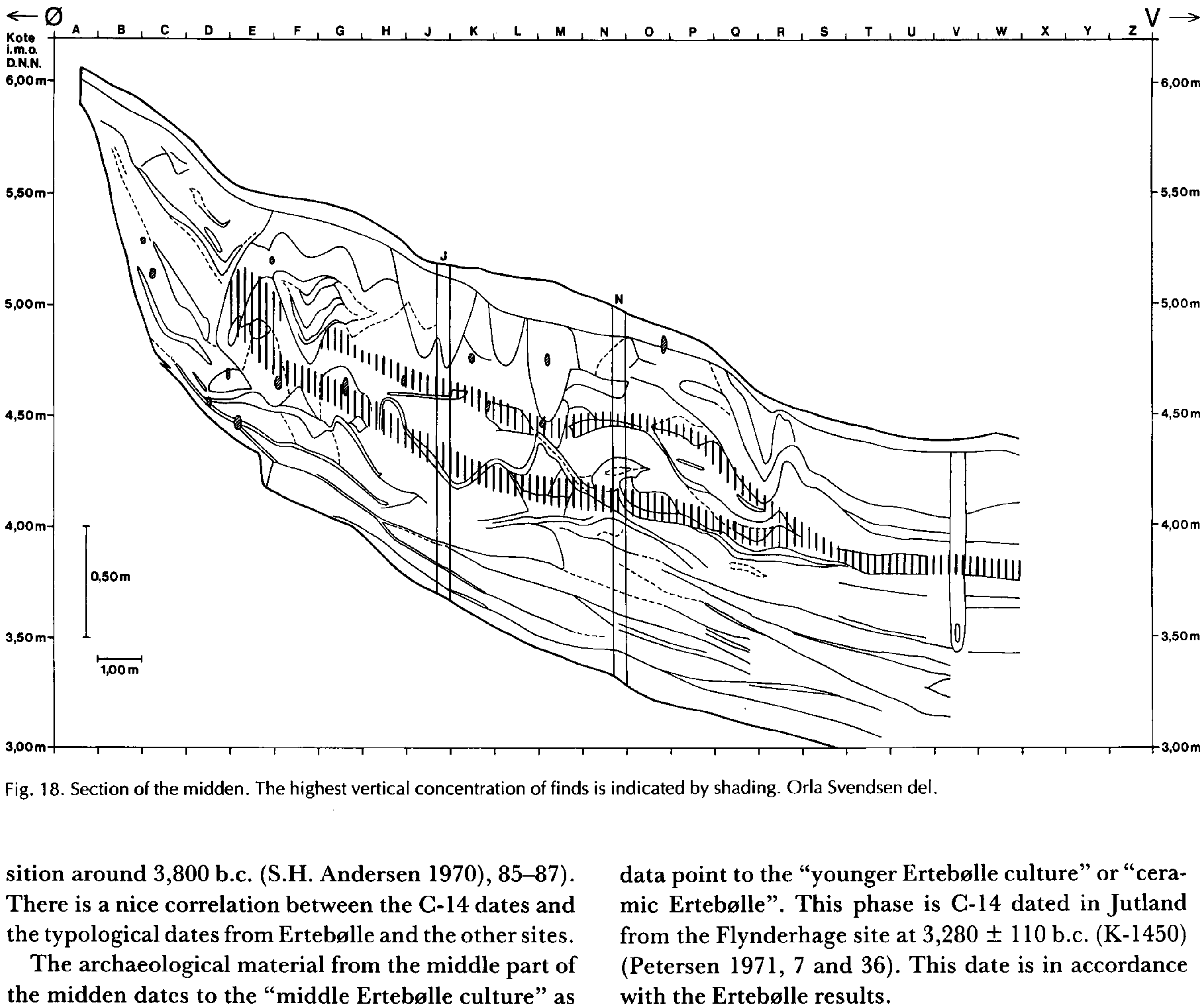


Fig. 18. Section of the midden. The highest vertical concentration of finds is indicated by shading. Orla Svendsen del.

sition around 3,800 b.c. (S.H. Andersen 1970), 85–87). There is a nice correlation between the C-14 dates and the typological dates from Ertebølle and the other sites.

The archaeological material from the middle part of the midden dates to the "middle Ertebølle culture" as described by Mathiassen (Mathiassen et al. 1942, 52–53 and 62). A similiar artefact assemblage is recorded from Norslund layer 2 (S.H. Andersen & C. Malmros 1966).

An identical artefact composition is also described and dated from the nearby small shell midden at Aggersund (S.H. Andersen 1980). This site is C-14 dated to 3,480 b.c. (S.H. Andersen 1979, 42 and 53) – which is contemporary with the major part of the Ertebølle midden.

The undisturbed shell midden associated with the youngest habitation phase at Ertebølle is very restricted in the new excavation; because of this, the number of finds is also very small. Therefore, the typological date of these horizons are not well founded, but all available data point to the "younger Ertebølle culture" or "ceramic Ertebølle". This phase is C-14 dated in Jutland from the Flynderhage site at 3,280 ± 110 b.c. (K-1450) (Petersen 1971, 7 and 36). This date is in accordance with the Ertebølle results.

It is essential to stress that the artefact assemblages found at the Ertebølle type site in a chronological sense cover most of this cultural phase (early, middle and late Ertebølle culture) as described in the literature (Clark 1975, 181–199, Petersen 1973, 77–128).

The relevance and use of Ertebølle as a type site is, therefore, still correct.

Economy

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, shellfish and a single charred hazelnut.

The list of species (see p. 59) displays a wide range of

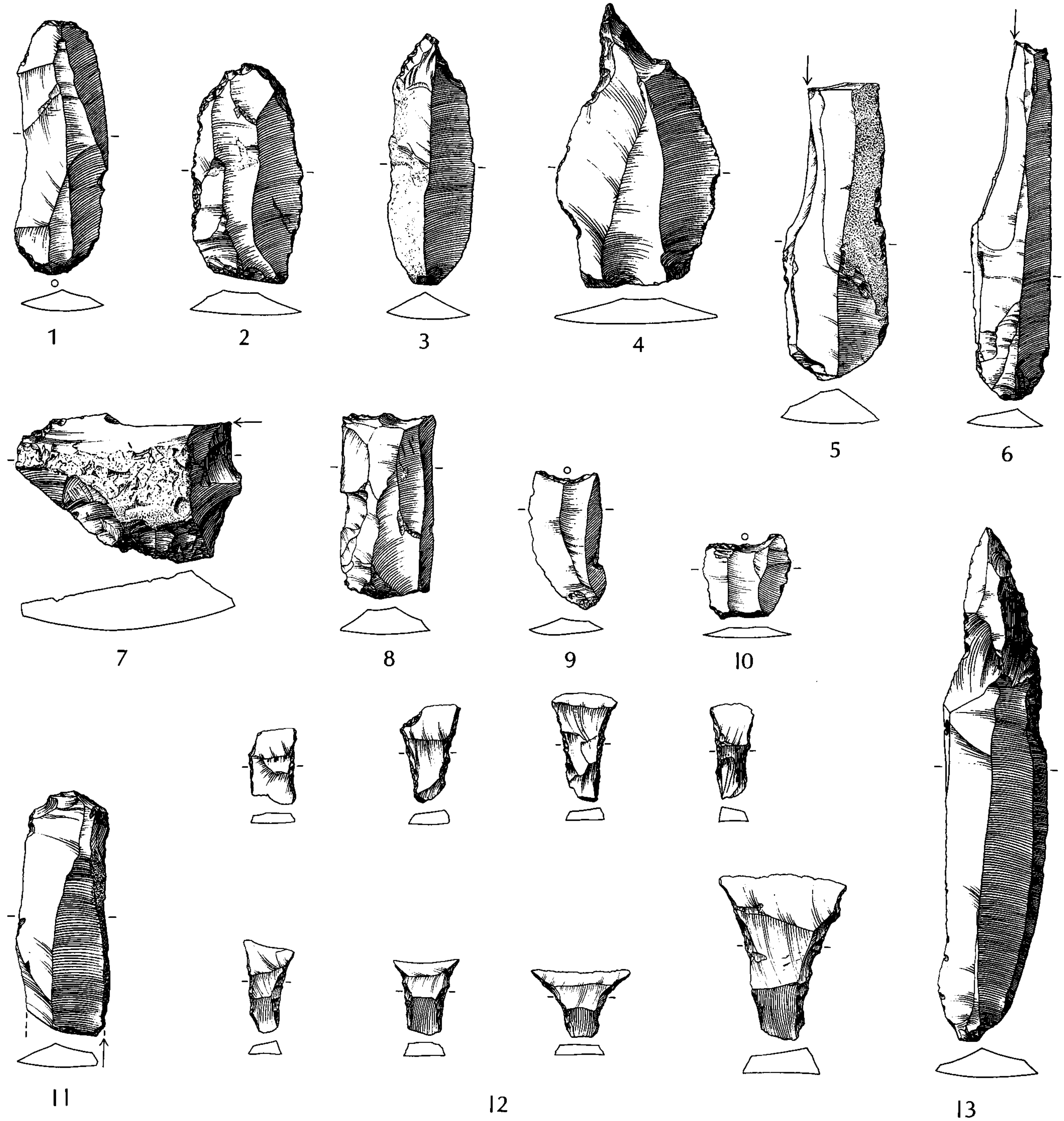
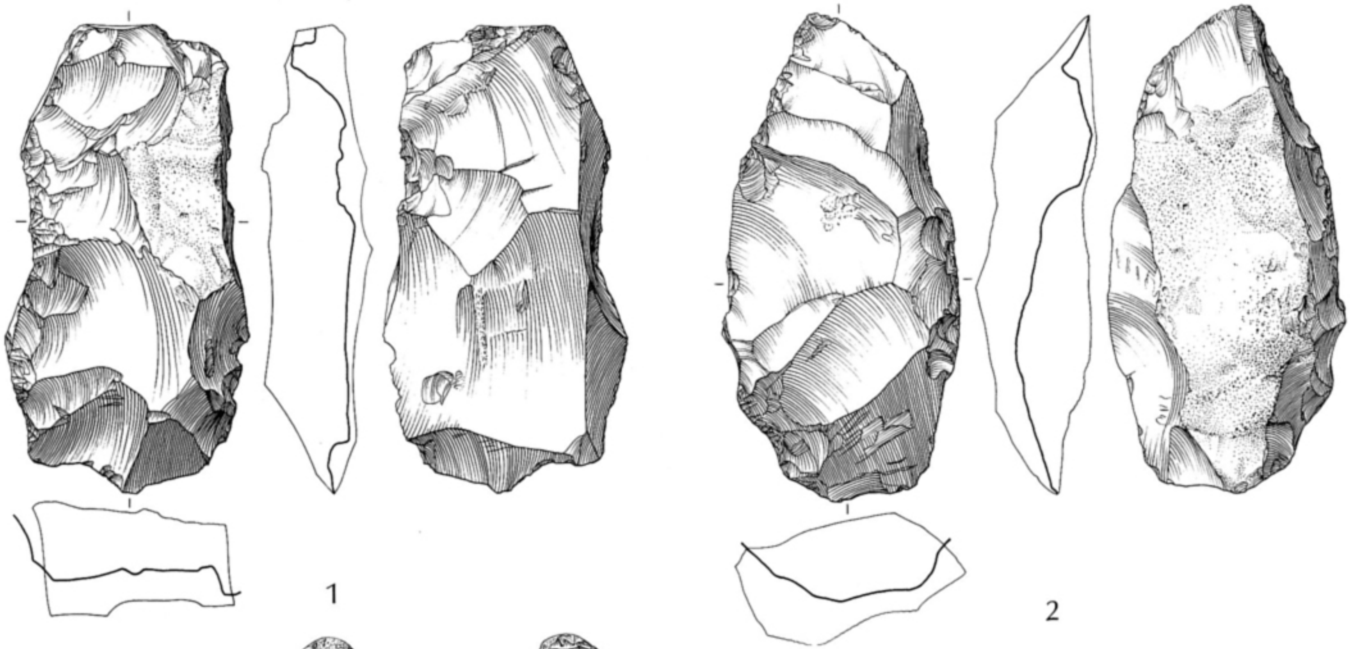


Fig. 19. Flint types from Ertebølle: 1) Double blade scraper. 2) Simple scraper. 3) Blade borer. 4) Flake borer. 5)–6) Angle burins on a break and on oblique truncation. 7) Transversal burin on lateral retouche. 8)–10) Truncated pieces. 11) Composite tool (scraper-burin). 12) Transverse arrowheads. 13) Blade knife. 2:3. Orla Svendsen del.



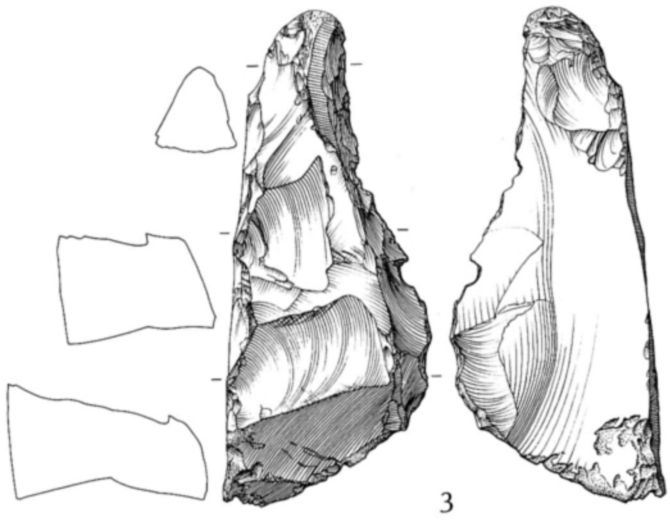
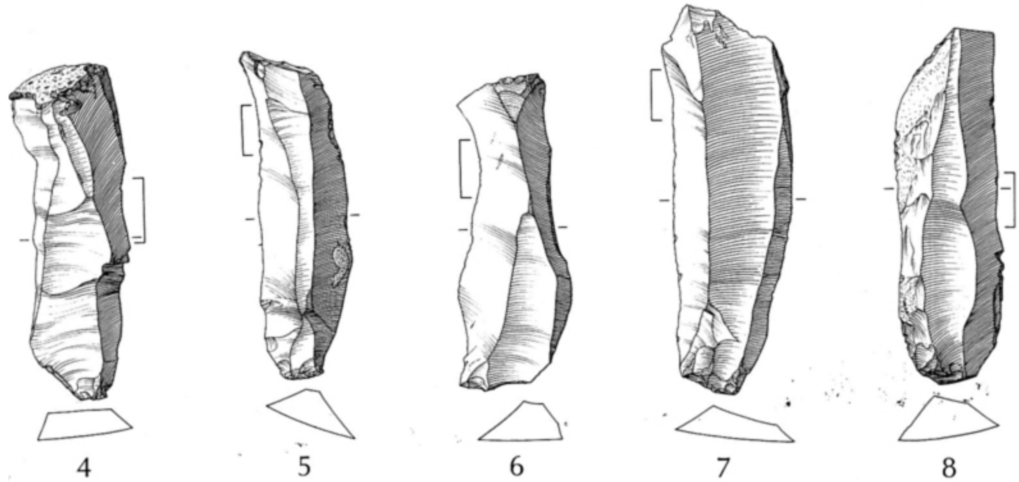


Fig. 20. 1) Asymmetrical and 2) symmetrical core axes (top); 3) borer / implement with a heavily worn and abraded point. Probably used for pressure flaking (centre). 4)–8) Blades used for shaving plant material – probably thin twigs. The rectangles indicate where traces of wear have been observed. The blades are found around the big fireplace in square "N". See (fig. 14 top). Orla Svendsen del. 2:3. – Analysed by Helle Juel Jensen (see ibid. 1986).



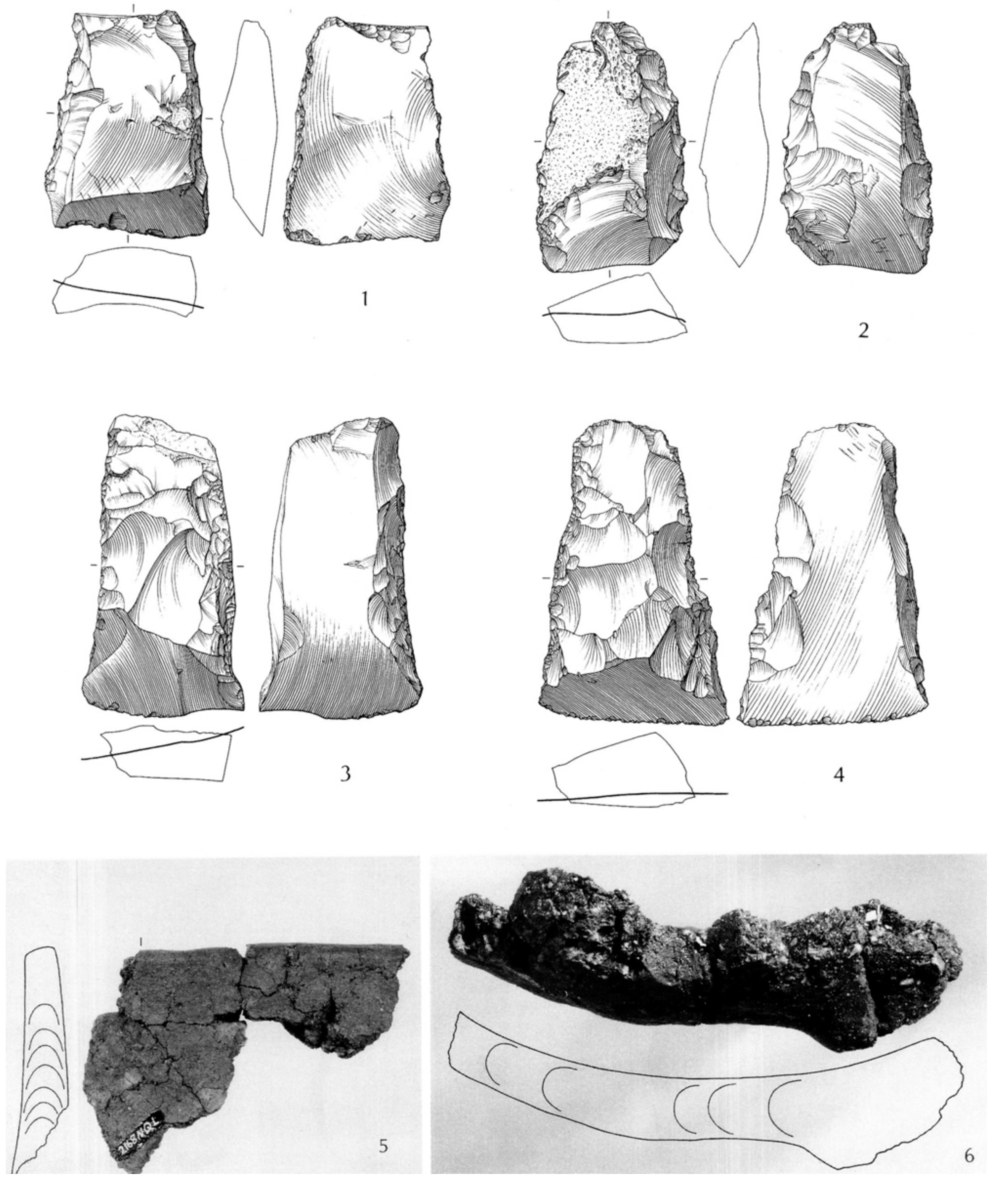


Fig. 21. 1) Symmetrical edge trimmed flake axe; 2) atypical flake axe; 3) asymmetrical flat-flaked flake axe; 4) symmetrical flat-flaked flake axe. Orla Svendsen del. 2:3.
(Bottom) Rimsherd of a thick-walled, pointed-based pot (left) and pointed base of a thick walled pot. P. Dehlholm photo. 2:3.

mammals, birds, fish, and a single reptile. The only domesticated animal is the dog.

A few bones of man were also recorded. These were found scattered throughout the midden matrix, but probably came from graves destroyed by later activities.

It is interesting to note that the bones in the midden in general are much smaller (less than c. 10 cm in length) than the ones found in the waste dumps at Ringkloster and Tybrind Vig (lake and sea deposits) (S.H. Andersen 1975, 1985). This difference may be explained by the fact that the bones from the kitchen-midden have been exposed to many different taphonomic factors such as dogs, weather, and walking to name a few. In contrast, the bone and antler material found at sites like Ringkloster and Tybrind Vig have been deposited in muddy wet layers outside the habitation area.

The vertical distribution of animal bone follow the same patterns as described for the flint debris (see fig. 18). To the west, there is a close correlation between the ash horizons around the fire places and the higher concentrations of bone.

The bones from mammals and birds are in most cases found individually, while fish bones either occur in layers (as described earlier) or as small concentrations (10–15 cm in diameter). These fish bone concentrations, of which we do not have any interpretation at present, display a similiar distribution pattern as the other animal bones, and concentrate around the fireplaces.

In a few cases, mammal bones are also found in small clusters (i.e. bones of juvenile red deer and wild pig). Bones from animals killed for their fur (i.e. pine marten, wild cat) are also found in 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, the roe deer (Capreolus capreolus), red deer (Cervus elaphus), and wild pig (Sus scrofa) were the most common species. Elk (Alces alces) and auroch (Bos primigenius) were represented by only a few bones.

Animals such as wild cat (Felis catus), lynx (Lynx lynx), fox (Vulpes vulpes), otter (Lutra lutra), wolf (Canis lupus), and pine marten (Martes martes) were killed for their fur.

Grey seal (Halichoerus grypus) were hunted at sea

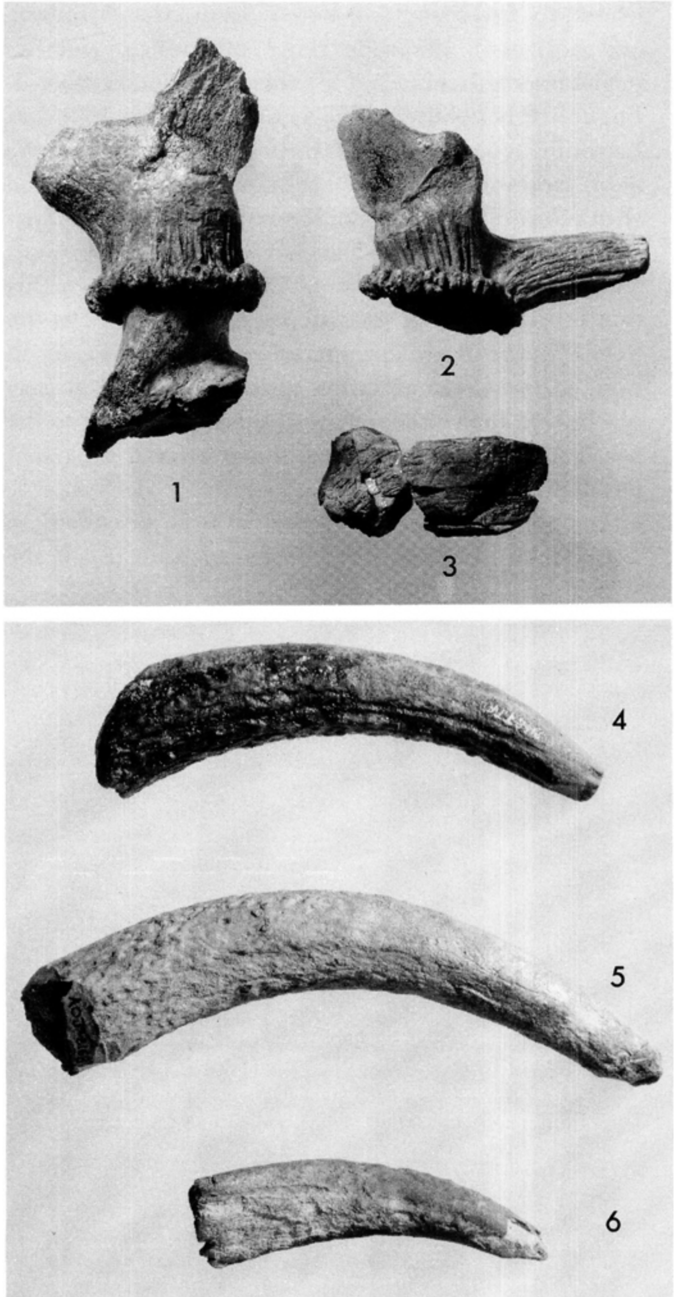


Fig. 22. 1)–2) Bases of red deer antlers (top) – waste from the production of antler axes and tines for pressure flaking; 3) Antler axe with the shafthole near the burr of the tine (older type in the Ertebølle culture); 4)–6) Sawed-off tines of red-deer antler. The point has been sawn off and rounded. Probably used for pressure flaking. P. Dehlholm photo. 2:3.

and along the coast. Also, a substantial number of swans (Cygnus sp.) and ducks (Anatidae sp.) were captured.

Fishing has been of great importance here as confirmed by the many fish bones (both concentrations and horizons), the wide range of species, and the technological items used for this activity (see Inge B. Enghoff this volume). The types of species found at Ertebølle (coastal site) is surprising, because of the many freshwater fish like eel (Anguilla anguilla), roach (Rutilus rutilus), and pike (Esox lucius). Marine species are also represented, such as cod (Gadus morhua) and garfish (Belone belone). The explanation for this interesting aspect of subsistence is to be found in the habitat at the time of occupation. A bay like area was in front of the site, numerous springs were within easy reach from the settlement, and there was a lake to the south-southeast which must have offered excellent possibilities for eel fishing.

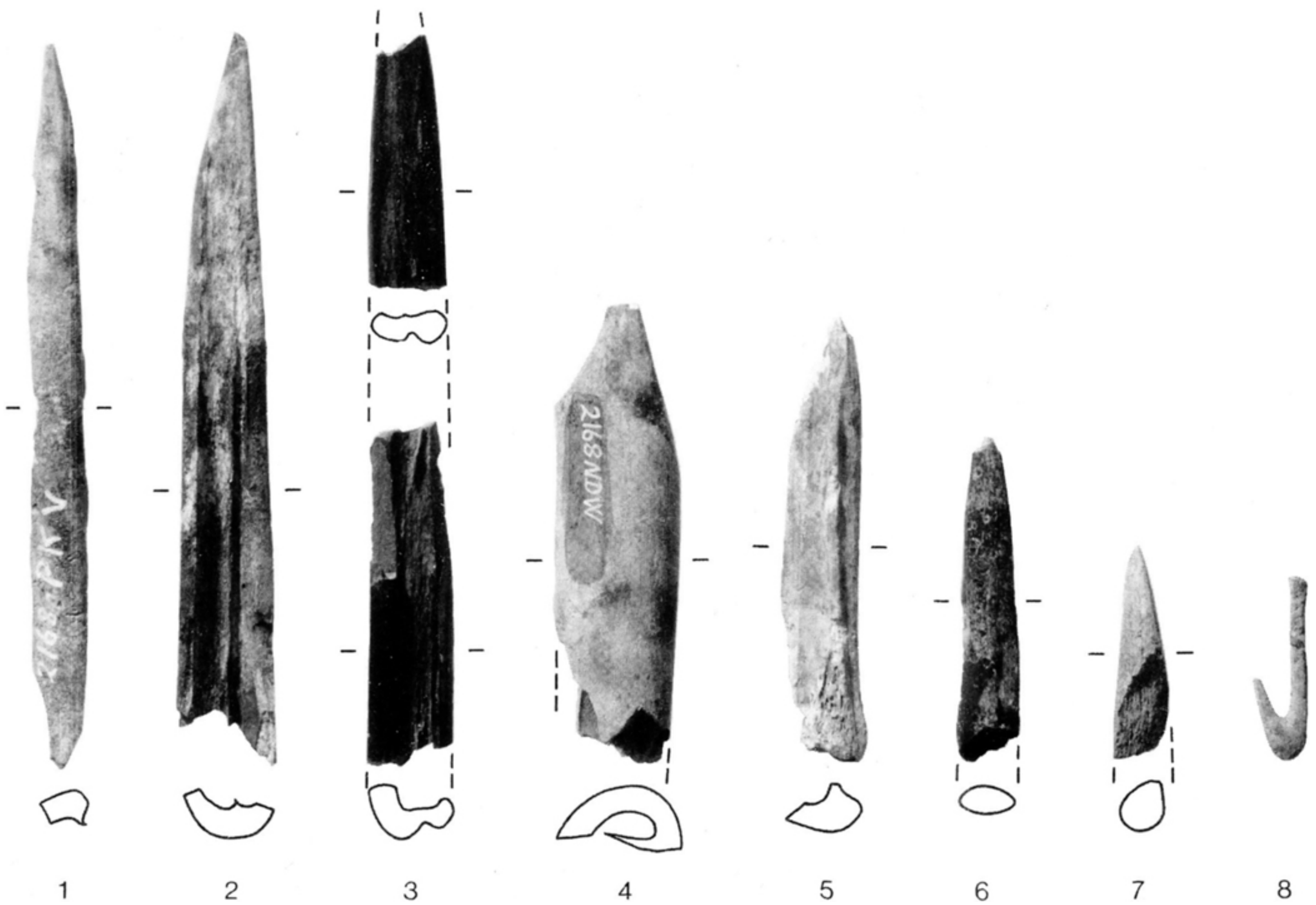
The percentage of bone from eel is far greater than normally at Ertebølle sites. One reason for this is the high content of fat in eel which makes this fish much more attractive than most of the other fish species. Everything points to the fact that eel fishing has been of great importance in the diet of the inhabitants, and that this type of fishing has been one of (or the) the decisive factor(s) for the positioning of the settlement.

Eel bones were found throughout the midden, thereby demonstrating that this type of fishing has been a constant factor with a long tradition.

Such great numbers of eel bones have never been documented before at any Danish Ertebølle coastal site. This aspect of subsistence probably explains why Ertebølle (type site) is one of the largest Late Mesolithic sites.

Gathering is documented by the many shells of oysters (Ostrea sp.), mussels (Mytilus sp.), cockles (Cerastoderma sp.), and periwinkle (Littorina litto-

Fig. 23. Simple bone points and fishhook. P. Dehlholm photo. 4:5.



rea). Also, a charred fragment of a hazelnut shell (Corylus sp.) was found.

Some information on seasonality is available (8). The occurrence of the juvenile red deer and wild pig indicate spring/summer, the cockles have been gathered between May and October (12), the presence of garfish indicates summer fishing, the eels have been caught in August, and finally the hazelnut points to early autumn. The presence of stag antlers still attached to the skull indicate winter. The animals that were 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, it is possible to state that summer, autumn, and winter indicators were found, but it would be premature to argue for a permanent year round occupation.

One of our future tasks is to analyze the content of the bones and the seasonal indicators of the different stratigraphic units of the midden, to see whether these indicators are localised or found in all the units. Such information will help correlate individual seasons with the different shell deposits.

CONCLUSION

The investigations at the Ertebølle type site has offered a wealth of new information. We have seen that this kitchenmidden is not only a midden (accumulation of shell fish), but a mixture of food waste and activity areas. It has been demonstrated that this midden has been organized into specific activity areas. These areas have been in use for long periods of time. This indicates a rather stable settlement system.

If we add to this the possibility of some graves, we have all the ingredients which scholars normally use to define settlement sites in a Mesolithic sense. The only feature which is lacking is houses.

It rises the obvious question: Is the shell midden the living area? The observations on the distribution of flint debitage and ash horizons clearly demonstrate that huts have not been positioned on top of the shell midden. Several other facts which support this observation are the lack of living space and the uneven surface. The information attained thus far, suggests that the people have been living *outside* the midden, but have performed the main part of their daily routines *on* the midden.

Today, there seem to be two possible answers to this question. Firstly, there is still a possibility that people have been living behind the midden. In this case, we do not have any definable traces of houses. Secondly, the hut(s) may have been standing *beside* the shell dumps (Meehan 1982, 116) and then later on were covered by deposits as the general layout of the site shifted its position along the coastline. This hypothesis is supported by the presence of well built stone fireplaces positioned on the subsoil under the midden layers and the frequency of cultural remains at the very bottom of the kitchenmidden.

A final solution to this question is one of the future tasks connected with studies of Danish Køkkenmøddinger.

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ERTEBØLLE. List of animal species identified 1980–84 (det. B. Bratlund and I. Bødker Enghoff).

Mammals: (*Mammalia*) (det. B. Bratlund)

Red Deer	(*Cervus elaphus*)
Roe Deer	(*Capreolus capreolus*)
Wild Pig	(*Sus scrofa*)
Lynx	(*Lynx lynx*)
Man	(*Homo sapiens*)
Wolf	(*Canis lupus*)
Dog	(*Canis familiaris*)
Fox	(*Vulpes vulpes*)
Wild Cat	(*Felis catus*)
Pine Marten	(*Martes martes*)
Otter	(*Lutra lutra*)
Aurochs	(*Bos primigenius*)
Grey Seal	(*Halichoerus grypus*)
Elk	(*Alces alces*)
Water vole	(*Arvicola terrestris*)

Birds: (*Aves*) (det. B. Bratlund)

Swan	(*Cygnus sp.*)
Duck	(*Anas sp.*)
Gull	(*Larus sp.*)
Capercaillie	(*Tetrao urogallus*)
Red-necked Grebe	(*Podiceps griseigena*)
Red-throated Diver	(*Gavia stellata*)
Velvet Scoter	(*Melanitta fusca*)
Godwit	(*Limosa sp.*)
Thrush	(*Turdus sp.*)

Fishes: (*Pisces*) (det. I. Bødker Enghoff)

Roach	(*Rutilus rutilus*)
Rudd	(*Scardinius erythrophthalmus*)
Eel	(*Anguilla anguilla*)
Cod	(*Gadus morhua*)
Saithe	(*Pollachius virens*)
Perch	(*Perca fluviatilis*)
Garpike	(*Belone belone*)
Flounder	(*Platichthys flesus*)
Herring	(*Clupea harengus*)
Three-spined Stickleback	(*Gasterosteus aculeatus*)
Pike	(*Esox lucius*)
Eelpout	(*Zoarces viviparus*)
Salmon/Trout	(*Salmo sp.*)
Whitefish	(*Coregonus sp.*)
Gobiids	(*Gobiidae*)
Bullhead	(*Acanthocottus scorpius*)
Sea Stickleback	(*Spinachia spinachia*)
Grey Gurnard	(*Eutrigla gurnardus*)
Turbot	(*Psetta maxima*)
Ray	(*Rajidae*)
Spurdog	(*Squalus acanthias*)

Reptiles: (*Reptilia*) (det. I. Bødker Enghoff)

Slowworm	(*Anguis fragilis*)

ERTEBØLLE. List of C-14 datings 1980–84.

K-4305	Oyster shells (Ostrea ed.)	3250 ± 90 b.c.
K-4306	Oyster shells (Ostrea ed.)	3600 ± 95 b.c.
K-4307	Oyster shells (Ostrea ed.)	3120 ± 90 b.c.
K-4308	Oyster shells (Ostrea ed.)	3200 ± 90 b.c.
K-4309	Oyster shells (Ostrea ed.)	3800 ± 95 b.c.
K-4310	Oyster shells (Ostrea ed.)	3590 ± 95 b.c.
K-4311	Oyster shells (Ostrea ed.)	3450 ± 95 b.c.
K-4312	Oyster shells (Ostrea ed.)	3750 ± 95 b.c.
K-4313	Oyster shells (Ostrea ed.)	3760 ± 95 b.c.
K-4314	Oyster shells (Ostrea ed.)	3480 ± 95 b.c.
K-4315	Oyster shells (Ostrea ed.)	3320 ± 85 b.c.
K-4316	Oyster shells (Ostrea ed.)	3420 ± 90 b.c.
K-4317	Oyster shells (Ostrea ed.)	4020 ± 95 b.c.
K-4318	Oyster shells (Ostrea ed.)	4060 ± 95 b.c.
K-4366	Charcoal (Alnus sp., Quercus sp., Ulmus sp., Tilia sp.)	3850 ± 95 b.c.
K-4519	Oyster shells (Ostrea ed.)	3470 ± 90 b.c.
K-4520	Oyster shells (Ostrea ed.)	3550 ± 90 b.c.
K-4521	Oyster shells (Ostrea ed.)	3560 ± 90 b.c.
K-4522	Oyster shells (Ostrea ed.)	3530 ± 95 b.c.
K-4523	Oyster shells (Ostrea ed.)	3630 ± 95 b.c.
K-4524	Oyster shells (Ostrea ed.)	3520 ± 90 b.c.
K-4525	Oyster shells (Ostrea ed.)	3530 ± 90 b.c.
K-4526	Oyster shells (Ostrea ed.)	3570 ± 95 b.c.
K-4527	Oyster shells (Ostrea ed.)	3490 ± 95 b.c.
K-4528	Oyster shells (Ostrea ed.)	3510 ± 95 b.c.
K-4529	Oyster shells (Ostrea ed.)	3280 ± 95 b.c.

NOTES

1. Despite the fact that the Ertebølle excavation took place in the years 1893–97, the term "Ertebølle culture" was not regularly used before 1919, when the Danish archaeologist Th. Mathiassen proposed this term.
2. Reports in the archives of the National Museum concerning finds from a shell midden at Krabbesholm near Skive in northern Jutland. See: "Oversigt over Videnskabernes Selskabs Forhandlinger" 1848–51, p. 12–13 and 46–50.
3. This interpretation of the Danish Køkkenmøddinger was first proposed by the Danish archaeologist J.J.A. Worsaae.
   From a visit at Meilgård in 1850 we have a remark in his dairy on the true nature of these sites.
4. These samples were taken from the south side of square E 9 and submitted for C-14 analyses by E. Thorvildsen and H. Tauber of the National Museum.
5. The Bjørnsholm Køkkenmødding was partly excavated by the National museum in 1931 (H.C. Broholm). Report in the National Museum, j.nr. 361/31. The report is unpublished, but briefly mentioned by Th. Mathiassen 1940 and 1942.
   In 1985 new investigations at this large site were resumed by the authors.
6. The project has been sponsored by the Danish Research Council for the Humanities, Aalborg historiske Museum, Aarhus Universitets Forskningsfond, Dronning Margrethe II's Arkæologiske Fond and Fredningsstyrelsen.
7. Archaeologists: Søren H. Andersen, M.A., University of Aarhus.
   Erik Johansen, M.A., Ålborg Historiske museum.
   Quaternary geologist and marine molluscs: Kaj Strand Petersen, Danish Geological Survey, Copenhagen.
   Zoologist: Bodil Bratlund, B.A. University of Aarhus.
   Fish specialist: Inge B. Enghoff, Zoological Museum, University of Copenhagen.
   Marine mollucs: Vibeke Brock, Department of Ecology and Genetics, University of Aarhus.
   Forameniferas: Ellen Lopez, Department of Marine Sciences, SUNY, New York. Stonybrook.
8. The bones of mammals and birds have been determined to species by Bodil Bratlund, B.A. University of Aarhus, Dept. of Prehistoric Archaeology.
9. See Kaj Strand Petersen this volume.
10. All C-14 dates are given in conventional C-14 years.

11. A waterroled and heavily patinated fragment of a polished axe of early neolithic type (pointed butted type) was found on the plateau behind the kitchenmidden. This type of axe (dated to the period 3,000–2,800 b.c.) demonstrates that at least one transgression (The Subboreal Transgression) flooded this area after the depositioning of the axe.
12. Information by Vibeke Brock (see note 7).

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Freshwater Fishing from a Sea-Coast Settlement –

the Ertebølle *locus classicus* Revisited

by INGE BØDKER ENGHOFF

INTRODUCTION

In the classical work on Danish shell middens (Madsen *et al.* 1900) Herluf Winge published results of investigations of fish and other bones from the shell midden at Ertebølle – the type site of the Ertebølle Culture. The present paper presents an analysis of the fish bone material recovered during the recent excavations of the Ertebølle shell midden during 1979–84 by S.H. Andersen and E. Johansen. See Andersen & Johansen 1986 for background information on these new excavations.

The Ertebølle shell midden is situated in northern Jutland, south of the small town Ertebølle at the Limfjord. When the settlement was inhabited during the late Atlantic period, it lay on the shore of a small bay. This bay was delimited by Ertebølle Hoved which extended further into the sea then, and by a system of beach ridges connecting a small island to the shore (Petersen 1986) (Fig. 1). The Ertebølle people had easy access to sea water in the bay, where they collected oysters and other shellfish, and in more distant waters. At that time, the water in the Limfjord was more saline than today, as there were more direct connections to the North Sea, i.a., in Vester Hanherred directly north of Ertebølle (Petersen 1986 and references therein). But there was also easy access to freshwater: the geology of the area indicates the presence of two now disappeared lakes within a few kilometres' distance of the settlement (Petersen 1986 and pers. comm.): one about a kilometre south-east of the shell midden, and another, larger one immediately east of Strandby, about three kilometres southeast of the shell midden; see Fig. 1.

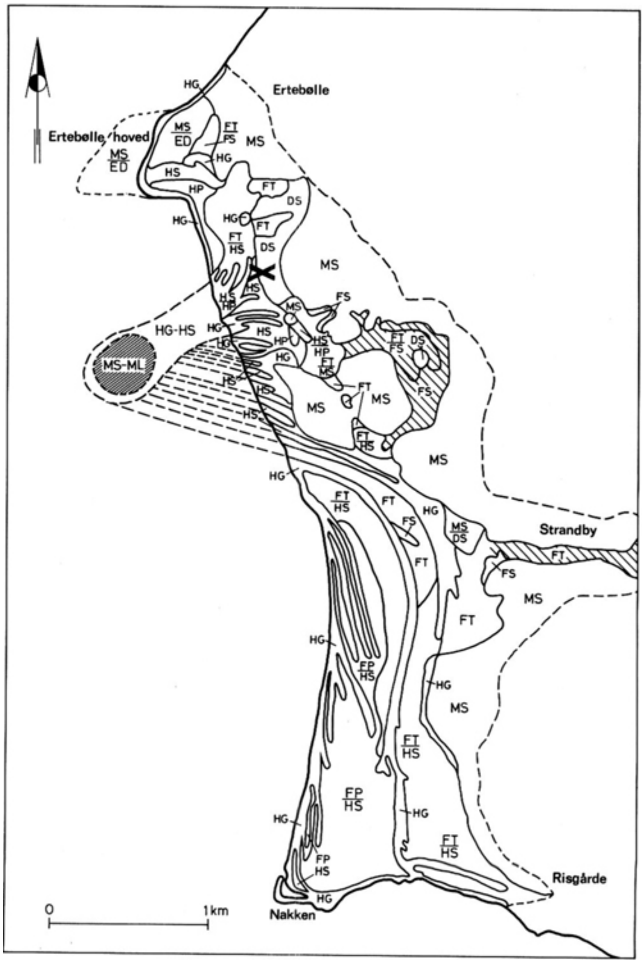

Fig. 1. Geological map showing the situation of the shell midden at Ertebølle in Atlantic times, at the shore of a small bay delimited by stippled lines. – cross: the shell midden, open hatching: Atlantic lakes (now dried out, the main part of the easternmost lake is outside the map), dense hatching: former island, FT: freshwater peat, FP: freshwater gyttja, FS: freshwater sand, HP: marine gyttja, HS: marine sand, HG: marine gravel, DS: meltwater sand, ML: till, clayey, MS: till, sandy, ED: mo-clay. Map provided by K.S. Petersen, Geological Survey of Denmark.

MATERIAL

The shell midden is at least 141 m long, up to about 20 m broad, and about 1.9 m thick (Andersen & Johansen 1986). The fish bone material analyzed derives partly from a 1 m broad and 29 m long trench cutting east-west through the midden. In addition some material is from a column sample (in the following referred to as the N-column) taken in connection with the trench in square N (Fig. 2). Excavations outside the midden proper revealed no fish bones.

The trench was excavated during the years 1980, 1983, and 1984. C_{14}-analyses of material sampled from the trench wall yielded datings ranging from 4060±95 b.c. (K-4318) to 3120±90 b.c. (K-4307) (conventional C_{14} years, like all datings cited in the present paper). The layers with fish bone material, however, covered a narrower interval, viz., ca. 3800–3100 b.c., and were mainly concentrated between 3600 and 3200 b.c. The fish bones in the trench occurred partly in an ash layer with scattered fish bones and in two pronounced fish bone layers, all of limited extent, partly scattered throughout the trench in small groups (see p. 68 and Andersen & Johansen 1986). The fish bones were frequently found under large oyster shells or in association with large mammal bones. The groups of fish bones were plotted on a three-dimensional system of co-ordinates, collected *in toto* and submitted for examination. Fish bones were sorted from the samples under the stereo microscope and identification of all bones was attempted.

The N-column (dimensions: 20 × 20 × ca. 121 cm) was taken from the southern trench wall in square N. The column was divided into 27 samples, as far as possible following the geological layers in the trench, otherwise with intervals of 5 cm. With three exceptions, where the samples were too small, 2000 g of each sample were sieved through progressively finer screens (8 mm, 4 mm, 2 mm, and 0.5 mm mesh). The three small samples were sieved in full. Fish bones were sorted from each fraction, and an attempt was made to identify all bones. Three of the samples, however (N 13, 14, 15) contained very large numbers of bones, and from these samples, subsamples were analyzed. For all column samples, the numbers of fish bones were converted to numbers per 2000 g. See Table 5.

The fish bones from both trench and column were mostly well preserved, some were even excellently preserved. Most fine processes etc. were, however, broken. Only 3 fish bones in total showed signs of having been burnt.

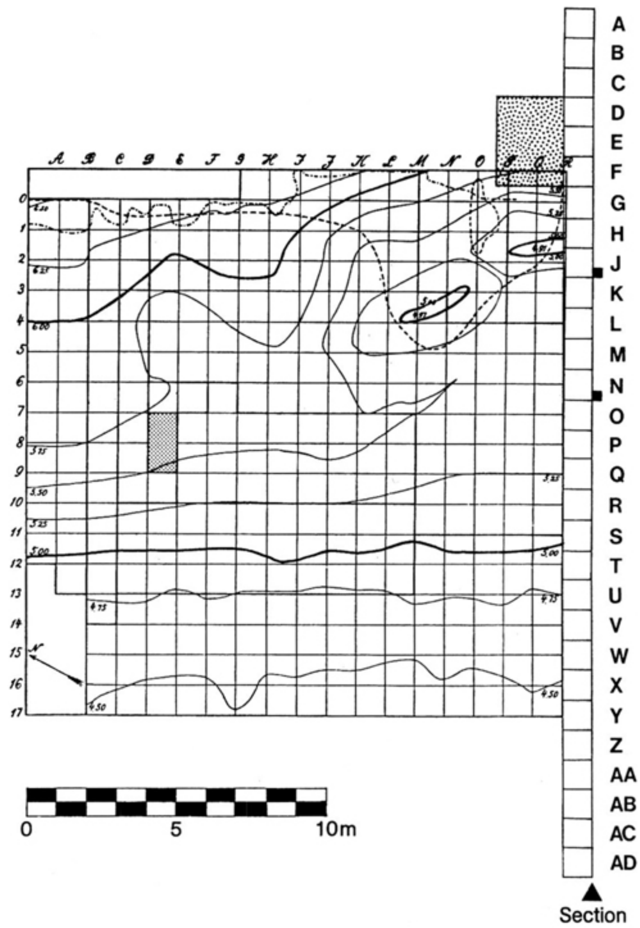

Fig. 2. Map of excavated areas in and around the Ertebølle shell midden. The newly excavated trench is shown superimposed on the map from Madsen *et al.* (1900). The positions of the column samples are indicated at squares J and N. The J-column was not analyzed for fish bones.

The Ertebølle shell midden appears always to have been situated on the beach, exposed to wave action and changing sea levels, for a detailed discussion, see Andersen & Johansen 1986. Without doubt, some of the bones in the midden were transported over short distances by the water. The studies by Petersen (1986) of the mollusc shells in the J- and N-columns show that there are “no reasons to assume that the midden was inundated by the sea for any length of time during the millenium of its accumulation”. The presence of large,

	Species	Trench	N-column	N-column, disregarding *Gasterosteus*
	Cyprinids (Cyprinidae), including	67.31	31.13	61.74
w	Roach (*Rutilus rutilus*) and			
w	Rudd (*Scardinius erythrophthalmus*)			
w	Eel (*Anguilla anguilla*)	17.31	8.75	17.35
	Gadids (Gadidae), including	8.42	0.57	1.13
w	Cod (*Gadus morhua*) and			
	Saithe (*Pollachius virens*)			
w	Perch (*Perca fluviatilis*)	2.77	3.66	7.25
w	Garpike (*Belone belone*)	1.30	0.18	0.35
w	Plaice/flounder/dab (*Pleuronectes platessa/Platichthys flesus/Limanda limanda*, including	1.08	3.54	7.02
	Flounder (*Platichthys flesus*)			
	Herring (*Clupea harengus*)	0.53	1.46	2.90
w	Three-spined stickleback (*Gasterosteus aculeatus*)	0.52	49.57	–
w	Pike (*Esox lucius*)	0.27	0.21	0.41
	Eelpout (*Zoarces viviparus*)	0.13	0.84	1.66
	Salmonids (Salmonidae), including	0.13	0	0
	Salmon/Trout (*Salmo* sp.) and			
	Whitefish (*Coregonus* sp.)			
	Gobiids (Gobiidae)	0.06	0	0
	Bullhead (*Acanthocottus scorpius*)	0.04	0	0
	Sea stickleback (*Spinachia spinachia*)	0.04	0.09	0.18
	Grey gurnard (*Eutrigla gurnardus*)	0.02	0	0
	Turbot (*Psetta maxima*)	0.02	0	0
	Ray (*Raja* sp.)	0.02	0	0
	Spurdog (*Squalus acanthias*)	0.02	0	0
		99.99	100.00	99.99

Table 1. The species of fish in the Ertebølle material and their relative frequencies (in %) in the trench and in the N-column. The species are arranged according to decreasing frequency in the trench. Species also recorded by Winge (in Madsen *et al.* 1900) are marked with a "w". Based on 9462 identified bones from the trench and 6697 (converted numbers, see text) from the N-column.

apparently undisturbed parts of the midden is another indication that the midden was not significantly affected by the sea. For example, around the large fireplaces, fine stratification shows that the same fireplaces were used for extended periods of time (Andersen & Johansen 1986). The fish bones studied derive almost exclusively from these undisturbed parts of the midden. For example, the N-column cuts through one of the fireplaces. It is therefore reasonable to assume that the fish bones which are object of this analysis owe their presence in the midden to activities of the inhabitants and were not washed ashore from the sea.

The material is kept in the Zoological Museum, Copenhagen.

SPECIES OF FISH AND THEIR RELATIVE FREQUENCIES IN THE MATERIAL

The fish bones were identified by using the comparative osteological collection of fish in the Zoological Museum, University of Copenhagen. Almost all bones were studied with a stereo microscope, because of their small size.

The results are shown in Table 1, where bones from the trench and bones from the column are kept separate. The relative frequencies of each species shown in the table were calculated on the basis of 9462 identified bones from the trench and 6697 identified bones from the column. The latter number is the sum of identified bones from each column sample, converted to numbers per 2000g of sediment. The real number of identified bones from the column was somewhat lower. The number of unidentified bones cannot be stated, as there was a gradual transition from well preserved bones through progressively smaller fragments to a homogeneous mass of pulverized bones.

Among the species on the list, those that were reported by Winge (in Madsen *et al.* 1900) from Ertebølle are marked with a "w". The new list comprises 21 species, that of Winge listed 9 species. In the following, the species will mostly be referred to by their Latin generic names only.

Table 1 gives a general survey of species and frequencies from the trench material. The dominant group of fish was the cyprinids, including *Scardinius* and in particular *Rutilus*. The cyprinids alone constituted 67% of the total number of identified bones. They were followed by *Anguilla* (constituting 17%), gadids, including *Gadus* and *Pollachius* (8%), *Perca* (3%), *Belone* (1%), and the *Pleuronectes/Platichthys/Limanda* group, including *Platichthys* (1%). The remaining species: *Clupea*, *Gasterosteus*, *Esox*, *Zoarces*, salmonids (including *Salmo* and *Coregonus*), gobiids, *Acanthocottus*, *Spinachia*, *Eutrigla*, *Psetta*, *Raja*, and *Squalus*, amounted to barely 2%.

The N-column included fewer species than the trench. Furthermore, there were apparently great differences in the relative frequencies of the species. *Gasterosteus* alone constituted about 50% of the identified bones. If, however, *Gasterosteus* is disregarded and the relative frequencies recalculated (Table 1, right column), a distribution very similar to that in the trench material appears. Cyprinids and *Anguilla* now constitute 62% and 17%, respectively. This indicates a local concentration of *Gasterosteus* bones in the N-column, with the other species occurring in largely the same frequencies as in the trench.

A survey of the numbers of different kinds of bones of each species/species group is given in Table 2 (only trench material).

The identification of several of the species demands further comments:

Spurdog – *Squalus acanthias*. Two half, hourglass-shaped vertebrae were assumed to derive from this species because of the proportions of the vertebrae and the width of the *canalis centralis*.

Ray – *Raja* sp. Two dermal denticles from a species of ray were found. They could not be identified to species, but as their basis was smooth, the common starry ray, *Raja radiata*, could be excluded. The dermal denticles most probably derive from the thornback ray, *Raja clavata*.

Salmonids – Salmonidae. Twelve vertebrae were identified as deriving from salmonids. Of these, three were referred to salmon or trout (*Salmo* sp.), and one to whitefish (*Coregonus* sp.).

Cyprinids – Cyprinidae. Including roach, *Rutilus rutilus*, and rudd, *Scardinius erythrophthalmus*. Most kinds of cyprinid bones are difficult or impossible to identify to species. However, identification is possible on pharyngeal bones (*os pharyngeum inferius*) and basioccipitals (*processus pharyngeus ossis basioccipitalis*). These two kinds of bone were identified to species, and the remaining cyprinid bones were presumed to belong to the same species as revealed by the pharyngeal bones and basioccipitals. A total of 295 cyprinid bones was identified to species, and of these, 98% were from *Rutilus* and 2% from *Scardinius* (see Table 3).

Gadids – Gadidae. Including cod, *Gadus morhua*, and saithe, *Pollachius virens*. Species identification of the gadid bones in the material was difficult because most of the bones were from very small individuals (total length from less than 20 cm and up to 30 cm) whose bones are less species-specific than bones from larger individuals. Two species were recognized, viz., *Gadus morhua* and *Pollachius virens*, on bones as, e.g., premaxillary, dentary, vomer, parasphenoid, and hyomandibular, and there were no indications of further species. 28 bones belonged to *Gadus morhua* and 41 to *Pollachius virens*. A further 74 bones could be identified as belonging to either *Pollachius virens* or pollack, *Pollachius pollachius*. As *Pollachius pollachius* was not otherwise indicated in the material, these bones were presumed to be from *Pollachius virens*, making the preponderance of this species even more pronounced. See also Table 4.

Gobiids – Gobiidae. Vertebrae and basioccipitale appeared to derive from black goby (*Gobius niger*), whereas keratohyale was not diagnostic to species. The genus *Pomatoschistus*, however, could be excluded.

Turbot – *Psetta maxima*. Two dermal denticles were identified to this species. The other Danish species of the family Scophthalmidae do not have such denticles.

Plaice/flounder/dab – *Pleuronectes/Platichthys/Limanda*. Including flounder, *Platichthys flesus*. These three species (in the following referred to as "pleuronectids") are difficult to distinguish on skeletal characters. Fortunately, the material included 67 dermal denticles

	Cyprinids	*Anguilla*	Gadids	*Perca*	*Belone*	Pleuronectids	*Clupea*	*Gasterosteus*	*Esox*	*Zoarces*	Salmonids	Gobiids	*Acanthocottus*	*Spinachia*	*Eutrigla*	*Psetta*	*Raja*	*Squalus*
HEAD BONES																		
Parasphenoideum	14	1	12	1					1	1								
Vomer		7	8	4														
Mesethmoideum		1																
Frontale														1				
Supraoccipitale			1					1										
Basioccipitale	19	4	6									1						
Prooticum							9											
Circumorbitalia	1																	
Otolithi	5		12															
Neurocranium unspecified							4							1				
Praemaxillare		10	18	4	8	1												
Maxillare	39		13	1														
Dentale	100	32	8	4	16				2				1					
Articulare	81	7	21	3			2											
Quadratum	50	1	24	3														
Palatinum			12						1									
Entopterygoideum						1												
Ectopterygoideum			15			3												
Praeoperculare	16		11	10														
Interoperculare			13															
Suboperculare													1					
Operculare	48	1	5	4														
Symplecticum			27															
Hyomandibulare	12	7	36		1		1											
Hypohyale	53		11															
Keratohyale	154	28	21	1			2					1						
Epihyale		5	18	1														
Stylohyale			3															
Urohyale	28	7	7			1												
Basibranchiale			4															
Hypobranchiale			8															
Os pharyngeum inferius	604		28	2														
Epibranchiale			15															
Pharyngobranchiale			29			8												
Detached teeth[1]	434								10									

(modified scales) of a very characteristic appearance (Fig. 3), deriving from *Platichthys*. *Pleuronectes* and *Limanda* do not have such denticles, which thus provide a means for indicating presence of *Platichthys* in subfossil materials.

Bones from all body regions are present for those species which are well represented in the material, see Table 2.

The list of species comprises the following freshwater fishes: *Esox*, *Rutilus*, *Scardinius*, *Perca*, and *Gasterosteus*. These are all very common in the vegetation belt in lakes. *Esox* and *Perca*, however, require water which is not deficient in oxygen. They all can furthermore be found in slowly running and brackish water. *Scardinius*, however, does hardly tolerate other than very low salinities. By contrast, *Gasterosteus* also occurs in salt water where it may form big schools near the coast during the summer.

	Cyprinids	*Anguilla*	Gadids	*Perca*	*Belone*	Pleuronectids	*Clupea*	*Gasterosteus*	*Esox*	*Zoarces*	Salmonids	Gobiids	*Acanthocottus*	*Spinachia*	*Eutrigla*	*Psetta*	*Raja*	*Squalus*
SHOULDER GIRDLE																		
Posttemporale			64	3	1													
Supracleithrale	9		54	6	3													
Cleithrum	3	33	2	1														
Postcleithrale			1															
Scapula	70				1	1	1											
PELVIC GIRDLE																		
Basipterygium	70			3				8										
VERTEBRAE	4449	1494	290	211	97	15	31	11	4	10	12	4	2	2	2			2
OTHERS																		
Tripus	22																	
Os suspensorium	88																	
Os anale						1												
Dorsal and ventral spines								7										
Dorsal scutes								8										
Lateral scutes								10										
Scales etc.[2]	+			+		67			+							2	2	
unspecified bones								4	8									
Total	6369	1638	797	262	123	102	50	49	26	12	12	6	4	4	2	2	2	2

Table 2. Specification of the 9462 identified bones from the trench. Numbers of identified bones of each kind and each species are given. Regarding cyprinids and gadids, see Table 3 and 4, respectively, for more information. – Notes: [1] Detached teeth of cyprinids derive from os pharyngeum inferius, those of *Esox* from oral bones. [2] "+" means that scales were found but not counted. The entry under Pleuronectids refers to dermal denticles of *Platichthys*, under *Psetta* and *Raja* also to dermal denticles.

The following species are marine: *Squalus*, *Raja*, *Clupea*, *Belone*, *Pollachius*, *Gadus*, *Zoarces*, gobiids, *Eutrigla*, *Acanthocottus*, *Spinachia*, *Psetta*, pleuronectids (including *Platichthys*). Of these, *Pollachius*, e.g., requires a high salinity, whereas others, e.g., *Zoarces* and *Platichthys*, are also numerous in brackish water. Several of these species: *Zoarces*, gobiids, *Acanthocottus*, and *Spinachia*, are characteristic of shallow water (the eel grass zone) near the coast. This habitat is also suitable for young individuals of the remaining marine species. The gadids and pleuronectids in the material are small individuals which must have lived near the coast during the summer half of the year. *Belone* visits Danish waters from April/May until autumn and spawns in shallow water in the eel grass zone. *Squalus* occurs from shallow water to 400 m depth, during summer it may be met with in the eel grass zone. *Clupea* lives pelagically on up to 250 m depth; juveniles occur in very shallow water.

Salmonids and *Anguilla* are migratory and may therefore occur in salt, brackish, and fresh water.

All species on the list occur commonly in Danish waters nowadays.

The above information on fish biology was mainly taken from Muus & Dahlstrøm (1964, 1967).

The relative frequencies of the species on the list give an impression of what kind of fishing the Ertebølle people practised. The frequencies cannot, however, be directly used as a measure of the importance of each species. Different species have different numbers of bones: *Anguilla* has ca. 115 vertebrae, whereas *Gadus* has ca. 50. Also, the species do not have equal chances of preservation in the soil (Höglund 1972: 52, Lepiksaar 1983, Lepiksaar & Heinrich 1977): some of the species on the list, especially *Anguilla*, pleuronectids, *Clupea*, and salmonids, have very fatty bones with a tendency to disintegration, when the fat transforms to fatty acids.

(The fatty bones are furthermore preferred by dogs and foxes.) *Clupea* bones are of a delicate structure, salmonid bones are poorly ossified (this is also true of many *Esox* bones). The cartilaginous fishes (*Squalus* and *Raja*) have particularly poor chances of preservation. At the other extreme, bones of *Perca* and *Gadus* are poor in fat and are usually well preserved in archaeological deposits. Cyprinid bones, too, have fairly good chances of preservation. This is illustrated by the present material which not only contains huge numbers of cyprinid bones but also a large number of different kinds of bones from the entire skeleton (Table 2), in spite of their small size.

	Rutilus	*Scardinius*
Basioccipitale	14	
Os pharyngeum inferius	275	1
Detached pharyngeal teeth		5
	289	6

Table 3. Cyprinid bones from the trench, identified to species.

	Gadus	*Pollachius virens*	*Pollachius* sp.
Parasphenoideum	2	2	
Vomer	2	1	
Basioccipitale	1		3
Otolithi	1		5
Praemaxillare	3	1	
Maxillare	1		5
Dentale	1	1	
Articulare	1	6	3
Quadratum	1		9
Palatinum		3	2
Ectopterygoideum	1		
Symplecticum		3	
Hyomandibulare	1	13	
Keratohyale		1	4
Urohyale		1	
Posttemporale	3	2	24
Supracleithrale	1		
Postcleithrale		1	
Vertebrae	9	6	19
Total	28	41	74

Table 4. Gadid bones from the trench, identified to genus/species.

DISTRIBUTION OF FISH BONES IN TRENCH AND COLUMN

The finds of fish bones in the trench were plotted on a section drawing of the southern trench wall. The fish bones occurred throughout the shell midden zone, i.e., from square D and westwards. They were, however, missing from the parts of the midden, where traces of marine activity were present. Fish bones were distinctly concentrated in the middle layers, from where their concentration abruptly declined both upwards and downwards. This general pattern was well illustrated by the distribution of fish bones in the N-column, where a concentration in the samples N 13, N 14, and N 15 was evident, see Table 5.

As mentioned earlier, the fish bones partly occurred in small groups, in an ash layer with scattered fish bones, and in two pronounced fish layers. The layers were in squares H-K, M-N, and P, respectively, and were of the following approximate horizontal extents: 170 cm, 120 cm, and 80 cm, respectively.

Squares L to O (especially M and N) contained particularly large numbers of fish bones: about two thirds of the 9462 identified bones from the trench.

The species of fish were thoroughly mixed up throughout the trench. Freshwater and marine species occurred together in the same small groups through the entire section. That is, no separate occurrences of, or phases with bones from freshwater and marine fishes could be recognized. The individual species also occurred throughout the section, with the exception of *Belone* and *Gasterosteus*. *Belone* was absent from the eastern part of the trench: it was present from square M and westwards with the exception of one vertebra in square G. *Gasterosteus* had a strongly localized distribution in the trench: from the middle of square M, through square N, and a little into square O, except for four bones in square E. The N-column cut through this local occurrence of *Gasterosteus* and therefore was strongly dominated by this species.

SIZE OF THE FISH

The fish bone material from Ertebølle was characterized by the remains of small fish. Some was from small species of fish, e.g., *Gasterosteus* (and *Rutilus*), part was from small individuals of species which may grow large, e.g., pleuronectids and gadids. Most gadid bones were from individuals of less than 20 cm to 30 cm total length, with a few from fish of 40–50 cm. Some of the

Clupea bones were from juveniles of about 5 cm, while others were from full-grown individuals.

Only *Anguilla* (see below) and in particular *Belone* bones were from longer fish. All *Belone* bones represented individuals of about 70 cm or more.

These considerations of fish size are based on simple comparison of the subfossil bones with recent fish skeletons of various sizes.

Only *Anguilla* and *Rutilus* bones were so numerous that construction of size-frequency diagrams was warranted.

The size of the subfossil *Anguilla* and *Rutilus* was estimated by means of regression equations, based on recent materials covering the size range of the species in question. Logarithmic equations were computed which expressed total length of the fish as a function of bone measurements. Measurements of subfossil bones were then substituted in the equations, resulting in estimates of total length of the subfossil fish (cf. Casteel 1976, Enghoff 1983). The recent base material for the equations was partly found in the collection of the Zoological Museum, Copenhagen, partly collected for the purpose.

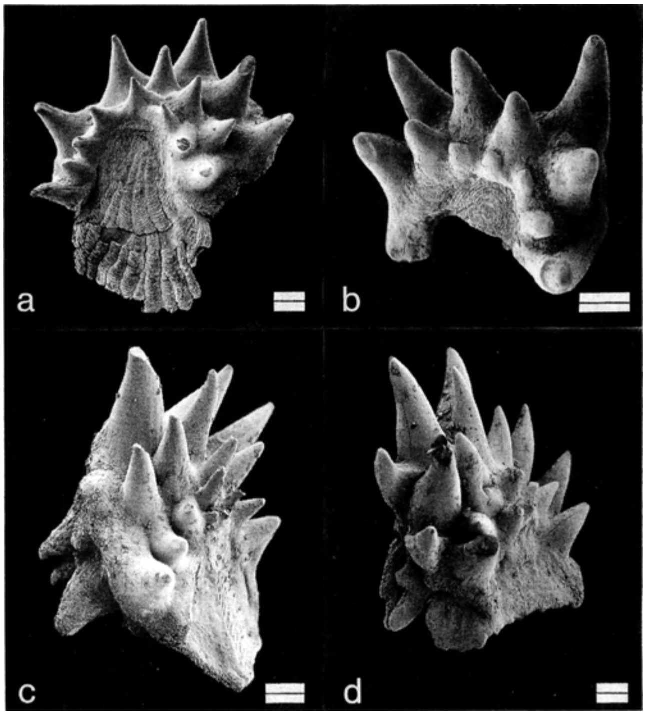

Fig. 3: Recent and subfossil dermal denticles from flounder (*Platichthys flesus*). – a,c: recent fish, b,d: Ertebølle material. Notice unmodified part of scales, especially prominent in a. – Scales 0.2 mm. Scanning electron micrographs.

Eel – *Anguilla anguilla*

Total length of *Anguilla* was estimated on the basis of four kinds of bone, viz., cleithrum, keratohyale, dentale, and first vertebra. It was not possible to find a single suitable bone (see Enghoff 1983, Höglund 1972) which was abundant in the subfossil material.

The bones were measured as follows:

Cleithrum: largest width at the elbow, as shown in Fig. 4.

Keratohyale: width as shown in Fig. 4.

Dentale: largest width in the front end, as shown in Fig. 4.

First vertebra: largest width of posterior face, according to Casteel (1976).

The measuring points were chosen on robust parts of the bones, known by experience to be mostly well preserved. The correlation between these measurements and total length of the fish was good. Measurements were taken with a slide caliper.

The relation between total length of *Anguilla* and the four abovementioned bone measurements is given by the following regression equations:

1. Equation for estimating total length in mm (TL) of *Anguilla* from width of cleithrum in mm (W_{cl}):

$$TL = 287.4749 \times W_{cl}^{0.7657} \; (r = 0.9904, n = 12)$$

2. Equation for estimating total length in mm (TL) of *Anguilla* from width of keratohyale in mm (W_{ke}):

$$TL = 345.2232 \times W_{ke}^{0.7460} \; (r = 0.9830, n = 14)$$

3. Equation for estimating total length in mm (TL) of *Anguilla* from width of dentale in mm (W_{de}):

$$TL = 279.2544 \times W_{de}^{0.8969} \; (r = 0.9720, n = 14)$$

4. Equation for estimating total length in mm (TL) of *Anguilla* from width of first vertebra in mm (W_{fv}):

$$TL = 225.2683 \times W_{fv}^{0.7832} \; (r = 0.9781, n = 14)$$

In all four equations the variables are highly correlated (r close to 1). All measurable bones of the four kinds in question were measured (none was burnt or deformed), and total length of the subfossil *Anguilla* was estimated according to the equations 1–4.

The resulting size-frequency diagram, Fig. 5, shows

Sample No.	Cyprinids	*Anguilla*	Gadids	*Perca*	*Belone*	Pleuronectids	*Clupea*	*Gasterosteus*	*Esox*	*Zoarces*	*Spinachia*	total identified bones per 2000 g
N-1, N-2, N-3 (superficial layers)												0
N-4												0
N-5	1											1
N-6	1											1
N-7												0
N-8	4	2		1				2				9
N-9	2	11						2		1	1	17
N-10	1	3	1			1				1		7
N-11	29	32		2		9		1		2		75
N-12	7	13						7				27
N-13	94	57	4	34		15	3	332	4	1		544
N-14	569	190	22	78	1	148	85	2608	10	28		3739
N-15	1329	238	7	129		63	7	368		17	5	2163
N-16	6	3								1		10
N-17	9	5		1								15
N-18	3				2					3		8
N-19	18	13	2		9	1	2					45
N-20		1										1
N-21	5	3	1				1					10
N-22	3	1	1									5
N-23	1	2										3
N-24												0
N-25		7										7
N-26		2										2
N-27	3	3								2		8

Table 5. Vertical distribution of identified fish bones in the N-column. Each sample consists of 2000 g of sediment, except N-4 (1450 g), N-12 (1340 g), and N-27 (1220 g). Of sample N-13, only 60% of the 0.5 mm fraction was analyzed; of samples N-14 and N-15, only 20%. Numbers of bones from these samples were converted to number per 2000 g.

that *Anguilla* in the Ertebølle material was fairly evenly distributed over the size range from ca. 30 to ca. 70 cm, with a few smaller and larger outliers.

Roach – *Rutilus rutilus*

Total length of *Rutilus* was estimated on the basis of first and second vertebrae. The vertebrae are robust, are easy to measure accurately, and were abundant in the subfossil material. The largest width of the posterior face of the vertebrae was measured, according to Casteel (1976). Owing to the small size of the vertebrae they were measured by means of an ocular micrometer.

The vertebrae, admittedly, were not identified to species, but as shown above, the cyprinid material at hand contained 98% *Rutilus* and 2% *Scardinius*. Thus a 2% contamination with *Scardinius* vertebrae may be expected among the *Rutilus* vertebrae; this can be regarded as negligible.

Furthermore, the cyprinids can be divided into two groups according to morphology of the second vertebrae (Le Gall 1984). All second vertebrae in the material belong to the group consisting of *Rutilus*, *Scardinius*, chub (*Leuciscus cephalus*), dace (*Leuciscus leuciscus*), and bleak (*Alburnus alburnus*); several possibilities of confusion are hereby eliminated.

The relation between total length of *Rutilus* and the vertebral widths is given by the following regression equations:

5. Equation for estimating total length in mm (TL) of *Rutilus* from width of first vertebra in mm (W_{fv}):

$$TL = 76.4364 \times W_{fv}^{0.8331} \ (r = 0.9961, n = 19)$$

6. Equation for estimating total length in mm (TL) of *Rutilus* from width of second vertebra in mm (W_{sv}):

$$TL = 77.7141 \times W_{sv}^{0.8900} \ (r = 0.9898, n = 18)$$

In both equations the variables are highly correlated. All measurable first and second *Rutilus* vertebrae were measured (none was burnt or deformed), and total length of the subfossil *Rutilus* was estimated according to equations 5–6.

The resulting size-frequency diagram, Fig. 6, turned out to be very interesting because the *Rutilus* individuals are grouped into clearly distinguished size classes. There is a great maximum at ca. 9 cm and a smaller one at ca. 13 cm. Indications of maxima at ca. 5 cm and ca. 16 cm are also evident. This size distribution is very similar to size distributions of *Rutilus* obtained by recent fishing over a short period in Danish lakes. A representative example of such a size-frequency diagram has been inserted on Fig. 6. The maximum representing the smallest size class is low in the "recent" diagram, like the 5 cm maximum on the Ertebølle diagram, because fish of this size are only rarely retained by the fishing tackle – otherwise this maximum would have been higher than the others. In the case of recent *Rutilus* each maximum is known to represent an age-group. The maxima on the Ertebølle diagram are therefore interpreted as age-groups as well.

The very pronounced division into age-groups of *Rutilus* from Ertebølle may be interpreted in two ways. Fishing may have taken place over a short period of the year, same period each year. If fishing had been extended over a long part of the growth season, the intervals between the maxima would have been filled up owing to the growth of the fish. The other possible interpretation is that fishing took place during winter, where the fish do literally not grow. (Fish are poikilothermic and their growth rate therefore depends on the temperature of the surrounding water: they grow during the summer half of the year, where the water is warm, but the growth almost ceases during winter, where the water is cold.)

The diagram, Fig. 6, is based on all measurable first and second vertebrae from the trench material. This implies that the size distribution pattern is characteristic of all of the phase of the settlement represented in the trench. The constancy of the pattern is supported by subdiagrams based on first and second vertebrae from larger, isolated groups of bones in the trench. These subdiagrams show exactly the same size distribution pattern, with the maxima at the same places.

The size frequency diagram cannot tell us at which time of the year the *Rutilus* were caught because the growth of *Rutilus* varies widely according to the environment. A growth ring analysis, on the other hand, might give an indication of the fishing season. Unfortunately, a growth ring analysis of the vertebrae which formed the basis of the size-frequency diagram was not practicable. Of *Rutilus* scales (which are regarded as generally well-suited for growth ring analysis (Cragg-Hine & Jones 1969)) only 7 fragments were found which were

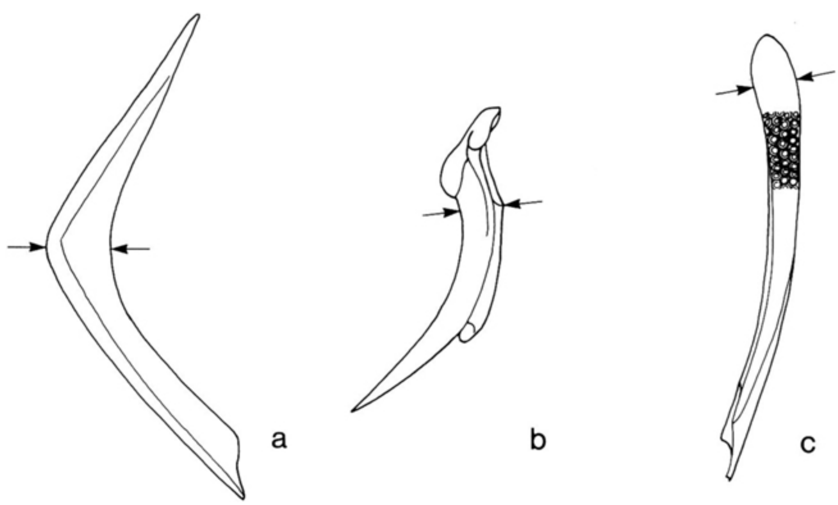

Fig. 4. Eel (*Anguilla anguilla*), definition of bone measurements. – a: right cleithrum, lateral view, largest width measured at the "elbow", b: right keratohyale, lateral view, c: right dentale, dorsal view, largest width measured in the front end (tooth sockets only shown on part of dentale).

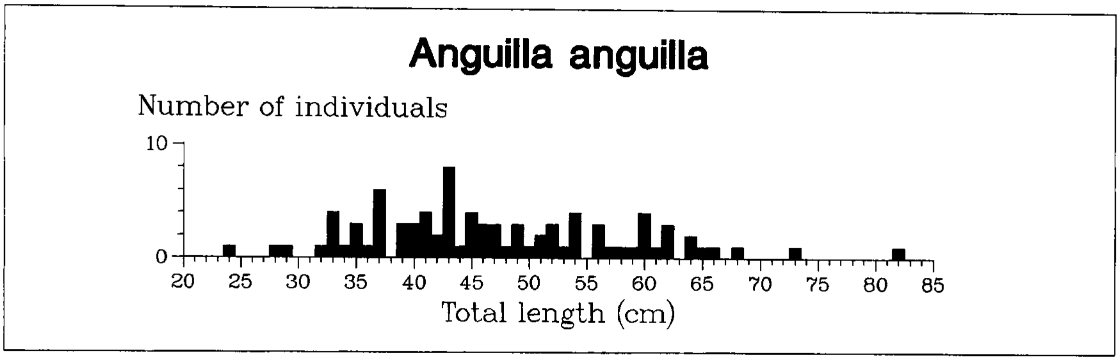

Fig. 5. Size-frequency diagram of eel (*Anguilla anguilla*) from Ertebølle. Total length estimated on the basis of measurements of cleithrum (N=32), keratohyale (N=28), dentale (N=15), and first vertebra (N=12).

sufficiently well preserved for analysis. These fragments, which all derived from one group of fish remains (from which no first and second vertebrae were recovered), were analyzed by Birgit Therkildsen and indicated capture through the period from spring to autumn, in conflict with the abovementioned interpretations of the size distribution.

DISCUSSION

The location of the Ertebølle settlement was convenient for exploitation of fish from both sea water, for example in the bay, and fresh water, for example in the two nearby lakes.

As far as the number of identified fish bones from Ertebølle is concerned, freshwater species dominate the assemblage, constituting 71% of the trench material. Marine species constitute only 12%, and migratory species, 17%. Many marine species were present in the material, but they were each represented by only few bones.

The relative frequencies of bones of different species provide an opportunity to estimate the fishing policy of the Ertebølle people. In spite of the reservations listed above (p. 67), the preponderance of freshwater fish bones is so overwhelming that it must be regarded as real. The fish species which were most important for the inhabitants of this settlement were mainly *Rutilus* (by virtue of its abundance) and *Anguilla* (by virtue of its size and high nutritive value). From the outset larger numbers of bones from marine species, especially gadids, were expected, considering the maritime situation of the settlement. The fish bone material from Maglemosegård, a roughly contemporaneous, coastal Danish settlement, thus included 2500 *Gadus* bones out of a total of 3000 (Aaris-Sørensen 1980). The Tybrind Vig material, also roughly contemporaneous with Ertebølle, was also dominated by bones of marine fishes, especially gadids (Trolle-Lassen 1984). The paucity of gadid bones in Ertebølle cannot be ascribed to poor chances of preservation (cf. p. 68).

The fish bone material forming the basis of Winge's results was excavated during 1893–97 and covers a large area of the Ertebølle shell midden (see Fig. 2). This material, which is in the Zoological Museum, Copenhagen, has been re-examined and shows the same tendency: dominance of freshwater fishes, in particular *Rutilus* and *Anguilla*. Winge (in Madsen *et al.* 1900) also noticed this. The pattern indicated by the newly excavated material thus seems to be of general validity for the Ertebølle shell midden and not to be a local phenomenon in the trench area.

The fish bones recovered during the old excavation (1931) of the Bjørnsholm shell midden, situated a short way north of Ertebølle, represent *Esox*, *Scardinius*, and *Anguilla* only (Rosenlund 1976). This may be a hint that the fishing of freshwater fishes from a sea-coast settlement was not unique to Ertebølle but was perhaps characteristic of a larger area. The recent excavations at Bjørnsholm (by S.H. Andersen and E. Johansen) will hopefully throw light on this problem.

At Ertebølle, all species except *Gasterosteus* and *Belone* occurred throughout the part of the trench cutting through the midden, and freshwater and marine species occurred together in the same small groups of bones. Several of the species may also occur in brackish water, but there is no indication of a nearby brackish water area, and furthermore, it is difficult to imagine a body of water holding at the same time truly marine species like *Pollachius* and *Psetta* and pronounced freshwater species like, e.g., *Scardinius*. It must therefore be concluded that two different fisheries were conducted at the same time: one freshwater and the other marine. The freshwater species were probably caught in the vegetation zone in one or both of the nearby lakes. The range of marine species and their sizes indicate that they were caught in shallow water near the shore, probably in the small bay at which the settlement was situated. The migratory species, i.e., salmonids and *Anguilla*, may have been caught in either fresh or salt water. The size-frequency diagram over *Anguilla* is of no help here, as differences between size distributions in fresh and salt water are not assumed to exist (I. Boëtius, pers.comm.).

The range of species (i.a., the many *Anguilla*) and the general small size of the fish suggest that fishing took place with fish traps at shallow water. Using fish traps during summer near the coast of Skagerrak the author caught *Anguilla* (mostly small, minimum 28 cm), *Limanda* (17–23 cm), *Platichthys* (18–21 cm), *Gadus* (13–30 cm), *Pollachius virens* (21–28 cm), and *Zoarces* (22–30 cm).

Remains of fish traps have not been found at Ertebølle. However, a study of the unretouched blades from Ertebølle by Helle Juel Jensen indicated that they were used for splitting thin branches or osiers – these might very well have been used for the manufacturing of fish traps. Remains of fish traps and wattles are known from several other, contemporaneous settlements. The only fishing tools found at Ertebølle were 5 fishhooks (length 2.5–3.9 cm). They were, of course, also used for catching, e.g., *Perca*, *Esox*, *Salmo*, and gadids, to mention the most likely species from the list. All these species, however, may also be caught in traps.

Belone is a seasonal fish and must have been caught during the summer half of the year. The other marine species in the sizes concerned will also most easily have been caught within the summer half where they live near the coast.

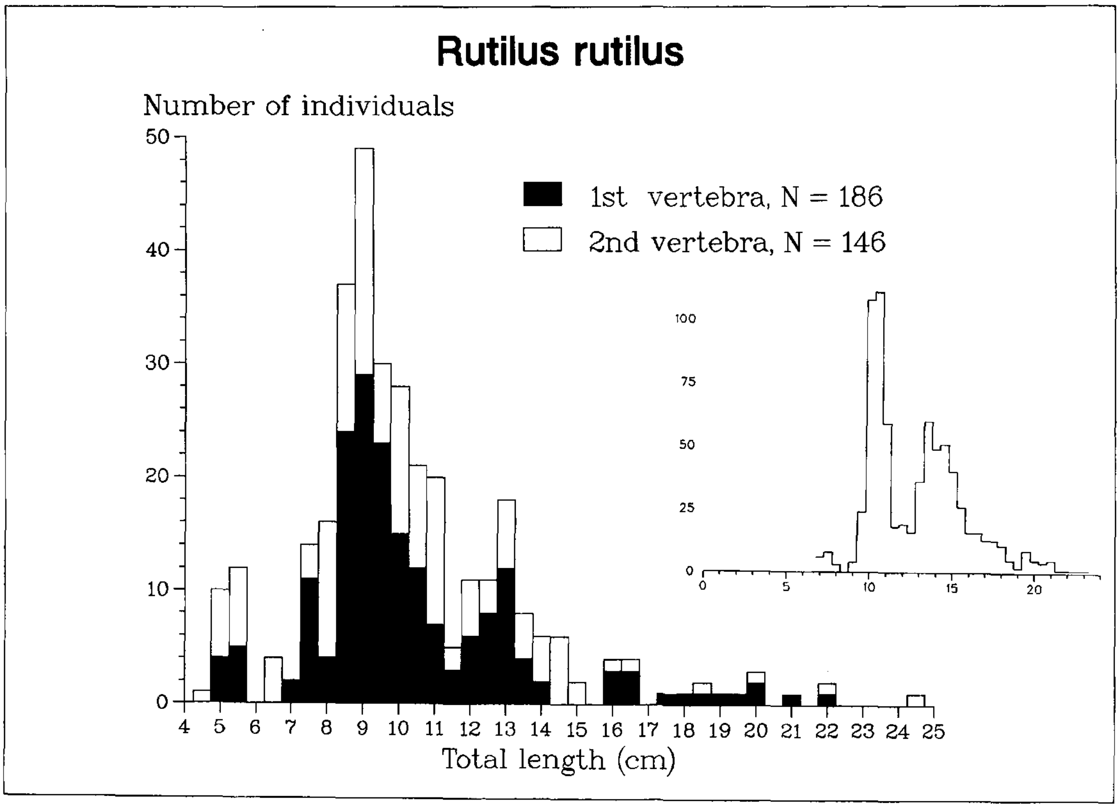

Fig. 6. Size-frequency diagram of roach (*Rutilus rutilus*) from Ertebølle. Total length estimated on the basis of measurements of first vertebra (black columns) and second vertebra (white columns). Inset: size-frequency diagram (total length) of recent *Rutilus* caught in a seine net during June 10–14 in Skjoldenæsholm Gårdsø, a Danish lake of 10.7 ha., depth 2–2.5 m (from an unpublished report by J. Dahl, 1969).

The clearly separated age-groups in the *Rutilus* size-frequency diagram, Fig. 6, supported by a similar pattern in subdiagrams (not shown) indicate that *Rutilus* was caught over quite a short period of time each year, or during wintertime (cf. the interpretation of *Pollachius* otoliths from the Oronsay shell middens (Mellars & Wilkinson 1980)). It is impressive that a size-frequency diagram with so nicely separated age-groups – not distinguishable from a diagram based on a recent, short-time investigation – can be obtained from a subfossil material (about 6000 years old). This indicates that the subfossil bones were well preserved, and that it was possible to measure them with a great degree of accuracy.

The results of the growth ring analysis are in conflict with the size-frequency diagram. With the reservations that follow from the small (7 scale fragments) and hence hardly representative material and from the sources of error inherent in growth ring analysis (Casteel 1976, see also Cragg-Hine & Jones 1969), the growth ring analysis indicates that *Rutilus* was caught throughout the summer half of the year. If the opposing results concerning *Rutilus* are weighted against each other, the numerically well-founded size-frequency diagram probably stil warrants the conclusion that the majority of *Rutilus* fishing took place during a short period of time each year – or during winter.

On the face of it, it appears peculiar that the Ertebølle people consequently conducted fishing after *Rutilus* during a particular, short period of the summer half year, where food of all kinds was abundant (the Atlantic period is considered to have been a very rich period in terms of food availability). But perhaps the short-time fishing each year was directed chiefly towards *Anguilla* rather than *Rutilus*. Very many *Anguilla* bones (1638, i.e., 17% of the trench material) were found, and *Anguilla* fishing is highly seasonal. In the autumn, when *Anguilla* migrates to the sea, there is a period with chances of great catches. In this case, *Rutilus* should be regarded as a secondary catch which was most probably exploited as well (see below). However, the possibility that the *Rutilus* size distribution reflects fishing during winter cannot be ruled out.

The fish bones were concentrated in the middle layers of the midden (Table 5). This could reflect a period of intense fishing, but there are other possible explanations: secondary diggings, present in the upper layers, may have caused oxidation of the bone material, and the low number of recovered bones from the lower layers may be in part caused by precipitation of manganese compounds and ochre obscuring bones. However, the N-column, which was sieved through a 0.5 mm mesh, showed the same low concentrations of fish bones in the lower layers. The conditions in the lower layers are further complicated by marine activity, which is particularly evident here.

The Ertebølle shell midden is characterized by small fish, *Belone* and *Anguilla* apart. It might be argued that the small fish, i.a., all the small *Rutilus* which constitute two thirds of the fish bone material, and the *Gasterosteus*, were too small to have served as food for the inhabitants.

In the "Material" section it was argued that the majority of fish bones in the midden could not have been washed ashore from the sea (and most of them were from freshwater fish which must have been caught inland). An explanation for their presence, especially in the small, delimited groups, which does not necessarily involve human activities, is that they represent gull pellets. Gull bones were numerous in the midden (Madsen *et al.* 1900). However, each delimited group of bones often contained remains from about ten species of both freshwater and marine fishes, whereas about ten recent gull pellets examined all contained remains from a single individual of fish only. This explanation is therefore little probable. It is also possible that the small fish were discarded as rubbish when fish traps were emptied for *Anguilla* or other species.

However, it appears far more plausible that also the small fish were eaten by the inhabitants. Today small fish are an important and constant source of food for many peoples all over the World. Furthermore, many of the graves (13 out of 85) in Skateholm, Scania (Sweden) (Jonsson 1986) contained fish remains which have partly been interpreted as preserved stomach-gut contents, and as food offerings consisting of a stew made from, i.a., *Anguilla*, *Rutilus*, *Scardinius*, and *Gasterosteus*. Many of the fish were small (up to 20 cm) individuals. *Gasterosteus* was numerous: one of the graves contained *Gasterosteus* bones representing more than 300 individuals. As in Ertebølle, the Skateholm material was characterized by the occurrence of several (up to 8) species of fish in each small group of bones. The vessels from Tybrind Vig, W Funen (Denmark) also should be considered. The food crust inside one of these vessels contained, among several other fish remains (presumably all from gadids), an opercular bone from a ca. 20 cm long *Gadus* (Andersen & Malmros 1984), that is, a gadid of similar size of most of those from Ertebølle.

In the light of the observations from Skateholm and Tybrind Vig it is considered that the Ertebølle people also ate small fish and that the groups of fish bones in some way represent remains from their meals. Winge (in Madsen *et al.* 1900) reported feces-like objects containing, i.a., bones from small fish. No objects suggesting such an interpretation were found in the present material, nor were any noted in the field during the excavation. (Fish bones may be found in excrements of both humans and dogs, although many bones are dissolved by digestive juices or destroyed mechanically during passage of the alimentary canal (Jones 1984)).

CONCLUDING REMARKS

Fishing at the Ertebølle settlement appears to have been conducted at two different places.

Surprisingly enough – we are dealing with the classical Ertebølle shell midden which was situated on the sea shore – the main fishing (represented by at least 71% of the bones from the trench) took place in fresh water, presumably in one or both of the nearby lakes. The numerically dominant species was *Rutilus*, which was caught during a short period of the year, same period each year, or during winter. The most reasonable explanation for this consequent behaviour may be that the freshwater fishing was done by means of fish traps set for migrating *Anguilla* in the autumn, with *Rutilus* as a secondary catch.

A less important fishing took place from the sea coast, presumably in the small bay, where the marine species were caught in shallow water, probably within the summer half of the year. Fish traps were probably the main tool for this fishing, too.

Presumably, both small and larger fish were eaten by the inhabitants of the settlement at Ertebølle.

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The Ertebølle 'køkkenmødding' and the Marine Development of the Limfjord, with Particular Reference to the Molluscan Fauna

by KAJ STRAND PETERSEN

INTRODUCTION

The western part of the Limfjord today forms a sound connected to the Kattegat in the east by the narrow Langerak, and to the North Sea in the west by the break through the beach ridges at the Agger spit (fig. 1). This has been the prevailing situation since the Agger spit was breached in 1825. At a stroke, this opening to the west changed the whole fishery in the fjord, from a well-established freshwater fishery to that of the present time with saltwater vertebrates and marine molluscs – although the molluscan fauna is very rich, its 85 species of shell bearing molluscs being among the richest in Danish waters. In particular, the Limfjord has a natural population of oysters, because temperature and salinity in the fjord are sufficient to allow a natural turnover. These conditions have become established since 1825, the marine molluscs being present as a result of immigration since the breach at Agger.

The preceding period, with fresh and brackish species, has left little trace on the deposits of the region. We know of the conditions almost exclusively from historical sources – Pontoppidan's *Danske Atlas* and *Schade's Beskrivelse til Øen Mors* [Description of the Island of Mors] (Pontoppidan 1769, Schade 1811). In particular it is the Limfjord fishery, which was of great importance before 1825, that is described (Rasmussen 1969).

THE EARLIER DEVELOPMENT OF THE LIMFJORD

Investigations at Agger (Petersen 1985a) of the marine deposit under the dunes show that the formation of beach ridges began during the Iron Age *at the earliest*. Throughout the long period from the Early Atlantic into the Subboreal period, there is continuous marine sedimentation. This means that the Limfjord was saline throughout this period, a fact also shown in several places by the dated raised marine deposits which are common in the interior Limfjord area, including the coastal cliffs off Ertebølle.

This development, with its continuous marine deposits, can also be seen in the northern part of the western Limfjord area; in the Vester Hanherred region these deposits can be as much as 30 m thick (Petersen 1981). This great thickness of deposit, which was also the case at Agger, can be explained by the history of the early formation of the Limfjord.

During the final phases of the Weichselian glaciation the melt water had run-off channels towards the northwest, and the sediment deposited by this melt water – the so-called terrace surfaces – is found in the Karup Å river system and in the Falborg valley. The Falborg valley comprises the area south of Viborg, and a stretch to the northwest across the present drainage areas of the Jordbro and Fiskbæk Rivers south of Lovns Bredning (Rasmussen and Petersen in prep.). We can place the formation of these terrace surfaces at around 16,000 before present, and these areas were subject to erosion from then until the Early Atlantic Transgression, as the sea level was very low during the Continental period (defined as beginning at the end of the Allerød, lasting into the Holocene around 7500 bp, cf. Petersen 1985b) – most of the North Sea was dry land. It was the powerful erosion taking place in this period that cut deep channels in the Limfjord region. In these were subsequently deposited the marine sediments of the universally rising seas during the Boreal and Early Atlantic. This eustatic sea level change might be linked to the melting of the North American ice shield – the Scandinavian one had melted earlier.

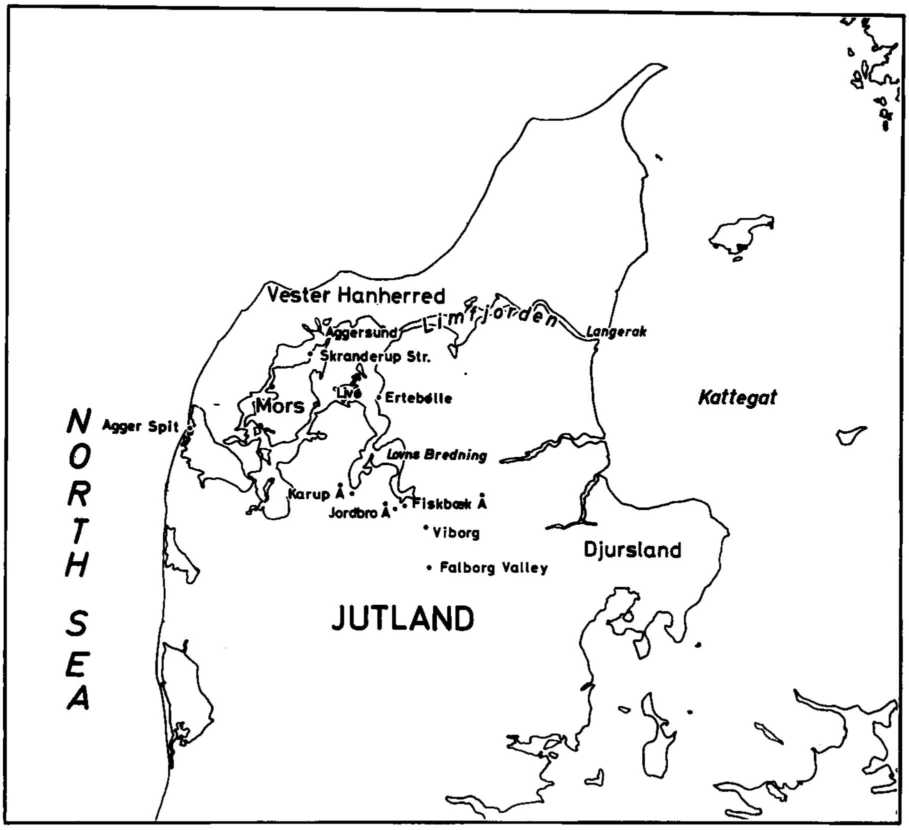

Fig. 1. Location map.

THE HOLOCENE FAUNA OF THE LIMFJORD

The fauna of the early transgressional phase was rich – and most of the species which would characterize the subsequent part of the Holocene were already present, such as the *Tapes* species and the oyster (Petersen 1985b p. 15). In all, 139 species of shell-bearing marine molluscs have been described/identified from the *Tapes* Sea. The many shell-bearing molluscs associate in various seabed communities, and not all can of course be found everywhere. Changes through time can be clearly seen in cores through the thick layers of marine sediments (Petersen 1981). The fauna may be dependent on depth of water or speed of sedimentation. The littoral-coastal fauna was, however, also very rich in the Limfjord area in earlier periods. This was one thing that V. Nordmann, who mapped parts of northern Jutland, called attention to (Jessen 1905, p. 151 ff.). On the basis of the highest marine limit he was able to show that many molluscan species lived in what was for them very shallow water. The same observation can be made along the coasts today, with for example horse mussels, *Modiola*, being washed up on the beach – this species normally lives outside the Limfjord, in deeper water. This situation is clearly important for our evaluation of the possibilities open to people in the Ertebølle period for collecting molluscs in the littoral zone.

Another situation of great importance is the appearance of shellfish as elements of either *infauna* or *epifauna*. To the former belongs first and foremost the cockle, *Cardium edule*, as an element of the latter can be mentioned the mussel, *Mytilus edulis*. As far as seabed types are concerned, the Limfjord has both areas of hard bottom – e.g. the mo-clay formation – and extensive areas of sand and gyttja.

THE AREA AROUND THE ERTEBØLLE *KØKKENMØDDING*

In the Ertebølle area, the seabed at Ertebølle Hoved is hard mo-clay, while to the south there are extensive areas of sand where hard mo-clay only appears sporadi-

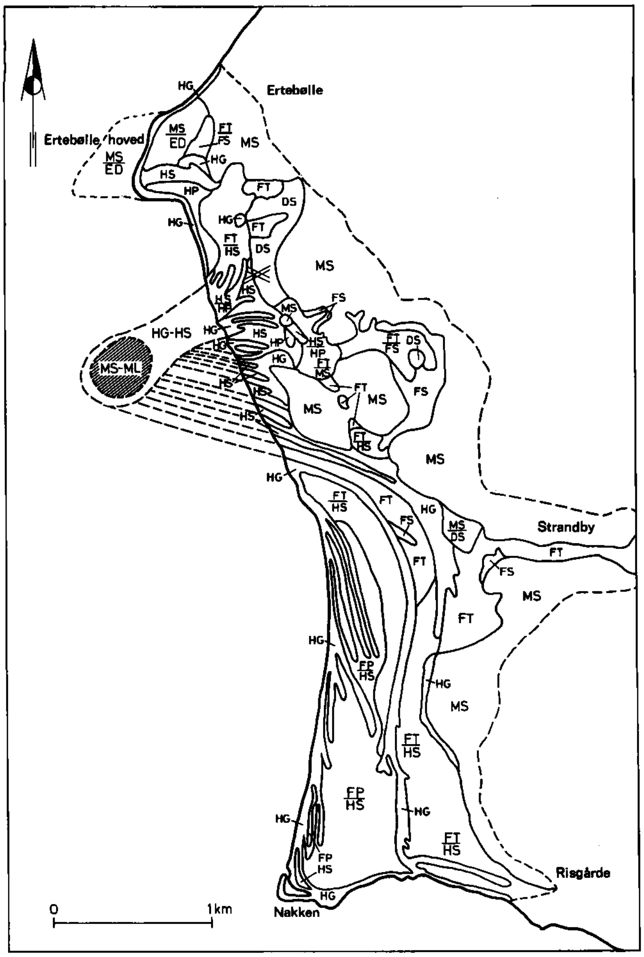

Fig. 2. Geological map of the area round the Ertebølle midden, which is marked with a cross. The letters stand for:

FT = freshwater peat	HG = marine gravel
FP = freshwater gyttja	DS = meltwater sand
FS = freshwater sand	ML = till, clayey
HP = marine gyttja	MS = till, sandy
HS = marine sand	ED = mo-clay

cally. Substratum conditions have changed through time since the Early Atlantic marine transgression, as a geological map of the area makes clear (fig. 2).

The slope under which the midden lies is regarded as having been cut by the Early Atlantic transgression. It is thought that, at this time (c. 8000 bp), the promontory of Ertebølle Hoved projected further towards the southwest, and that an island of glacial origin lay a short distance out in the Limfjord. Supported by this island complex, a system of raised beaches was formed, of which traces are visible today off the *køkkenmødding* and further south.

Very large raised beaches were laid down in near the settlement, and also further south off the narrow exit from the lowlying area near Strandby. The cliffs behind this raised beach complex were formed in the Early Atlantic, similar to those near the settlement.

Cores have been taken to establish whether marine sediments of this early phase were deposited in the lowlying area east of Strandby. An examination of the possibility that the area east of Strandby was inundated during the early phase of the Limfjord's marine stage (the Early Atlantic) was attempted, by seeking for macro- and microfossils such as molluscs and foraminifera/diatoms in the sediments in the lowlying area. The investigation gave a negative result, in that no fossils were found, so that the development of the basin cannot be elucidated.

The sequence of layers, with peat/gyttja resting on glacial sediments in all three cores, may, however, indicate that the area east of Strandby was a shallow freshwater basin throughout much of the Holocene.

The raised beach complex can be followed as far south as Risgårde, as shown in fig. 2. A more recent complex is being formed off the Nakken promontory. It is the current straightening of the coast which has cut through the older raised beach area, and led to the disappearance of the "island" and the raised beaches running out to it. A residual of erratic boulders is, however, found on the beach south of the settlement, and testifies to the highlying moraine upon which the raised beaches were originally formed.

THE RELATIONSHIP BETWEEN MIDDEN AND FAUNA

On the north side of the raised beaches off the settlement at the present coastline, *in situ* faunal elements approximately on the + 1 m contour have been dated: *Tapes*, *Ostrea* and *Cardium* 6000±100 bp; *Ostrea* 5840±95 bp; and *Mytilus* 5790±95 bp (K-4340, K-4341 and K-4342 respectively, all uncalibrated dates).

Sand-filled hollows between the ridges of the raised beaches have, from a slightly higher level (+ 1.5 m) produced a pure *Cardium* fauna dated to 5280±90 bp (K-3680). On the beach in the bay south of Ertebølle Hoved are *Cardium* dated to 3690±80 bp (K-3679) – in other words from long after the formation of the *køkkenmødding*, which stopped at around 5000 bp after starting about 6000 bp (Andersen and Johansen 1986).

SHELLFISH

Ostrea edulis (Linné)
Cerastoderma edule (Linné)
Mytilus edulis (Linné)
Venerupis decussata (Linné)
Venerupis pullastra (Montagu)
*Venerupis aurea (Gmelin)
Littorina littorea (Linné)
Littorina saxatilis rudis (Maton)
Littorina obtusata littoralis (Linné)
Hinia reticulata (Linné)

ACCESSORY MARINE MOLLUSCS

Bittium reticulatum (Da Costa)
Peringia ulvae (Pennant)
Macoma balthica (Linné)
Parvicardium exiguum (Gmelin)
Timoclea ovata (Pennant)
Hiatella arctica arctica (Linné)
Gibbula cineraria (Linné)
Cingula semicostata semicostata (Montagu)
Triphora perversa adversa (Montagu)
Lacuna vincta (Montagu)
Rissoa albella (Lovén)
Rissoa lilacina (Recluz)
Odostomia unidentata (Montagu)
Buccinum undatum (Linné)
Acmaea virginea (Müller)

TERRESTRIAL GASTROPODS

*Vallonia costata (Müller)
Vallonia pulchella (Müller)
Pyramidula rotundata (Müller)
Hyalinia pura (Alder)
Clausilia bidentata (Strøm)
*Vitrea crystallina (Müller)
*Eulota fruticum (Müller)
*Helix hortensis (Müller)
*Carychium minimum (Müller)
*Cochlicopa lubrica (Müller)
*Vertigo angustior (Jeffreys)

Table 1. All the species of molluscs found in the Ertebølle *køkkenmødding*. An * indicates species only found in the earlier examination (Madsen et al. 1900).

It has earlier been suggested (Petersen 1986) that an examination of the dated *in situ* fauna off the midden, compared with the molluscan composition of the dated midden itself, would give a good chance of examining the Ertebølle choice of diet. It emerges that the oyster was the preferred shellfish in the early phase of the midden (op. cit. table 2).

Two column samples (J and N), taken from the midden for the purpose of examining the shellfish, have now been studied. They reiterate that the oyster was the predominant shellfish (figs. 3 and 4). However, in a level of column sample N (N 17 and 15–11), dated to around 5460 bp, the curve of the *Cardium* peak begins; this is close to the date (5280 bp) of the formation of shallow sand flats after the raised beach formation – when *Cardium* becomes the completely dominant faunal element off the settlement. In column sample J, a lesser marked *Cardium* peak is correspondingly dated to begin around 5430 bp, and thus might reflect the initial formation of shallow sand flats off the settlement.

The main elements in the shellfish of the midden are *Ostrea*, *Cardium* and *Mytilus*, but *Tapes*, *Littorina* and *Nassa* are also present – athough, as shown in both figures 3 and 4, they could at no time have formed an important part of the diet.

For column sample N, accessory marine and terrestrial small molluscs are also listed. Among the marine, *Bittium reticulatum* is particularly predominant – although in no layer does it appear in sufficient quantities to justify the conclusion that individual layers represent *in situ* marine deposits. In support of this is the ubiquitous appearance of small terrestrial snails – particularly *Vallonia pulchella*. These are regarded as having lived on the midden during its formation.

Table 1 lists all the species found in the midden, without taking into account the numbers in which they appear. There are 25 marine species, of which only a few formed part of the diet, while the rest must be regarded as carried into the midden by chance, "accessory marine molluscs".

SEA LEVEL CHANGES AND THE ACCUMULATION OF THE MIDDEN

As mentioned in the section on the area around the midden, the slope below which the midden lies is regarded as cut by the Early Atlantic transgression. The basis for this is that, in the Vester Hanherred region north of Ertebølle, deposits of shells, *Ostrea/Cardium*, at + 3.5 m are dated to around 7000 bp on abraded surfaces off slopes like that behind the Ertebølle *køkkenmødding*.

On the nearby island of Livø, and on Skranderup beach on northwestern Mors, there is evidence of a regression around 6000 bp (Petersen 1976). Formation of the midden began in this period, as mentioned in the section on the relationships between midden and fauna.

As shown by the examination of the two column samples (J and N), there is nothing that can be interpreted as an autochthonous marine layer, so there are thus no reasons to assume that the midden was inundated by the sea for any length of time during the millennium of its accumulation.

Experience of a multi-lobed body of water like the Limfjord, however, makes it not unlikely that wind action or shorter periods of high water level could have *redeposited* parts of the midden. Allochthonous shell midden material cannot be recognized by means of methods used in this study, however, but should rather be visible in the appearance of the artifacts (Andersen and Johansen 1986).

The dating of a definite shallow water fauna, the Cardiidae of the shallow sand flats, to around 5280 bp, at a higher level than the earlier faunal elements dated off the settlement, testifies to a rising sea level towards the latest phase of the midden.

The final flooding of the midden can be demonstrated archaeologically by water-rolled flints. This can be referred to the Early Subboreal, when the highest marine limit is attained in this area. High-lying raised beaches at Aggersund at + 6 m are dated to around 4990 bp (Petersen 1976).

THE SPECIES COMPOSITION OF THE *KØKKENMØDDING*

Table 1 also lists species identified in the shell midden during the early excavations (Madsen et al. 1900). Within marine molluscs this only adds *Venerupis aurea.*

The situation is different regarding the 11 species of terrestrial gastropods, however, of which 7 were identified by the earlier work of J. Collin Jr. (op. cit. p. 81).

The predominant shellfish in the midden, *Ostrea edulis, can* be found dispersed on the soft seabed, but is most frequently found in banks – and this is the way they were found by the Ertebølle people. This is shown by a umber of the other species found in the midden, such as *Venerupis* spp, *Bittium reticulatum, Parvicardium exiguum, Hiatella arctica, Gibbula cineraria, Triphora perversa, Odostomia unidentata, Buccinum undatum* and *Acmaea.* These are most commonly described together from subfossil oyster banks and, as is characteristic of the Limfjord, also from shallow areas.

The other, briefly predominant element in the midden comes from deposits in fjords and sounds with soft seabed (cf Nordmann (Jessen 1905)). This is *Cerastoderma edule* with species like *Littorina* spp., *Macoma balthica, Rissoa* spp., but also *Bittium reticulatum* and *Parvicardium exiguum* which are also known from the oyster banks.

A large concentration of Cardiidae is found in lagoon formations, to which the sand flats off the midden can be referred.

All the various environments mentioned are highly saline. A few species, *Venerupis decussata* and *Venerupis aurea*, are no longer found in the region. Furthermore, from the size of the subfossil oyster banks and the high species variety in the midden it must be assumed that the natural renewal of the oyster population was greater than it is today. This suggests higher temperatures and greater salinity in the Atlantic sea than is the case at the present time.

According to statements by Steenberg (1911) concerning the habitats of land snails in Denmark, woodland appears to have been predominant among the species found in the Ertebølle *køkkenmødding. Vertigo angustior* and *Cochlicopa lubrica* are, however, exceptions, listed as coming from open and dry areas. It is, however, significant that this must be somewhat revised according to Kerney and Cameron (1979), who specifically state that the most common landsnail in the Ertebølle midden, *Vallonia pulchella,* is *not* found in woodland, but in open calcareous environments. It is not specifically stated that *Vallonia costata* is not found in woodland, but it is also found in open calcareous environments. Evans (1972) mentions *Vallonia costata* as one of the first species to colonize England after the Weichselian, and states that it is a species "of open habitats, rarely entering woods". It must be mentioned that many of the landsnails found in the Ertebølle midden are also known from other middens in Jutland – for example Meilgaard on the Djursland peninsula, Eastern Jutland. As regards the landsnails, there is therefore (concurring with the authors in Madsen et al. 1900) no reason "to doubt that they also derive from the Stone Age, but full certainty cannot be reached". However, with regard to degree of certainty that the snails do

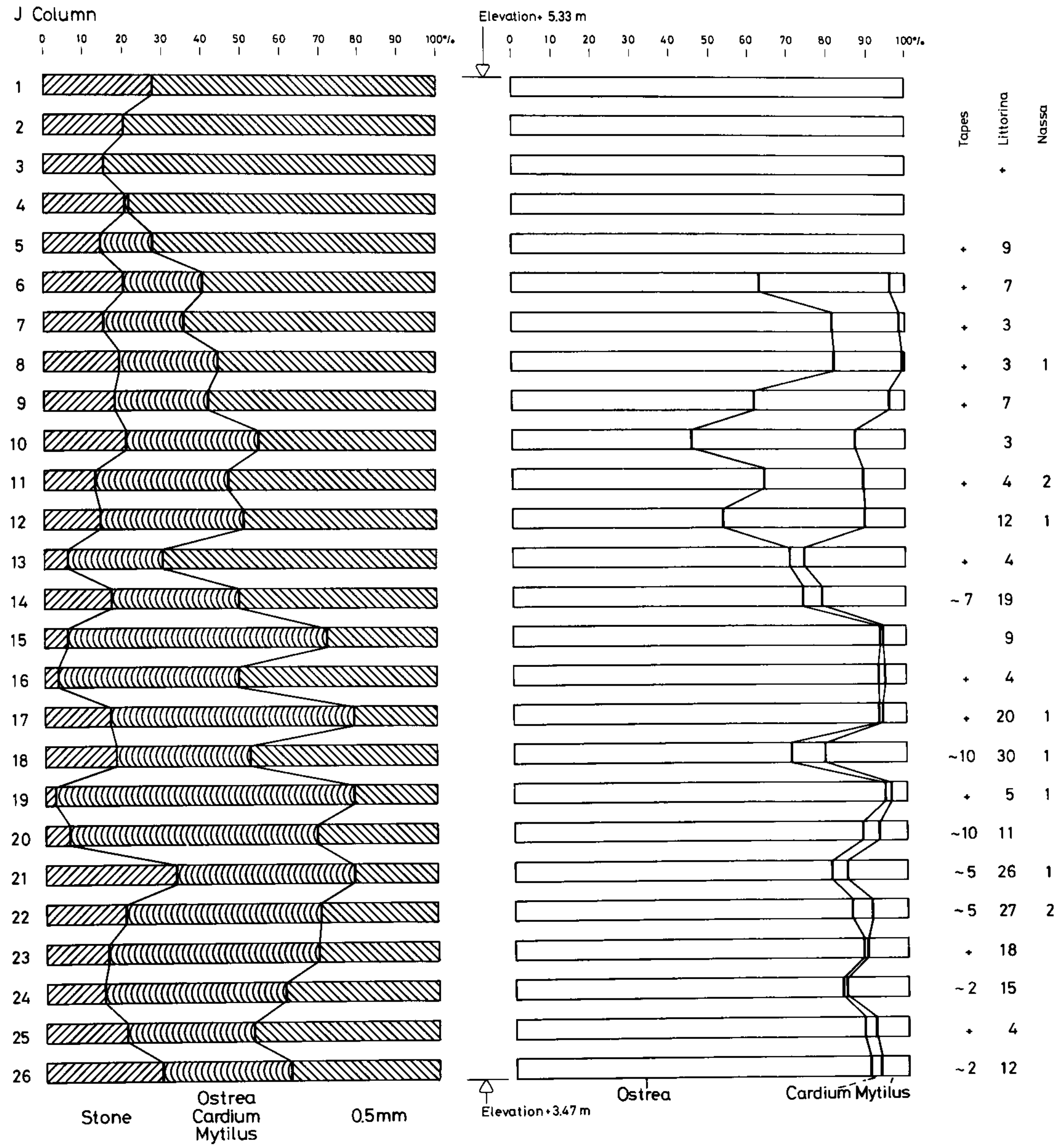

Fig. 3. Column sample J. Percentage by weight in the samples of up to 2000 g of stones, shell material (*Ostrea/Cardium/Mutilus*), and material under 0.5 mm. The division by weight of the species *Ostrea edulis*, *Cardium edule* and *Mytilus edulis* is given. Potential dietary elements are given in number of individuals.

derive from the period of midden formation, their presence *throughout* column sample N seems to demonstrate contemporaneity.

On the basis of the data from column sample N (fig. 4), one could suspect that the appearance of "many" *Bittium* shells could be linked with the *Cardium* maximum, as small snails can easily be included during the digging of Cardiidae – an element of the infauna. The many remains of fish in column sample N were also found in the *Cardium* level; these are examined by Inge Enghoff (1986). Whether there is any dietary connection with cooking – there are fireplaces at the level of the *Cardium* maximum – is something I will not discuss, and I will now let the tables speak for themselves without involving myself in further speculation.

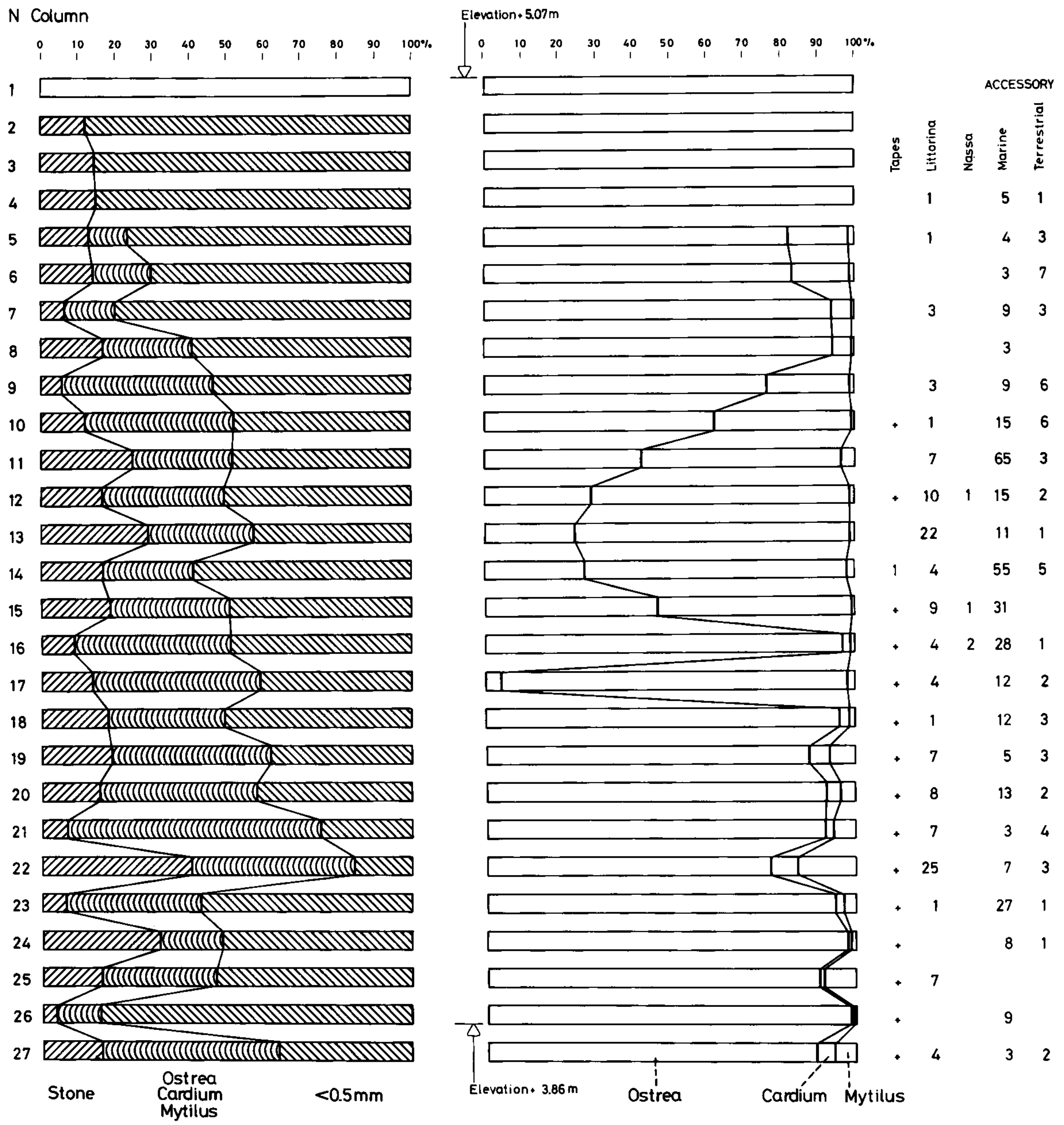

Fig. 4. Column sample N. Percentage by weight in the samples of up to 2000 g of stones, shell material (*Ostrea/Cardium Mytilus*) and material under 0.5 mm. The division by weight of the species *Ostrea edulis*, *Cardium edule* and *Mytilus edulis* is given. Potential dietary elements are given in number of individuals. Accessory elements of small marine snails and mussels and terrestrial gastropods are found throughout this column sample.

CONCLUSION

In the above the development of the western part of the Limfjord is briefly presented, and the marine molluscan fauna of the area's early stage – the Atlantic – discussed on the basis of earlier works. It emerges that the Atlantic molluscan fauna was rich in species, and studies of areas close to the midden show that the Ertebølle people had rich biotopes to collect in.

Comparing this with the examination of the two column samples (J and N) from the midden, it appears that the oyster (*Ostrea edulis*) was the preferred shellfish.

The cockle (*Cardium edule*) is predominant only in a few layers of the midden. Experience shows that the shells of the mussel (*Mytilus edulis*) survive less well, but as this study is based on weight even small fragments have been included in the data base. It is thus possible to state that the mussel was less sought after as a dietary item.

Besides the division into percentages of the weights of the three species mentioned above, individuals were counted of *Tapes* (*Venerupis* spp.), *Littorina* (*Littorina* spp.) and *Nassa* (*Hinia reticulata*). These are all potential food species, but never achieved any importance. With regard to size, individuals of particularly *Littorina saxatilis rudis* and *L. obtusata littoralis* are present which are so small that they must be ruled out as a food source.

The accessory marine molluscs listed in table 1 are only a small part of the Atlantic fauna of small snails and mussels, and they are regarded as having been carried into the midden by chance. Attention is drawn in this connection to the presence of stones throughout both column samples. As the figures 3 and 4 are based on percentages, a correction factor must be applied as the density of stone is 2.7 while that of shell is about 1. Despite this, there is still so much that the stones must have been brought into the midden via the collected shell material, and perhaps also attached to strands of seaweed.

Regarding the appearance of terrestrial gastropods, one must particularly note that they appear throughout the whole of column sample N. The most common, the *Vallonia* species, are characteristic of open, calcareous environments – and a *køkkenmødding* must be described as exactly that.

Translated by Peter Rowley-Conwy

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The Bog Find from Sigersdal

Human Sacrifice in the Early Neolithic

by PIA BENNIKE and KLAUS EBBESEN
with a contribution by LISE BENDER JØRGENSEN

Much peat digging took place in Danish bogs during the 1940's, to supply fuel for the wartime economy. Many archaeological finds were made as a result, and due to organised efforts on the part of the National Museum many of these were saved for future research (Th. Mathiassen 1947: 1 ff – K. Ebbesen 1985: 28).

One of these finds comes from Sigersdal Mose, near Veksø in northern Zealand (Stenløse parish, inventory no. 110. NM I A 44.101–2) (Danish "mose" = bog) (fig. 1). Peat was dug here in 1948–49, and a lugged flask and two human skeletons (one with a cord round its neck) were found in 1949 on the 3rd and 11th of April respectively. Svend Th. Andersen carried out an examination of the find location in the period 16th – 23 rd July the same year together with Hans Helbæk and B. Brorson Christensen.

A long stretch of bog lies between Veksø and Søsum running into Værebro River to the east. A good kilometre northeast of Veksø a side valley runs up towards Sigersdal farm. The find comes from the east side of

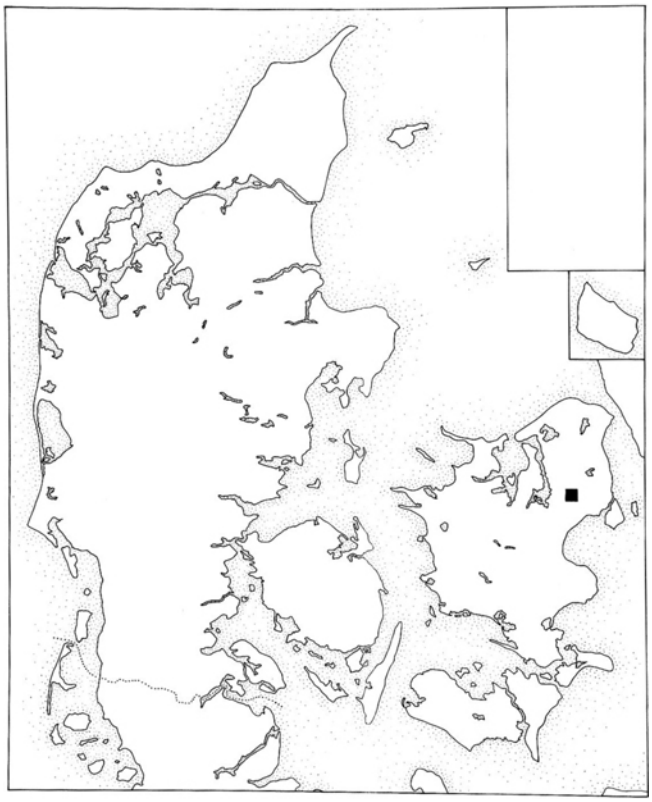

Fig. 1. Sigersdal is located in northern Zealand.

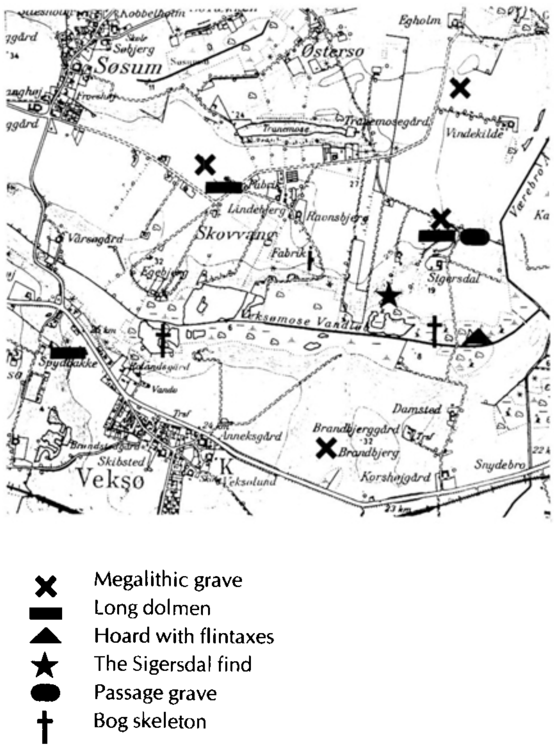

Fig. 2. Early neolithic sites and finds in the Sigersdal area. Reduced from map sheet 1513INV. Approx. 1:40,000. Reproduced with permission from the Geodetic Institute no. A.404/85.

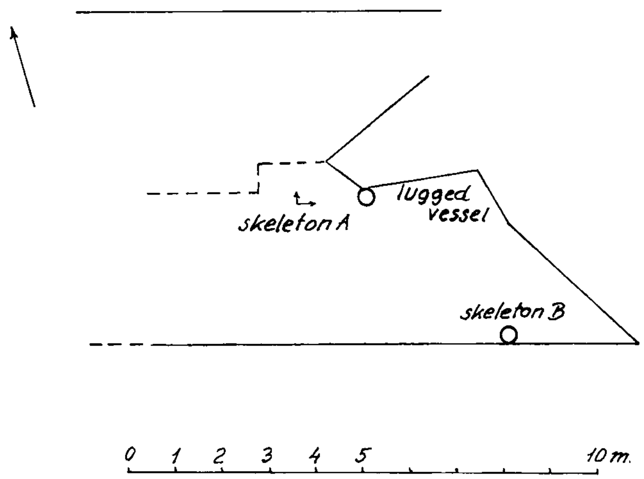

Fig. 3. The positions of the finds in the peat cuttings.

this side valley, which has steep slopes on three sides (fig. 2). Here the peat diggers found: a human skeleton (skeleton B); a lugged flask; a cow's skull; three lower jaws of cattle (all quite young); part of a horse skull (possibly broken before deposition); fragments of the skull of a relatively old goat; the lower jaw of a roe deer; the carapace of a pond tortoise; and ribs of horse or cow (fig. 3). A few bones of another human skeleton (skeleton A) were also recovered, the rest of which still lay in situ when Svend Th. Andersen arrived. It was therefore photographed and documented in great detail before excavation.

It is the detailed investigation of skeleton A together with carbon 14 determinations that makes this find quite unique. Skeleton A has been dated to 2700 ± 140 bc (K-3744); skeleton B to 2730 ± 75 bc (K-3745). The two people were therefore deposited in the bog during early neolithic phase C, in about 3,500 BC (recalibrated years).

THE ANTHROPOLOGICAL INVESTIGATION

The position of the bones

The detailed planning and drawing of the bones was undertaken from several angles, and this has been of the greatest importance for the attempt to reconstruct events in Sigersdal Mose. A first glance at the plans and photographs (figs. 4 and 6) appears to indicate that the bones of *skeleton A* were all disturbed; but closer examination has revealed that only a small number of bones in fact lay separated from the others and out of anatomical order.

The right femur, the left half of the pelvis, the ribs and the vertebrae are all bones from the central part of the skeleton, and they are all displaced from their natural positions. This observation is of importance for the subsequent interpretation of the placing of the corpse in the bog.

Some of the bones belonging to the skeleton had already been removed before the arrival of the excavators, and their original positions can only be guessed at. One can assume, as the following discussion shows, that the bones that were removed first did not lie below the bones drawn on the plans. Among the bones removed by the peat diggers were the left humerus, radius and ulna. As the skeleton belonged to a young individual, some of the epiphyses of these bones had not yet fused onto the shafts. Thus the distal epiphysis of the left radius was still in situ, together with the bones of the left hand. All these bones lay to the left of the head. There is therefore reason to believe that the bones of the left arm lay uppermost in the bog, and that this arm was strongly flexed at the elbow. Had this not been the case, the bones of the hand and the epiphysis of the distal radius would not have been found where they were. We do not, however, know how the humerus lay in relation to the scapula, and we have therefore not included this bone in fig. 5.

The left femur and right half of the pelvis were also among the bones removed by the peat diggers, and are therefore not included in S. Th. Andersen's drawing. The position of these bones is more difficult to determine. It is therefore likely that they lay apart from the rest of the skeleton, like their opposite numbers. This assumption will be supported in the following.

The excavator's drawings of the position of the bones in the bog are extremely useful, because they show the positions of the bones viewed not only from above, but also from other angles, so that one can among other things determine the relative levels at which the bones were found (fig. 4). The drawings also show why the first communication to the National Museum referred to a skeleton "standing on its head in the bog". The cranium is positioned relatively deep – but so are the feet and tibia particularly of the right side. The soles of the feet and the rear of the legs lay upwards, and the cranium lay face down, correctly positioned with re-

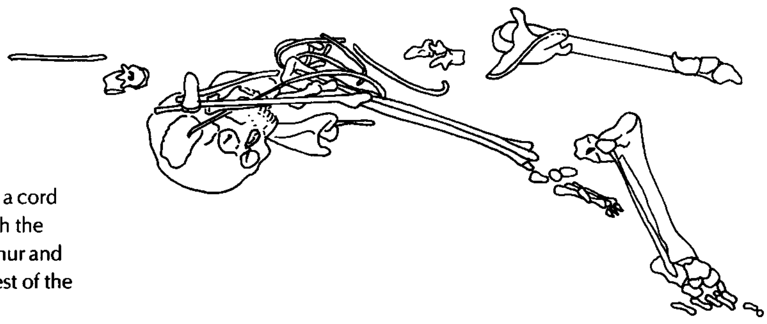

Fig. 4. Excavation drawing of the bones of *skeleton A*, which had a cord around its neck. The drawing shows the different levels in which the bones lie. The distal end of the right leg lies deepest. The right femur and left half of the pelvis lie higher up, slightly displaced from the rest of the skeleton.

spect to the first five cervical vertebrae with the abovementioned cord.

In forensic medicine it is known that bodies that have been in water for a time usually end up face down (fig. 7) (Ponsold 1957, 376 ff). This is in part due to the decay which will almost inevitably take place in the abdominal cavity, and the gases that form as a result. The rate of decay will of course depend on various circumstances, primarily the temperature of the water. At very low temperatures of under 4°C, decay will slow or maybe completely stop (Gregersen 1979, 54), and this may for example be important with regard to the preservation of the famous bog corpses. The gases which normally form would cause the body to float close to the bank in the orientation described above. If the depth of water is not great, it may be only the abdominal region that floats, while the head and extremities remain in contact with the bottom.

The process of decay also depends on the medium in which the corpse lies. Those processes of decay that take one week in open air, take two weeks under water or eight weeks under ground (Gregersen 1979, 54). If the water level in the bog was low, and the head, upper torso, arms, and lower parts of the legs were on the bottom submerged in water, then that part of the body which was exposed above or close to the surface could have been affected by quicker processes of decay in the open air. These bones could therefore have becomed

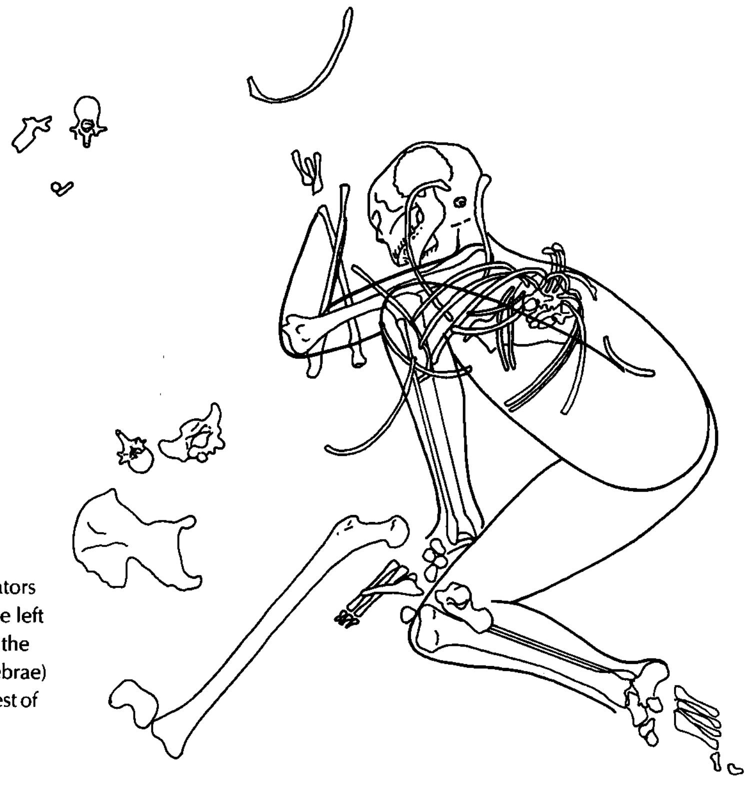

Fig. 5. Some bones of *skeleton A* were removed before the excavators arrived (of the large bones, these included those of the left arm, the left femur and the right pelvis). Others (the right femur, the left half of the pelvis, the sacrum and some smaller ones including ribs and vertebrae) were not in their correct anatomical positions. The position of the rest of the bones gives an impression of the position of *skeleton A*.

Fig. 6. *Skeleton A* during excavation. Not all the bones are in their correct anatomical positions.

detached from the soft tissues and articulations more quickly, and thereafter carried a little way away by the current. It can also be seen on the drawing (fig. 5) that the separate bones all lie on the left side of the body. They almost all derive from the central part of the body. As was the case with the radius and some other bones, the epiphyses of the femur had not fused onto the diaphysis. The drawings show, however, that the distal epiphysis lay correctly positioned in relation to the shaft, although the whole femur complete with epiphysis lay separately from the skeleton. This might mean that the cartilage that joined these two parts of the bone had not decayed when the bone was carried away from the rest of the skeleton. This explanation of the displacement of some of the bones from and around the pelvis may, however, be somehow contradicted by the fact that the decay of a body lying in water usually starts at the distal part of the extremities and ends at the lower part of the torso, because of the very heavy ligaments in this area. Experience from forensic medical cases therefore suggests (Markil Gregersen, pers. comm.) that the displacement of the bones may have been caused by ice or faults in the bog. Another possible explanation could of course be that the body had been cut into sections before it arrived in the bog. If this was the case, however, traces of such butchery should

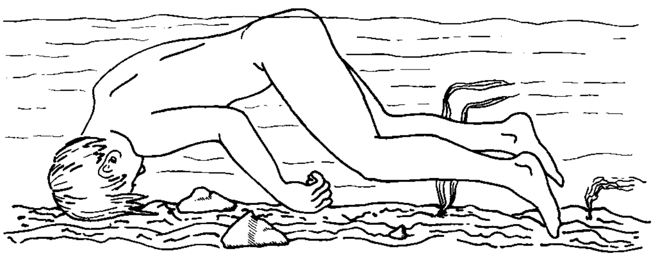

Fig. 7. In forensic medicine it is known that a body in water will often lie in the position shown, with the stomach downwards and the back uppermost. Because of gas formation in the stomach and intestinal regions, as well as any air remaining in the lungs (if death is not due to drowning), the corpse will rise to the surface relatively soon, still in the position shown. This may explain the position of *skeleton A* on the bottom of the bog. (After Ponsold 1957).

be visible on the bones (which are very well preserved); and none are visible.

Because of the rather unusual relative positions of the bones, the excavator suggested that the body fell with its legs crossed, maybe after being hit on the head. The theory that the legs were crossed was based on the position of the feet, and the fact that they lie deeper than the rest of the bones.

The anthropological examination of the bones compared with the drawings has shown that both legs were strongly flexed, but that they were not crossed. The position of both femurs and of the lumbar region of the vertebral column had to be reconstructed; but judging from the positions of the tibiae, and the rest of the vertebral column and thorax, the bones can hardly have been positioned differently than shown in fig. 5.

The left tibia lay with its knee in front of the thorax, and so did the patella. The left leg must therefore have been flexed maximally both at the hip and the knee. The right leg was less flexed at the hip; the femur pointed directly to the front, while the knee joint was completely flexed so that the tibia pointed to the rear. The bones of the right arm lay approximately in their presumed original position, with the hand in front of the face.

As the face was positioned obliquely downwards and the soles of the feet upwards, one must assume that the body was not lying completely on its right side, but also partly on its stomach.

There is unfortunately no corresponding information available for the position of *skeleton B*, as all the bones of this skeleton were removed by the peat diggers before museum personnel were called in. The only comment in the excavation report is that the skeleton, according to the peat diggers, lay approximately in a natural position. It is also stated that most of the bones lay in the dark gyttja, above the lighter calcareous gyttja into which only few of the bones extended. Contrary to *skeleton A*, (fig. 8), some of the bones are missing. Most of the bones missing from *skeleton B* (fig. 9) are from the hands, feet, thorax and vertebral column, in other words mainly the smallest bones of the skeleton. From the hands and feet, for example, there is only one single bone, a left metatarsal. As the missing bones are almost all small ones, they could have been removed by the current; but it is most likely that *skeleton B* was not excavated as carefully as most of *skeleton A*. Erosion cannot explain the lack of small bones in *skele-*

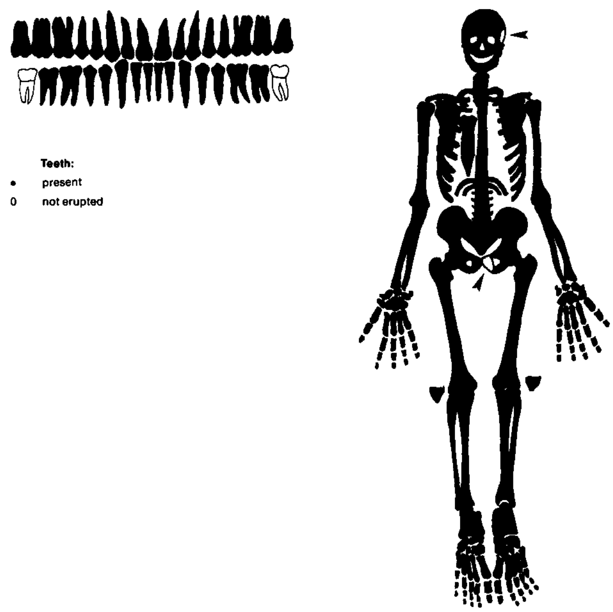

Fig. 8. Black shading shows which bones and teeth were present in Sigersdal *skeleton A*. The skeleton was almost complete. All that was missing was a fragment of the skull, and a part of the left pubic bone, which had been eroded away. All the teeth were present, except for two wisdom teeth which had never developed.

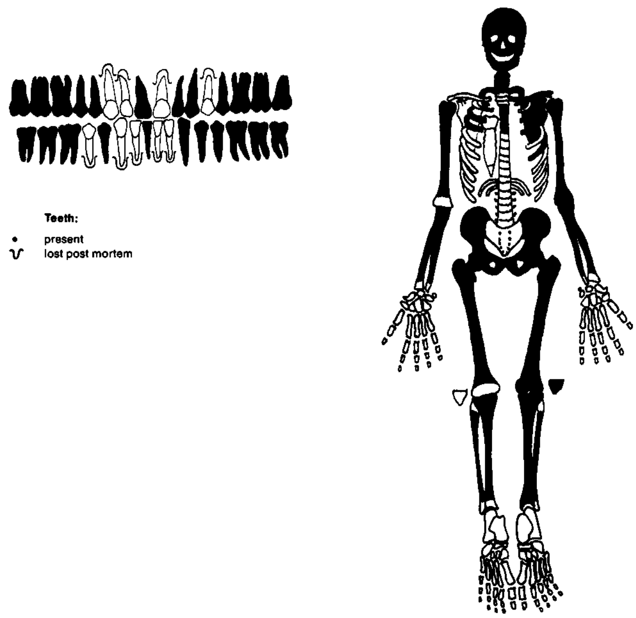

Fig. 9. Black shading shows which bones and teeth were present in Sigersdal *skeleton B*. A number of bones are missing, particularly the smaller bones of the hands, feet, vertebral column and ribcage. Because of the young age of the individual, many epiphyses had not yet fused onto the rest of the bone, and are therefore missing. All the teeth were present at death, but nine were lost during the removal of the bones from the bog.

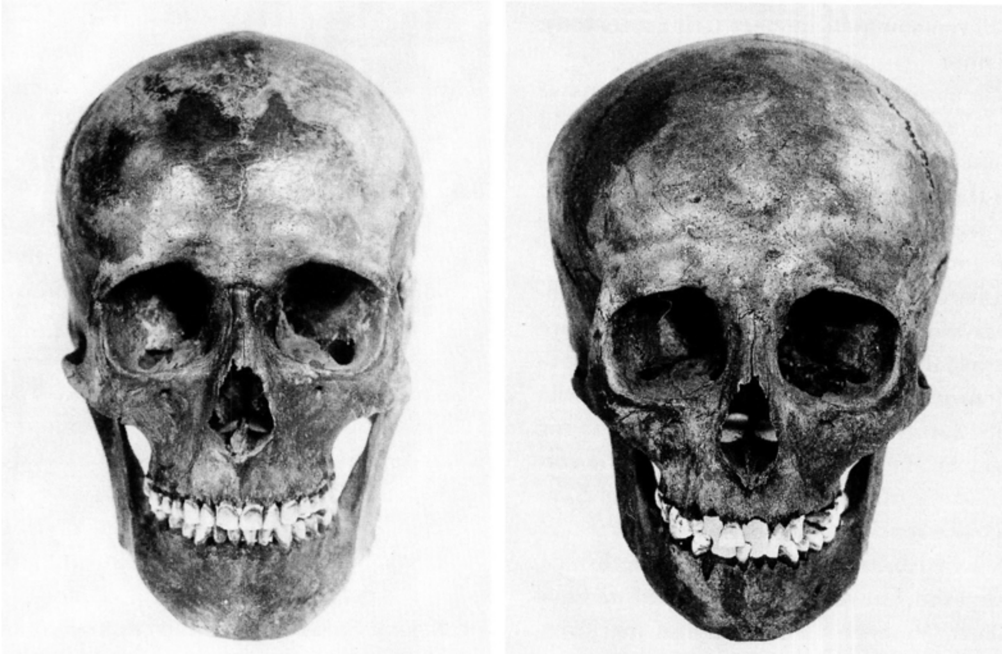

Fig. 10. The skulls of *skeleton A* (left) and *skeleton B* (right) from Sigersdal. There is a considerable size difference between the crania. This is partly due to developmental differences, as *skeleton A* was 18–20 years of age, while *skeleton B* was only about 16. The skull of *skeleton B* still shows some juvenile characteristics which disappear with adulthood (fig. 12). There are also a number of features common to the two skulls, for examples the unusually long narrow nose and the size and shape of the orbits. Photo: G. Hahn.

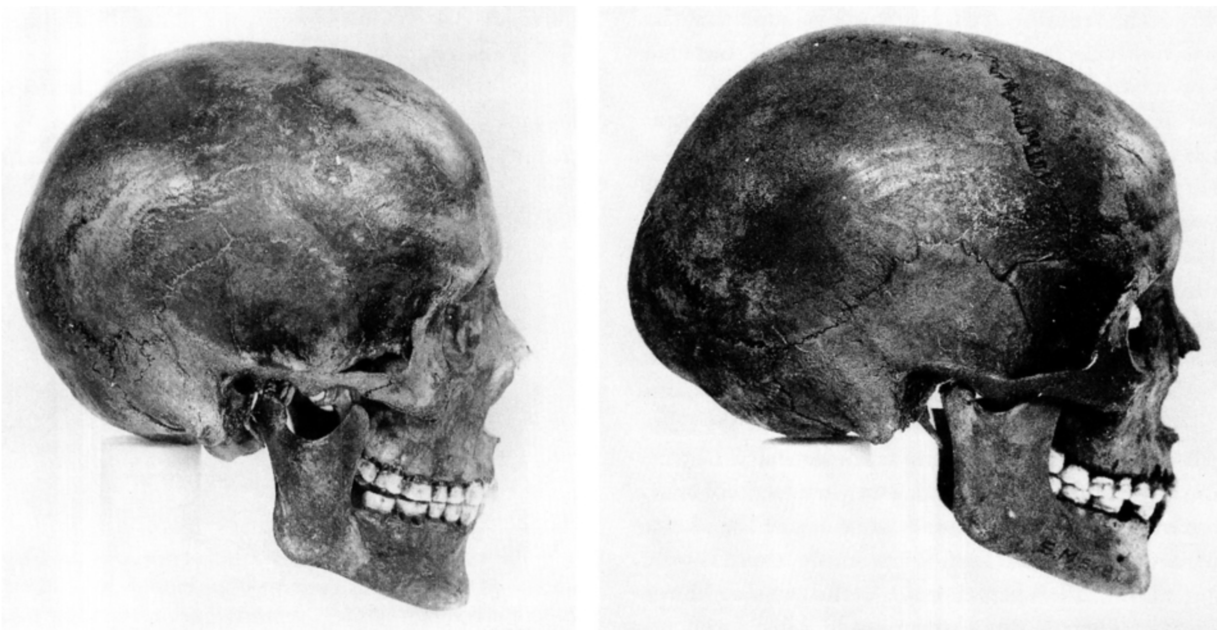

Fig. 11. Profile view of the skulls of *skeleton A* (left) and *skeleton B* (right). The obvious dissimilarities are due to among other things the different developmental stages of the two individuals. Both skulls are mesocephalic, however, with cranial indices (cranial breath × 100 divided by cranial length) of 75.7 (skeleton A), and 78.0 (skeleton B). Photo: G. Hahn.

ton B, as the rest of the bones are just as well preserved as those of *skeleton A*.

Anthropology

The two crania from *skeleton A* and *skeleton B* from Sigersdal Mose look rather different from each other (figs. 10 and 11). This is, however, mainly due to the differences in age and developmental stage, because they are both young individuals in which skeletal development has not yet been completed. *Skeleton A* is determined to have been around 18–20 years old, *skeleton B* around 16 years old, at the time of death. In a child the facial region is smaller relative to the neurocranium than in an adult (fig. 12) (Martin and Saller 1959, 1171 ff), and the neurocranium reaches 80% of its total size by the age of 3 years. The skull of a child is often shaped differently from that of an adult, having pronounced convexities (so-called tubera) on both sides of the frontal, parietal and one of the occipital bones, so that when viewed from above the skull appears almost pentagonal. This shape gradualy disappears as adulthood is reached, although to a lesser degree in women than in men. The male cranium changes most from its original form, among other things due to its increased size and more pronounced muscle attachments. This is one of the ways in which the anthropologist can determine the sex of an adult skull. These changes do not take place until puberty, however, which means that crania of children can only be sex-determined with considerable reservations. Sex determination of the two skeletons from Sigersdal Mose is problematic for these reasons, and can therefore only be undertaken with considerable reservations.

The skull of *skeleton A* has mainly female features, but there are some reservations, partly due to the young age of the skeleton, and partly due to the presence of a frontal (metopic) suture which other researchers have demonstrated can result in a more female shape of the skull. This includes a steeper cranium, the absence of frontal sinuses, and a broader frontal bone (Martin and Saller 1959, 1316). The pelvis has both typical male and female characteristics. The other bones, particularly those of the limbs, are relatively long, and the stature would have been considerable for a female. However, muscle attachments and robusticity are not pronounced, although articular breadths (for example at the knee) have values lying between typical males and typical females. Taking all these characteristics into consideration, sex determination points mostly towards the skeleton being a female. However, because the skeleton is not yet fully developed (cf the missing muscle attachments), this determination is so uncertain that it has little value. Investigations already in progress of these and other early neolithic skeletons from Denmark may lead to a more trustworthy determination, by means of comparative analyses of various characteristics and measurements.

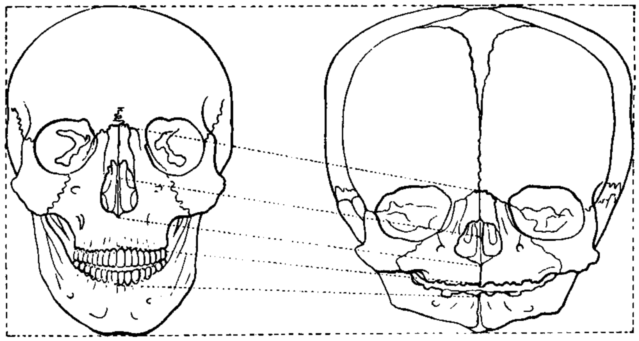

Fig. 12. The proportions of face and cranium in newborn and adult individuals. The large convexities which appear on the frontal, parietal and occipital bones of the child give the skull an almost pentagonal outline when viewed from above, and disappear gradually with age. The cranium of *skeleton B* still has juvenile cranial characteristics. After Martin and Saller (1959, 1171).

Sex determination of *skeleton B* involves even greater uncertainty, as this individual is only around 16 years of age. The characteristics of both pelvis and skull are female. However, the secondary sexual characteristics which typify the male skeleton do not appear until puberty.

The cranium of *skeleton B* for example still has the tubera mentioned above (figs. 10 and 11), which probably is the main reason for the differences between the crania of *skeleton A* and *skeleton B*. The cranial types themselves are in fact quite similar, and both can be described as mesocephalic. The cranial index (cranial breadth × 100 / cranial length) of *skeleton A* was 75.7, of *skeleton B* 78.0. Mesocephalic skulls have values between 75.0 and 79.9. The average value for women in the subsequent periods, the middle and late neolithic, is 77.6 (n = 53) (Bröste et al. 1956, 45), which also belongs to the mesocephalic category. Average head shape seems to get a little longer in the iron age: values for the early Roman iron age, the late Roman iron age

TABLE I

Nasal breadth (M54)

	n	x̄	s.d.	var.
middle/late neolithic	36	23.9	1.65	21–26
late Roman iron age	17	23.7	1.93	21–29
Viking period	18	23.4	1.62	20–26
SIGERSDAL SKELETON A		22.0		
SIGERSDAL SKELETON B		19.0		

Nasal height (M55)

	n	x̄	s.d.	var.
middle/late neolithic	36	46.3	3.49	39–53
late Roman iron age	17	49.2	2.51	43–53
Viking period	18	47.3	1.81	44–51
SIGERSDAL SKELETON A		54.0		
SIGERSDAL SKELETON B		52.0		

TABLE II

	n	x̄	s.d.	var.
middle/late neolithic	36	51.9	4.56	43.4–68.3
late Roman iron age	16	48.3	4.23	41.5–58.0
Viking period	18	49.6	3.38	41.7–55.3
SIGERSDAL SKELETON A		40.7		
SIGERSDAL SKELETON B		36.5		

Table I–II. Nasal index M54/M55 in women from different periods of prehistory. This index is calculated by dividing the height of the nasal fossa by its width. It is clear that the average values vary widely from period to period, and the indices for the Sigersdal skulls lie outside the ranges of variation of all other periods.

and the Viking period are respectively 72.9 (n = 23), 71.1 (n = 21) and 74.6 (n = 25) (Sellevold et al. 1984, 190).

Despite the youth of *skeleton B*, there are facial features on the two skulls which are so similar that they might suggest a possible biological relationship between the two individuals. This is particularly so regarding the long, narrow shape of the nasal bone and fossa (fig. 10). That their nasal morphology is unusual emerges from tables 1 and 2, where breadth and height measurements are compared with average measurements from a large number of Danish crania from the middle and late neolithic, the iron age and the Viking period. In several cases the measurements from *skeletons A and B* fall outside the ranges of variation of the skulls of the different periods. The orbits in both skeletons are very round and relatively large; together with the long narrow noses, the faces may have been regular and harmonious.

With regard to a possible biological relationship, further study must be delayed until the investigation of all Danish early neolithic skeletons in relation to skeletons of the immediately preceding and succeeding periods is completed. This will focus on among other things various non-selective characteristics on bones and teeth. One such characteristic is the presence of a frontal suture in adults and juveniles, the metopic suture. At birth, this suture divides the frontal bone in two, but it usually ossifies during the first year of life. In some individuals this ossification does not, however, take place.

Skeleton A from Sigersdal Mose has this metopic suture (fig. 10), while *skeleton B* does not. This does not rule out the possibility that *skeletons A and B* might have been biologically related, however. Torgersen has shown that non-ossification of the suture is determined by a dominant gene which occurs with varying frequency. In one family the suture was found in 50% of the adults (Torgersen 1951, 209).

The many measurements taken on the two skeletons from Sigersdal will be included in a future publication reviewing all the early neolithic skeletal finds from Denmark. Outside this context the measurements have only limited utility, and must in any case be used carefully because the bones are not fully adult and have not completed their development.

Stature has occasionally been calculated on the basis of femur length (Trotter and Gleser 1952), but this measurement only gives a minimum height. The stature of *skeleton A* was calculated by this means to 167 cm, of *skeleton B* to 154 cm. Mesolithic and early neolithic female skeletons from Denmark are in average not more than 154 cm in height, so in view of this the stature of *skeleton A* is considerable, yet another factor which should prevent us from too readily ascribing a sex to this individual.

Dentition

Figs. 8 and 9 show which teeth are present in the two skeletons. All the erupted teeth are present in *skeleton A*. The two mandibular wisdom teeth (8–8) were however never formed. The dentition is in general very regular, and there are no caries. There are already faint traces of paradontose-like alterations in the molar region, despite the young age of some 18 years and minor tartar formation is visible on several teeth.

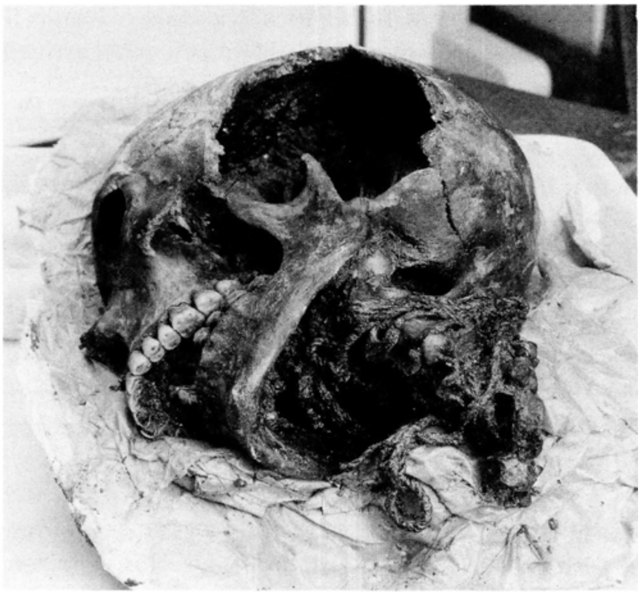

Fig. 13. The skull of *skeleton A* from Sigersdal during excavation in the museum. The skull, the upper cervical vertebrae and the cord were removed from the bog as one unit for later excavation. The photograph shows how the cord was positioned, and also that the jaw was displaced to the right. The large lesion on the left side of the skull was probably inflicted by peat digging implements.

Fig. 14. Close up view of the lesion in the skull of *skeleton A*. Study of its edges shows that the three penetrations can hardly have been made by neolithic weapons. They are more likely to have been made by peat digging implements. Photo: G. Hahn.

The dentition of *skeleton B*, like the rest of the skeleton, has been affected by the circumstances of excavation. All the teeth were present on the death of the individual, but 9 are now missing; these were most likely not recovered during the "excavation". All four of *skeleton B*'s wisdom teeth are formed, and they have erupted to almost the same height as the rest of the molars. One mandibular molar (6–) has a large caries cavity. Caries were relatively rare in the subsequent neolithic periods – in the middle and late neolithic the frequency of caries in molars was 4.5%. There was a difference in the two sexes: the frequency in males was 4.0%, in women 5.7% (Bennike 1985, 161). Tooth wear was moderate in both individuals, although of course much heavier than today. In *skeleton B* there are enamel defects in several teeth, indicating growth disturbances at around 2–3 years of age. There are also slight traces in the upper surface of the orbits and the parietals, linked with a deficiency, probably of iron.

Early neolithic skeletons from bogs

The two skeletons from Sigersdal Mose were found at the same time, 5 m apart (fig. 3). Other finds of two early neolithic skeletons lying quite close together are also known. There is no uniform distribution of age and sex in such finds, almost all combinations being represented.

Two male skeletons were found in a bog at Døjringe near Sorø. One was not quite fully grown. Two skeletons were also found in a bog at Tysmosen near Copenhagen; these were of children aged 8 and 10 years. Two skeletons of young people were found in a bog at Boelkilde on the island of Als, but their sex has not yet been determined. The well-known skeleton from Porsmose on southern Zealand, with arrowheads lodged in the maxilla and sternum (Becker 1952) was however found alone.

Traces of lesions

The bones belonging to *skeleton B* show no traces that can reveal cause of death, but the skeleton was excavated by peat diggers so there could have been a cord round its neck as with *skeleton A* without this being noticed. Many of the smaller bones and some of the teeth are lacking in *skeleton B* (possibly due to less careful excavation), while *skeleton A* is almost complete.

The cord found around the neck of *skeleton A* (fig. 13) must be regarded as a clear indication that this young person did not voluntarily choose to meet his/her end in Sigersdal Mose. There is a large aperture on the left side of the cranium (fig. 13), earlier regarded as a lesion resulting from violence probably before death. There are no signs of healing round the edges, and such a lesion would fit well with the other find circumstances and the cord round the neck. The recently completed re-examination of the skeleton however produced no definite evidence that the injury was inflicted during life, or even before the body was submerged in the bog. The edges of the large aperture suggest that it was made much later than the neolithic, perhaps during peat digging less than half a century ago. The upper edge of the lesion on the left parietal has three regular, semicircular penetrations, each about 1 cm in diameter, and with a distance between their upper points of about 1.9 cm. At the third penetration the fragment of bone has not been completely broken off, but remains attached to the cranium although depressed inwards (fig. 14).

It is difficult to see how this could result from use of any neolithic weaponry, whether axe, mace or flint halberd. It is more likely to result from a toothed peat digging implement such as a fork.

The entire aperture measures 4.5 × 9.5 cm. Many of the edges are not breaks but natural suture lines. It is therefore more likely that part of the bone was broken off, rather than smashed in.

The skull, the articulated cervical vertebrae and the cord were all lifted from the bog as a single unit which could subsequently be excavated in the laboratory, and the position of the individual bones recorded photographically. The report on the excavation of the skull states that "those parts of the cranium that were smashed in were found inside the skull, lying almost against its right side. Under the fragments lay what appeared to be part of the brain". The report adds that it was not quite certain that the fragments of the cranium lay precisely as indicated.

The re-examination of the skeleton and the photographs have made it clear that only a small part of the missing cranial bones in fact lay within the skull. The rest, covering the large aperture, was probably never seen by the excavator. This is rather odd, as even the smallest of the other bones was recovered and may still be examined. The missing cranial fragment should have been recovered during such a careful excavation if it had been there when the museum personnel arrived on the scene.

Closer examination of the excavation report reveals that "some of the bones were removed by the workmen so that the peat cutting could continue, but the rest, in the bottom of the grave, were left in situ. The skull and thorax were partially exposed by the workmen". It is thus likely that the skull was smashed during the peat cutting. The fact that the skull and the adjacent area was uncovered by the peat diggers supports this theory. It is therefore likely that the cranial fragment, which is the only missing part of the skeleton, disappeared during the peat digging.

Photographs of the cranium in situ show that the mandible was pushed to the right, and displaced from its correct articulating position. The position of the left articulation cannot be determined because of the missing cranial fragment. The jaw was probably pushed from the left towards the right, perhaps through a blow or pressure. If this happened before or shortly after death, it would not have been possible to disarticulate the jaw in this way because of the various tendons and soft tissues. These circumstances demonstrate that there are no reasonable grounds for assuming that the large aperture in the left side of the cranium was an ante mortem injury, or can in any way be connected with the individual's death or deposition in the bog. There is a smaller, partially healed depression on the left side of the frontalbone. This injury was inflicted much earlier, and probably resulted from a slight accident.

The colour of the bone at the edge of a lesion can often give an indication of when the injury was received, i.e. whether the lesion occurred at death or much later in time. After the excavation of the skull, it was treated with beeswax and poppy-seed oil until the bone structure was completely filled. Both this and the tanning effect of the bog mean that the bones, including the broken surfaces, are coloured dark throughout. Broken edges of recent lesions are usually paler than those of older ones, but this criterion cannot be applied here.

Lesions on other skeletons

It is quite common for such problems to arise during the examination of skeletons from archaeological exca-

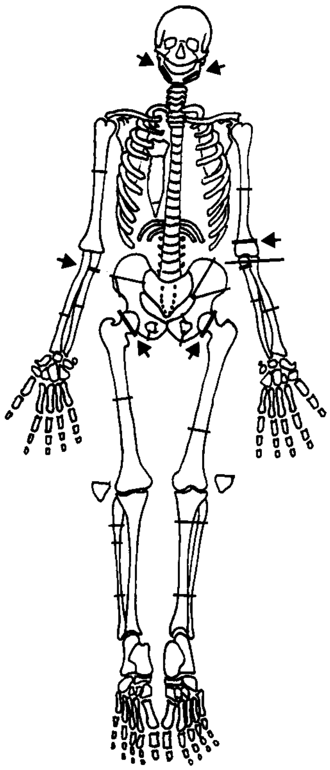

Fig. 15. Markings on the skeleton from Føllenslev Bog show where the bones are probably broken due to pressure from the surrounding deposits and other natural causes, and where there are signs of possible chop marks (arrows). The second category might be evidence of an attempt to butcher the body before it had decayed. This theory is suggested firstly by the symmetry of the lesions, and secondly by their appearance. There is no sign of any splitting of bones for marrow.

vations. It is usually possible to decide with certainty whether a lesion was inflicted before or after death when there are visible signs of healing at the edges. When there are no signs of healing, it can even in forensic studies of bog corpses where skin and soft tissues are preserved, however, be impossible to determine whether a lesion was inflicted before or after death. This was the case, for example, with the injured face of the female body from Borremose (Andersen and Gertinger 1982, 23 ff). Nor could it be determined with certainty when a lesion on a skeleton from Stenstrup Mose on Zealand was inflicted. This skeleton also had a cord round its neck when it was found, and also dates from the neolithic (Bennike and Ebbesen 1985).

While discussing neolithic skeletons with lesions, a find from Føllenslev Mose near Holbæk must be mentioned. The find was excavated by C.J. Becker in 1947 and dated to the early neolithic (Rech 1979, 51f). C.J. Becker interpreted the find as a ritual deposition of disarticulate human bones but without indications of cannibalism. The bones have recently been radiocarbon dated to 1580 bc (= 1945 BC, recalibrated, K-3747), *i.e.* the late neolithic period.

Most of the bones of the Føllenslev skeleton were (according to the find description) in a disarticulated state, and it was concluded that this must have occurred in antiquity. It is also stated that some of the bones are broken, and separated from their articular ends, which was also believed to have happened in antiquity. Fig. 15 shows the many breaks in these bones. The overwhelming majority were probably broken by natural causes, such as pressure from the surrounding deposits (a common cause of breakage). A few of the breaks show traces of lesions, but the surfaces of the breaks are remarkably pale, although they should be darker if the lesions were inflicted in prehistory. There are no clear sharp or smooth surfaces on the heads of the femurs, and in several cases the points where lesions might be expected are so badly preserved that no observations can be made. Both femoral heads are, however, fragmented in an unusual way, in a vertical sagittal plane. Those parts of the acetabula (the pelvic articulations of the femur) where one would expect to find traces if lesions were inflicted with the soft tissues present, are unfortunately so badly preserved that it cannot be determined whether the parts are missing due to lesions or bad preservation. It is, however, rare for femoral heads to fragment in this way without a reason.

Other bones of this skeleton do show lesions resulting from a sharp tool such as an axe. They are present on both ulnas, on the rear, in a similar position on each bone. On the right ulna the lesion is only about 20 mm deep, while on the left it continues obliquely upwards and ends on the lowest part of the humerus. The bones of the arm must have been in their correct anatomical positions, and the lesion must have been inflicted while the soft tissues were still present. The arm has been cut through, and one stump of bone (the upper part of the ulna) was still present. There were also lesions on the underside of the mandible, although less clear on one side than on the other. The mandible had two almost identical fractures uncharacteristic of natural breakage.

As shown above some traces of lesions are clearer than others. What is interesting in this case is the symmetry with which they occur in three places on the skeleton from Føllenslev. As the bones are stated to have been found in considerable disorder, it seems unlikely that a spade could have inflicted such symmetrical damage. It is also clear that at least the bones of the right arm must have been articulated when the damage occurred. There are thus reasonable grounds to assume that the lesions were all inflicted in prehistory, as the excavator concluded. Many of the other breaks definitely occurred after burial, due to pressure from the surrounding deposits or some similar cause, and no traces of the use of any weapon are visible.

The reason for the partial butchery of the individual in prehistory must remain an open question for the time being. The bones have been discussed with zoologists, who regularly see the remains of prehistoric meals in the form of animal bones from archaeological sites. In their opinion there is no evidence that the skeleton was butchered in order to be eaten. There is thus nothing that indicates cannibalism in this case either.

THE ARCHAEOLOGICAL INVESTIGATION

The peat diggers found a large lugged vessel between the two skeletons. This was fragmented, but the workmen succeeded in recovering most of the sherds. The lugged vessel is thus nearly complete (fig. 16 a–b). It consists of a neck 9 cm high and 11 cm wide, and nearly cylindrical, and a sharply differentiated ovoid or globular body with a small basal surface. Seven heavy lugs with narrow perforations are located almost on the widest point of the belly. The upper third is decorated with fine, low and broad vertical mouldings, placed at approximately equal distances apart. The diameter is about 34 cm, the height about 41 cm. There is one impression of emmer (*Triticum dicoccum*, identified by Hans Helbæk).

Because of its shape the lugged vessel is dated to early neolithic C, and is referred to the Virum group (Ebbesen and Mahler 1979, 11 ff). It thus dates to the same period as the skeletons. Unfortunately the pot contains no preserved food remains which could be radiocarbon dated. The question of whether it was deposited at the same time as the two young people or separately must therefore remain open. The probable close biological relationship of the two individuals suggests that there was a single deposition consisting of one large storage vessel and the two young people. Deposition could, however, also have taken place as three separate events with a few years between them.

There can be little doubt as to the sacred nature of the find. The lugged vessel must be placed together with the other Funnel Beaker culture pots found in bogs, and at least as far as skeleton A is concerned we are dealing with Denmark's oldest documented human sacrifice, carried out in early neolithic C around 3500 BC (recalibrated).

The finds described here are not the only ones from the locality. In 1948–49 the neighbouring peat cutting produced 10 goat skulls, a probable aurochs skull, and three fragments of polished thin-butted axes. 300 metres further east in the bog a hoard originally containing 13 large thin-butted axes of type I was found (fig. 17 – Nielsen 1977: no. 14). This is one of the larger known hoards of thin-butted axes, although it is probably a little older than the lugged vessel and the skeletons (Nielsen 1977, 72 ff).

A small neolithic site has been recorded immediately west of the findspot, on the top of a small promontory projecting into the bog. The finds are said to include among other things heavy discoidal scrapers, and fragments of thin-butted flint axes. It cannot be determined if the sacrifices were carried out from this site. About 500 m to the north is a group of three megalithic graves (fig. 2). A mound measuring 6 × 9 × 2 m contains a dolmen oriented north-south, with the opening to the south, built of three supporting stones and one capstone. There was also a long dolmen, now completely destroyed, and a passage grave oriented NNW-SSE with its passage to the ESE, originally with three capstones. 700 m to the WNW is a long dolmen oriented east-west, and 500 m beyond it in the same direction was a destroyed "dolmen". On the opposite side of the boggy area, about 1 km to the south, was another megalith, now destroyed. The placing of the sacrifice, the settlement and the megaliths in the landscape is thus that already well-known from early neolithic C (Ebbesen 1982, 60). The votive offerings took place in the wet area. The settlement was on the edge of this; and the graves lay further back, towards the bottom of the slope. In general the connection is clear, but no definite link between the various finds can be documented. The

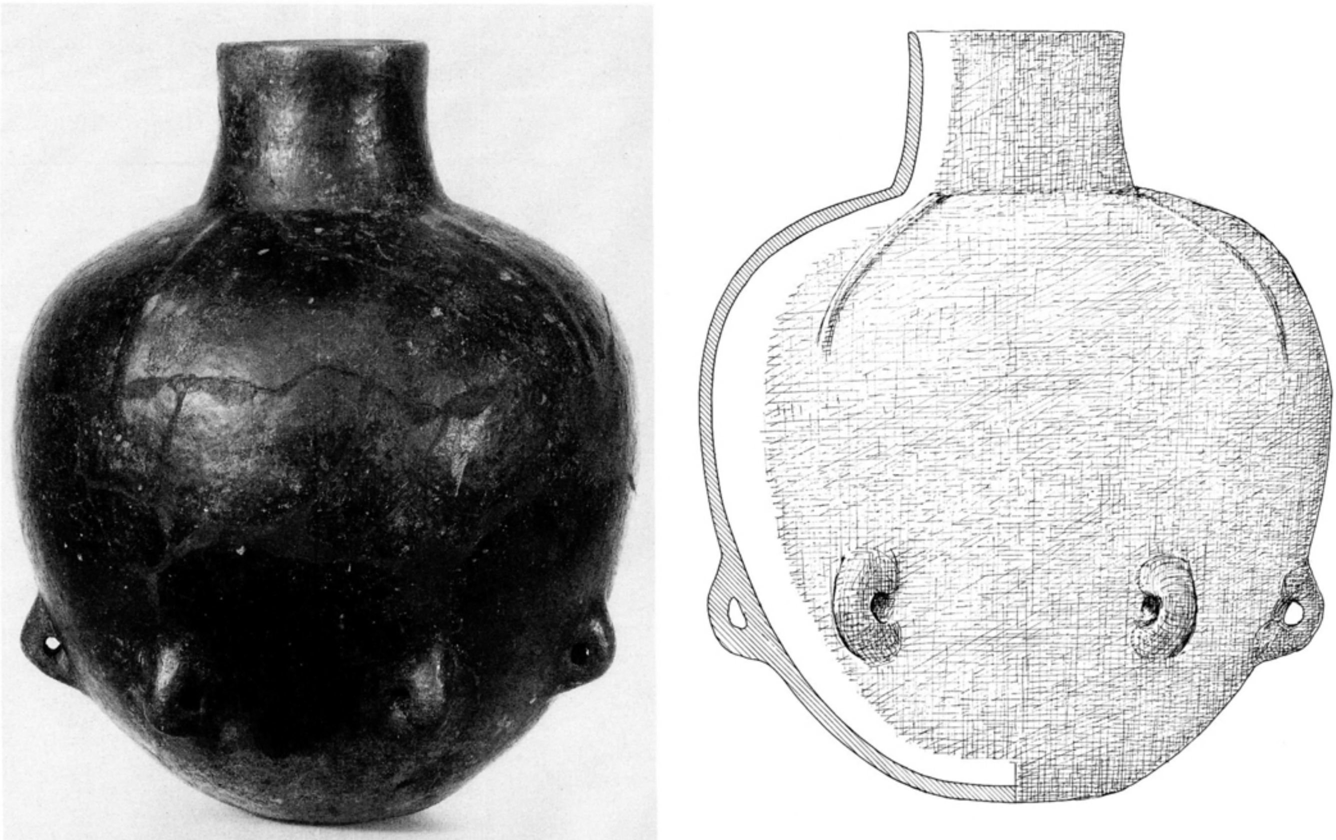

Fig. 16. The lugged vessel from Sigersdal. Photo: L. Larsen; drawing: H. Ørsnes.

exact chronological situation is also unclear in such a case, where we could be talking in terms of years or even months.

Bog finds of Funnel Beaker Culture pottery

The lugged vessel from Sigersdal Mose represents a particular group of neolithic pottery, which first became known through peat digging during and immediately after the Second World War, via the so-called "bog trips" organised by the National Museum.

The overwhelming majority of these finds were made in the period 1940–55, while the number of finds from for example the last century is very limited (fig. 22). Finds from recent times are hardly known. The most frequent depth under the bog surface at which they are found is about 2.0 m, and the overwhelming majority is below 1.5 m (fig. 20). Find frequency through time, and depth of discovery, are very different from those of thin-butted axes (fig. 26–27). This must result from a combination of the depth in the wet area at which the original depositions took place, and the depths at which peat has been dug in recent times. The pots seem to have been deposited in what was at the time open water, while the flint axe hoards were placed on the water's edge. This is the cause of the difference in find depth, and consequently also of discovery date.

In 1948 the neolithic bog pottery was studied in depth by C.J. Becker, who published 152 finds in all (Becker 1947). 110 other early and middle neolithic finds, mainly small, can be added to this (catalogue II). The discussion also covers 31 pots found in lakes, rivers or the open sea. A total of 436 early and middle neolithic pots are thus known from wet areas. In the following they are dated according to the classic system of neolithic chronology with some reservations towards its earlier part (Ebbesen and Mahler 1979, 11 ff; Madsen and Petersen 1982/83, 93 ff).

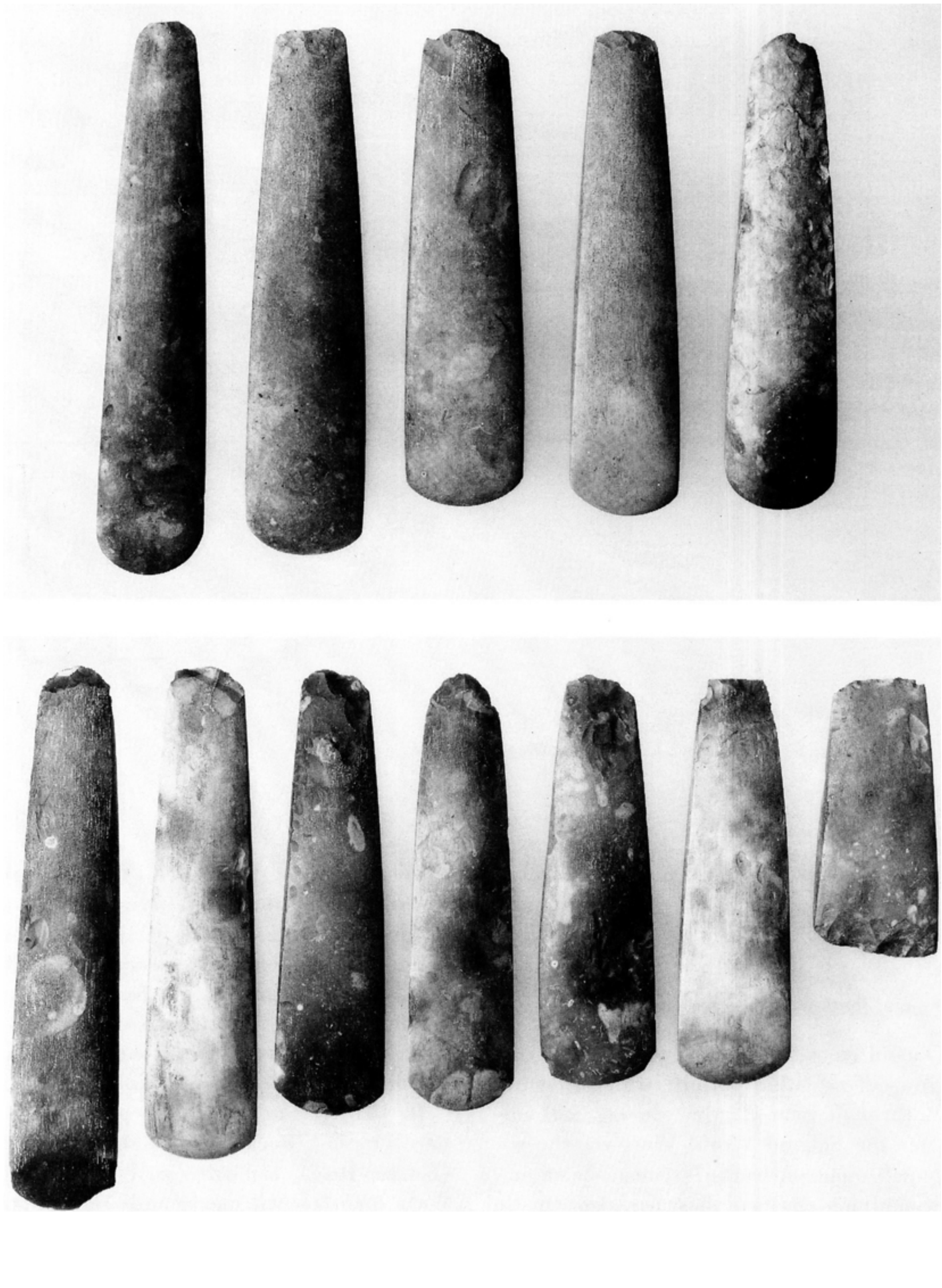

Fig. 17. Hoard of thin butted axes found at Sigersdal. Photo: L. Larsen. 1:4.

The early neolithic A and B groups are represented by 32 and 40 pots respectively. Over half the dated pots come from early neolithic C and middle neolithic I, which have yielded 109 and 72 pots respectively (fig. 21). This depositional practice stops almost completely during the period of the Blandebjerg style, and only a few pots from bogs are known in the later middle neolithic (MN II: 9; MN III/IV: 1; MN V: 4). From the later periods of the neolithic, very few pots from bogs are known (Davidsen 1976, 161 ff; Becker 1947, 119). A number of Ertebølle vessels recovered from wet areas are probably to be regarded as the predecessors of this sacrificial practice (Ebbesen 1980, 12, note 3: also a pot from Neverkær Mose, E. Albrectsen 1974, fig. 8). The deposition of pots in wet areas is thus a practice which as far as the neolithic is concerned occurs mainly in early neolithic C and middle neolithic I.

Geographically the new finds show a similar spread to that published by C.J. Becker (fig. 18). There is no reason to doubt Becker's (1947, 270 ff) interpretation of the finds as votive.

The selection of pottery used for the wet area sacrifices is relatively uniform (figs. 19, 21). In the early neolithic, funnel and cylinder necked beakers predominate, followed by lugged beakers and bowls, and (in early neolithic C) also lugged and collared flasks, which also comprise an important part of the pottery used as grave goods. In middle neolithic I, funnel and cylinder necked beakers are still the most common types, followed now by Troldebjerg bowls, while the rest of the ceramic forms are only rarely used in wet area sacrifices. In the later parts of the middle neolithic the number of pots is so small that one cannot speak of any regular votive practice.

Votive offerings of pottery of early and middle neolithic date are known not only from wet areas, but also from before the entrances of large dolmens and passage graves. Such sacrificial layers have been studied several times in recent years, so their composition is relatively well-known (Kjærum 1967, 9 ff; Jørgensen 1977; Ebbesen 1978, 1979). There are clear differences in the pot types in the wet area and the megalith sacrifices. Clay spoons make up about 10% of ceramic products in the megalith sacrifices, but are never found in bogs. Footed bowls are much more common in megalith sacrifices than in wet areas. Funnel and cylinder necked beakers, on the other hand, are rather more common in finds from wet areas than from before megaliths. They are the most common type in both, but are not present in the same proportions. In megalith sacrifices the funnel and cylinder necked beakers fall clearly into two groups with regard to height and rim diameter: very large storage vessels, and relatively small ones for drinking. In wet area finds of funnel and cylinder necked and lugged beakers, the height and rim diameter do fall within the same range of variation, but the commonest rim diameter is about 20 cm, and a considerable number have diameters between 20 and 30 cm. These wet area finds are typically medium sized, rather coarse pots. Although the same pot types dominate wet area and megalith sacrifices, therefore, there are some differences between them. If the clear differences in the choices of pot types and the chronological differences are also born in mind, it is clear that the wet area and the megalith sacrifices represent two different sacrificial practices. It is natural to see the megalith sacrifices as an expression of ancestor worship. On the other hand, the wet area sacrifices, probably involving foodstuffs, most likely represent a fertility cult.

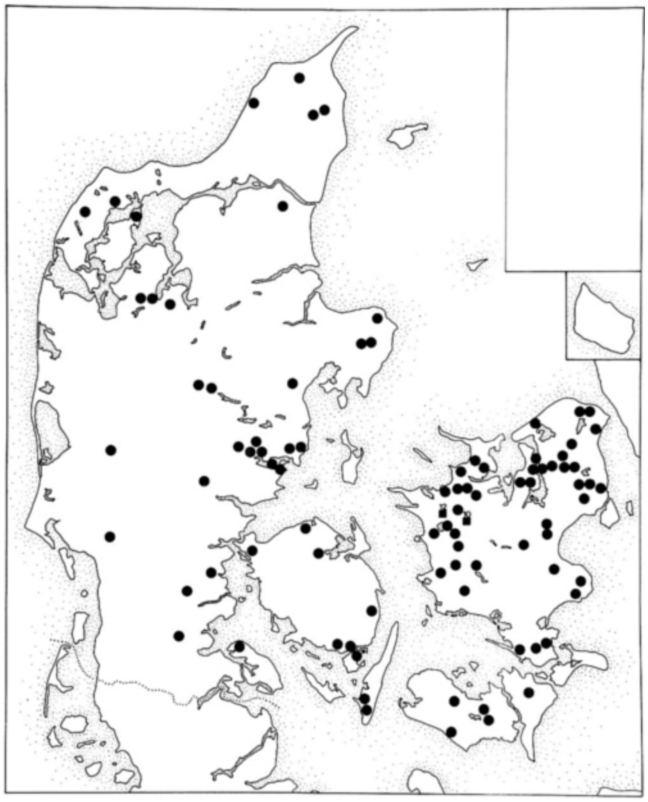

Fig. 18. Distribution of bog finds of neolithic pottery found after 1946.

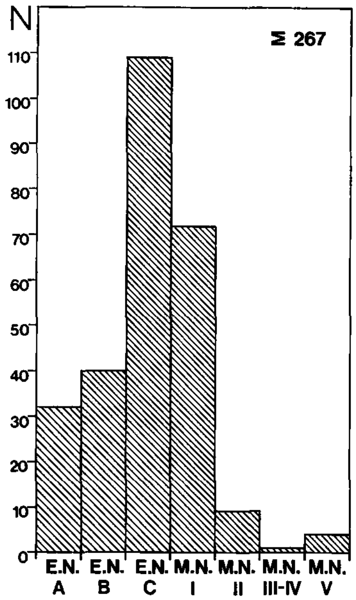

Fig. 19. The quantity and date of the bog vessels of the TRB Culture in Denmark.

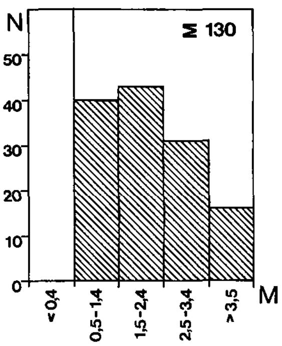

Fig. 20. Find depths of bog vessels.

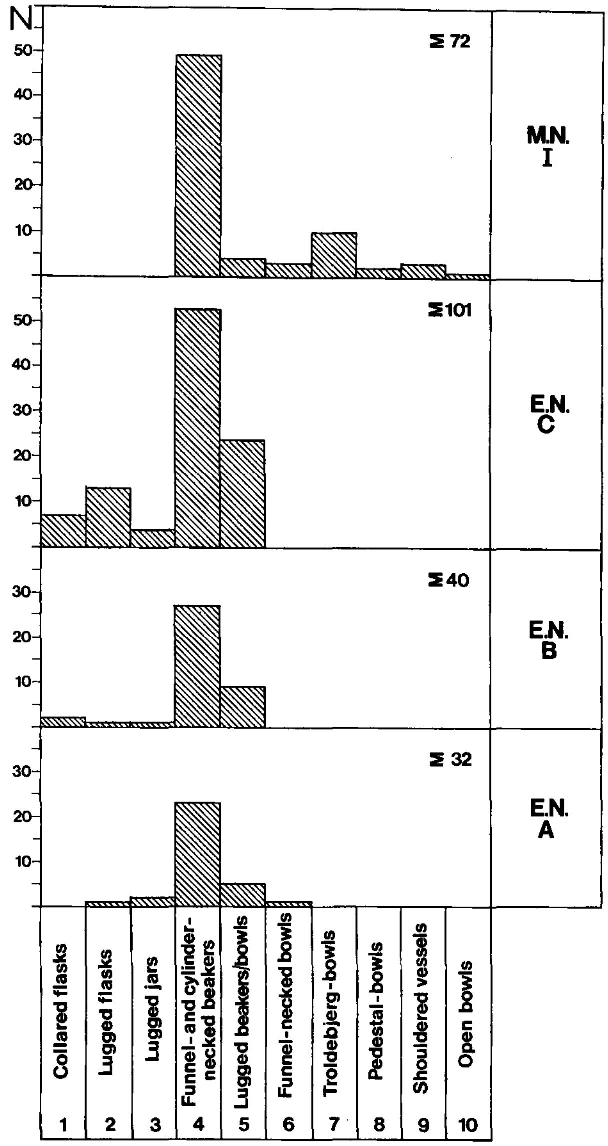

Fig. 21. The quantity of different types of vessels in the bog finds from the early neolithic and the MN I.

Conclusion: Neolithic human sacrifice

The skeleton from Sigersdal Mose represents a particular type of find: a human, found in a bog, most commonly during peat cutting. The late bronze and early iron age bodies have been objects of particular interest (Glob 1965; Lund 1976; Thorvildsen 1952, 33 ff; Fischer 1979, 7 ff; Ebbesen 1986).

The bog corpses are so well preserved purely because they were deposited in acidic water with temperatures below 4°C (Gregersen 1979, 45 ff). Bodies deposited in these same bogs during the summer have almost completey disappeared. Finds of skeletons almost all come from alkaline bogs.

There is a large number of skeletons from bogs (Becker 1947, 274 f; 1971, 27 ff; Christensen 1967, 150 ff; Fischer 1979, fig. 2; Dieck 1965; 1972, 365 ff; Bennike and Ebbesen 1985, 28 ff; Ebbesen 1986), and two more skeletons are known from the wet area that yielded the Sigersdal skeletons. Neither of these are dated, nor are

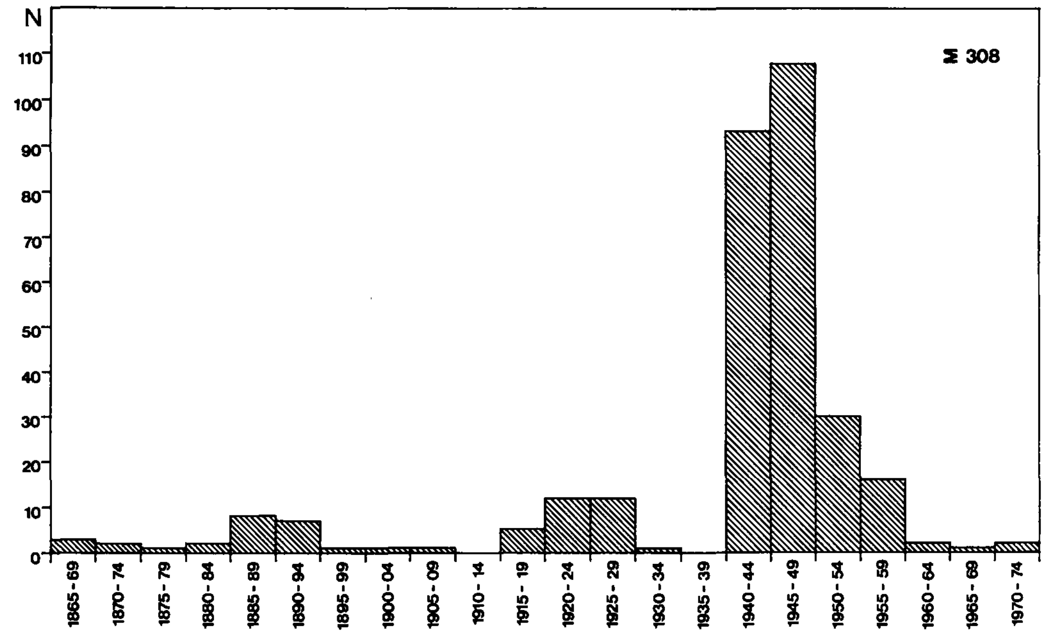

Fig. 22. The number of bog vessels according to year of discovery.

most of the other 500 or so known from Danish bogs.

The best known find is that from Porsmose, in Toksværd parish. This is of a man 35–40 years of age, who has been killed by two bone-tipped arrows, which are still lodged in his nasal fossa and sternum (Becker 1952, 25 ff). The skeleton has been radiocarbon dated to 2760±90 bc (K-3748). Like the Sigersdal individual, the Porsmose man met a violent end, but in his case there is no certainty of any cultic connection. He may equally well have been killed by an enemy and thereafter disposed of in water.

The interpretation of a male skeleton found in 1941 in a small bog near Stenstrup dairy, Højby parish, is more certain. It had a rope round its neck, the other end of which was attached to two large stones weighing 15–20 kg, the rope being wound round them several times (Bennike and Ebbesen 1985, 28 ff). This skeleton has been dated to 1600±80 bc, i.e. to late neolithic C, and most probably represents a human sacrifice.

The same is true of two early neolithic skeletons found in 1946 at Bolkilde on the island of Als.

There may be another parallel in the find from Sludegårds Sømose in Frørup parish (Albrectsen 1954, 14 ff). This is a large sacrificial find containing objects mainly from the Funnel Beaker culture. There are also parts of the skeletons of four individuals, including one skull which has clearly been struck on the temporal bone. Neither radiocarbon nor pollen dates are available, however.

Another group of bog finds comprises small heaps of human and animal bones, occasionally also containing chance admixtures of fragments of artifacts. Human bones usually only form a minor part. There can be little doubt that these depositions took place in connection with cultic activities – in this case presumably feasts where humans made up part of the menu (Becker 1947, 274 ff; Rech 1979, 48 ff; Ebbesen 1982, 75; 1986).

This practice is best documented from the early iron age (Vestergaard Nielsen 1938, 297 ff; Kunwald 1949, 13ff; 1970, 48 ff; Becker 1971, 40, note 76; 1980, 219 ff; J. and K. Ferdinand 1961, 47 ff; Simonsen 1953, 61 ff; Struve 1967, 56 f; Jankuhn et al. 1958, 189 ff; Liversage 1980, 51 f; Albrectsen 1944, 241 ff; 1946, 448; 1949, 11ff; 1974, 85 f). A couple of finds may date from period VI of the bronze age (Broholm and Fischer Møller 1934, 23 ff; Broholm 1946, M 215 a and M 221 a – the find from Radbjerg Mose, Veggerløse parish (Broholm 1946, 171 ff) is too uncertain). Some finds of this type are also known from the neolithic.

A find that has long been known must be mentioned first, that from "Myrebjerg" near Nordenbro, Magleby parish (Winther 1929, 51 ff; Broholm and Fischer-Møl-

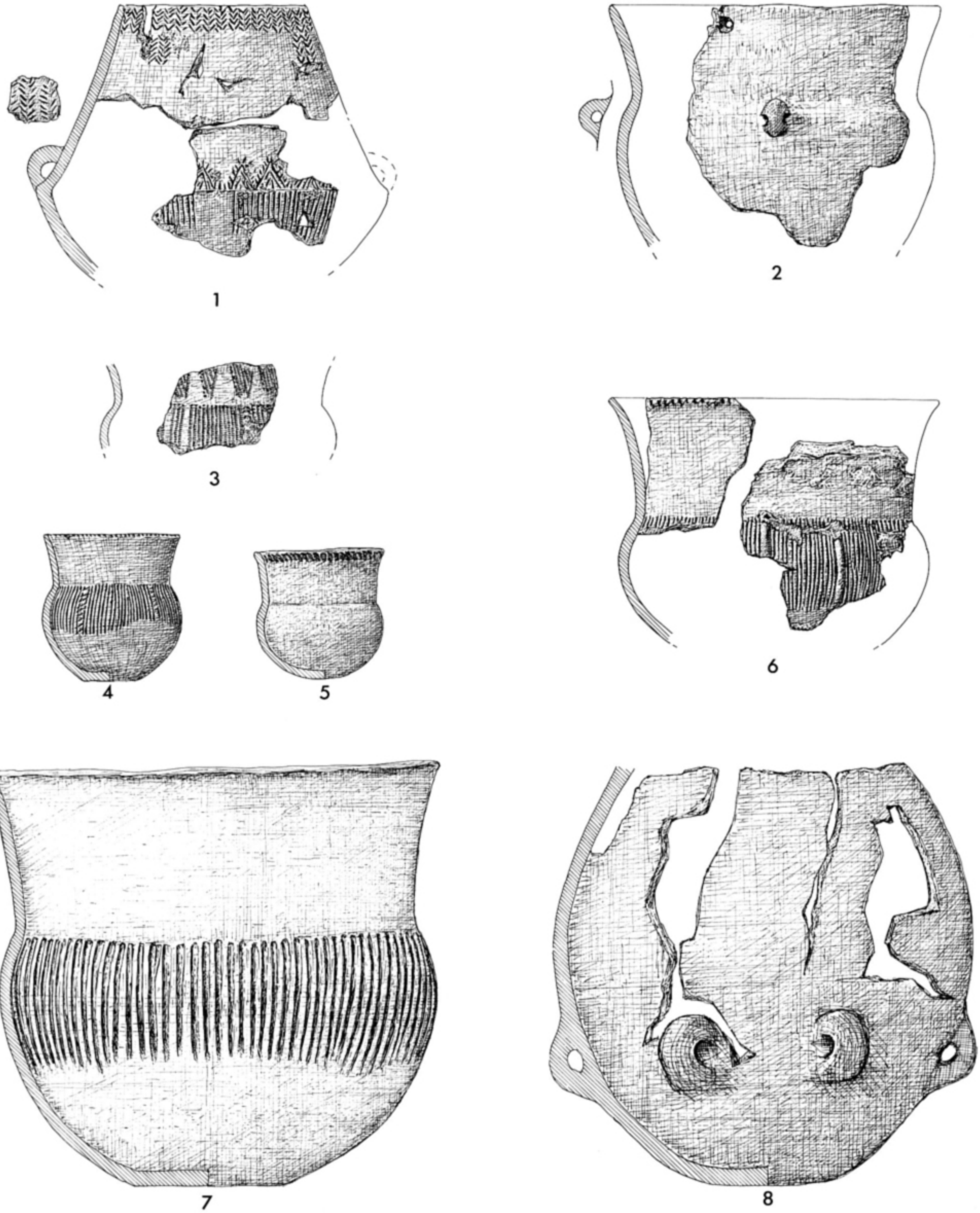

Fig. 23. Neolithic pottery from bogs (catalogue 1). Drawing: H. Ørsnes. 1:4.

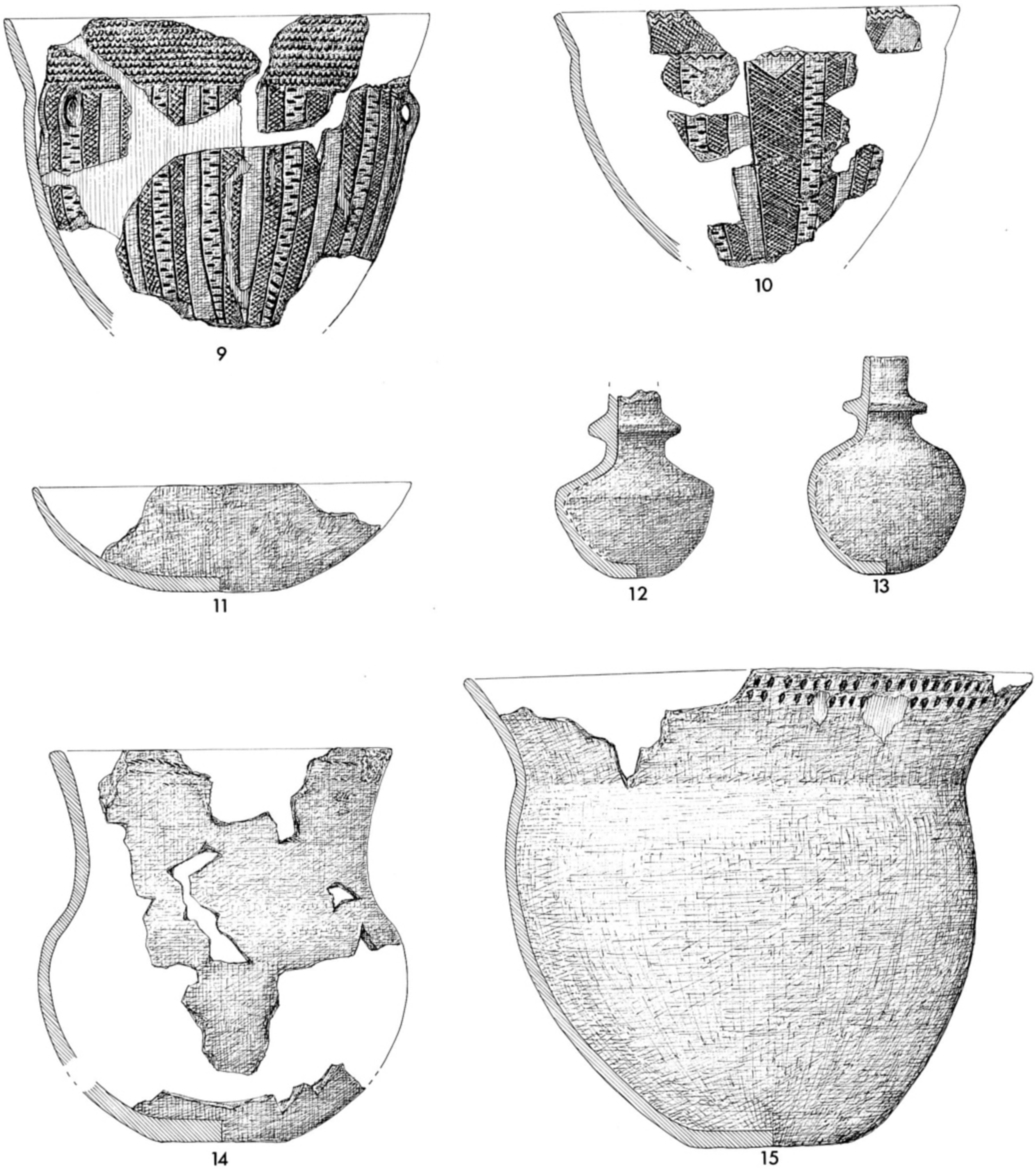

Fig. 24. Neolithic pottery from bogs, continued. (Catalogue 1). Drawing: H. Ørsnes. 1:4.

	EN A	EN B	EN C	MN I	MN II	MN III-IV	MN V	Undat.	Total
Collared flasks		2	7					13	22
Lugged flasks	1	1	13					2	17
Lugged jars	2	1	4					9	16
Funnel-and cylinder-necked beakers	23	27	53	49			2	55	209
Lugged beakes/bowls	5	9	24	4				11	53
Funnel-necked bowls	1			3				1	5
Troldebjerg-bowls				10					10
Pedestal-bowls				2					2
Open bowls				1				6	7
Shouldered bowls				3	1				4
Pendant wessels					3	1			4
Beakers/bowls with concav neck					4			7	11
Bucket-shaped wessels							2		2
Unidentified			8		1			65	74
Total	32	40	109	72	9	1	4	169	436

Fig. 25. The number of different vessel types in the bog finds from the various periods of the TRB Culture (early and middle neolithic).

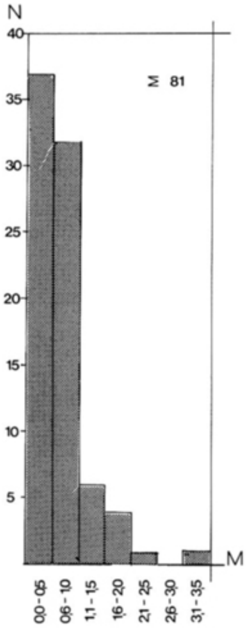

Fig. 26 (left): Depth of bog finds of hoards with thin-butted axes.

Fig. 27 (right): Year of discovery of bog finds of hoards with thin-butted axes.

ler 1934, 23 ff; Skaarup 1985, 76 f). The heap of bones includes elements from domestic cow, sheep, pig, horse and human. The human bones come from at least five different people: two children aged 3–4 years, two young persons aged 15–20 years; and an adult woman of about 25–30 years. All the bones are smashed. The find was earlier dated to the bronze age (period IV bronze items were found in peat from the same cutting); but the find contains cord ornamented pottery from early neolithic C/ middle neolithic I, and a radiocarbon date has been obtained of 2690±320 bc (K-3702). The find must thus date to early neolithic C.

A similar find is known from Føllenslev, in Føllenslev parish (Becker 1945, 167 f; 1947, 275), and a couple of other finds are described in the literature. C.J. Becker interprets them as cultic food sacrifices, a view followed by Rech (1979, 51 f) and which is also followed here.

The Sigersdal find thus provides crucial new information about prehistoric sacrificial practices. Human sacrifices, most visible in the case of the bog corpses, are not restricted to a short period in prehistory. They are known from most millennia in prehistory, and Sigersdal (the oldest find known so far) is only a few centuries later than the introduction of a neolithic economy.

Translated by Peter Rowley-Conwy

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The String from Sigersdal Mose

by LISE BENDER JØRGENSEN

Around the neck of the skeleton from Sigersdal Mose was found the remains of a piece of string – in all probability the cord with which the victim was strangled.

According to the report, the string seems to have been laid double, and twisted several times around the neck of the deceased. A knot on the string is still to be seen, but is probably partly undone: it may now at best be termed a granny knot, and would not have been able to hold anything (fig. 28–29). The string is now in 12 pieces, the longest fragment 30 cm, diameter 3 mm. It is S-plied from three Z-spun yarns, and made of vegetable fibres.

The date of the find, phase C of the Early Neolithic (*c.* 3,500 BC), calls attention to the string; organic material, especially textiles to which group the Sigersdal string must be assigned, from such an early date are very rare. From North Europe only a small group of Stone Age textiles can be listed: in Germany a Late Neolithic find from Wiepenkathen, Kr. Stade in the Elbe-Weser-Triangle and two pieces from Central Germany, both belonging to the TRB culture, Spitzes Hoch and Kreienkopp (v. Stokar 1938, p. 103, and Schlabow 1959); and from Denmark a small number of finds dated to the Ertebølle culture or the Early Neolithic.

The three finds from the Ertebølle culture are Møllegabet (Dejrø) and Skjoldnæs, both submarine settlements off the coast of Ærø (Skaarup 1980, 1981 and 1982), and a similar settlement at Tybrind Vig off the west coast of Funen (Andersen & Bender Jørgensen 1985, Andersen 1985). The two sites from Ærø both yielded pieces of string: Møllegabet a float with a piece of line still attached to it (Skaarup 1980, p. 6); Skjoldnæs an eel spear wound with lashing (Skaarup 1981, 1982 p. 166); the Tybrind Vig site has yielded several strings and plaits, together with fragments of fabric in a technique best termed ***nålebinding***, i.e. a sewing technique (Andersen & Bender Jørgensen 1985).

The Early Neolithic Period has up to now supplied three sites: Tulstrup Mose, North Zealand (Becker 1947, p. 10ff) with several pieces of string, plaits and fabrics in twined weave; Kongsted Lyng from South Zealand (Becker 1947, cat. 89, p. 42) with a piece of string, and finally the bog corpse of Sigersdal Mose.

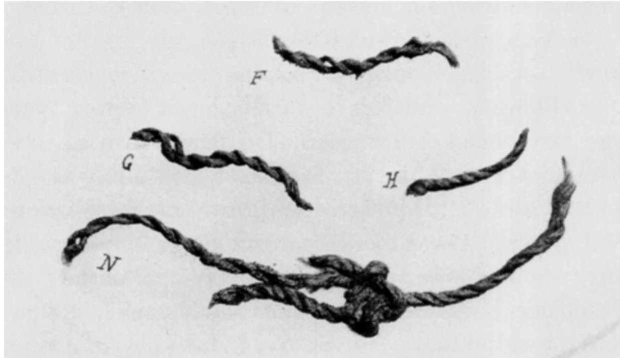

Fig. 28. Fragments of the string from Sigersdal Bog with knot. Photo: L. Larsen. 1:2.

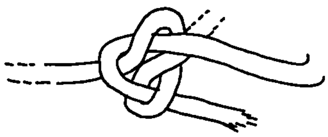

Fig. 29. Drawing of the "granny knot" from Sigersdal Bog.

The Sigersdal Mose corpse has been dated by the Carbon 14-method; the other finds here listed are all dated by archaeological means, i.e. by accompanying artefacts. The Ertebølle sites all belong to the phase Dyrholmen II (4500–4000 BC), the two Early Neolithic sites to respectively phase B (Tulstrup Mose) and C (Kongsted Lyng), i.e. within the chronological range of 4000–3400 BC. This means that all Danish samples of Stone Age textile remains date within a thousand years: appr. 4500–3400 BC; no samples from the remaining part of the Neolithic have yet been found (note 1); the next find is dated to phase 1 of the Bronze Age, i.e. after 1800 BC (Bender Jørgensen 1986, cat. D:I:1).

Late Mesolithic/Early Neolithic textiles from Denmark are still rare and very much fragmented, and fall into several categories such as string, plait and various kinds of fabric. Some features, however, are consistent: without exception all pieces have been identified as made from vegetable fibres; and similarly, they are all Z-spun (and sometimes consequently S-plied).

The next chronological group of Danish textile finds, from the Early Bronze Age, are always made of wool. They have S-spin as a normal feature; most fabrics have S-spun warp, Z-spun weft, some have S-spin in both systems. The latter combination becomes the rule in the Late Bronze Age and in the Pre-Roman Iron Age.

The vegetable fibres of the Stone Age textiles are usually very much decayed and therefore they are difficult to identify according to species. Some fabrics, however, have been determined: Tulstrup Mose as lime bast (Becker 1947, p. 10f); Tybrind Vig possibly as willow bast (note 2); Skjoldnæs possibly as nettle (Skaarup 1982, p. 166). These identifications suggest that a wide range of basts were exploited by the people of the Late Mesolithic/Early Neolithic, most likely closely adjusted to the individual purpose. Wool fibres have not been found; considering the small sample of finds this may be accidental, but it is more likely because woolly sheep had not yet been introduced in North Europe in the period in question. Sherratt has argued (1983) that wool first was introduced in North and Central Europe in the 3rd millenium BC, probably in a Corded Ware Culture context; this suggestion fits well into the pattern presented by the Danish material.

The second common feature of the Danish Stone Age textile remains, the Z-spin, may perhaps be seen as a feature of the vegetable fibres. In more recent times, the preparation of wool and vegetable fibres demanded very different sets of tools, and it seems a reasonable interpretation that S-spin was introduced in North Europe with the new fibre material.

The string fragments from Sigersdal may look rather sorry and insignificant; but in connection with other similar remains from the period around the transition between the Mesolithic and the Neolithic they may be fitted in as a useful piece in the great puzzle of Prehistory.

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NOTES

1. A find from Øksenbjerg on Funen, published by S. Müller in 1913, has often been quoted as a sample of linen cloth from the Early Neolithic Period. In 1979, E. Munksgaard showed that the piece in question was neither linen nor Neolithic (Munksgaard 1979).
2. Letter of 13/11-1985 from B. Lorentzen & A. M. Rørdam, Danmarks Farmaceutiske Højskole, to Else Østergaard of the Textile Conservation Laboratory of the National Museum.

ACKNOWLEDGEMENTS

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The work on textile remains is part of a research project on North European textiles supported by a grant from the Carlsberg Foundation.

Catalogue I

Notes to illustrations and maps

Fig. 2 (sb = parish inventory number)
Respectively Stenløse parish, sb 88 (Kunwald 1949, 11 ff, upper); sb 102 (surface find in private collection); sb 16 (NM I A 49.327, B 15.326–27 and C 29.911–12. Aner and Kersten 1973, 89 ff); sb 17 (Langben Rises Grav, a passage grave completely destroyed in 1875, regarded by Müller in the same year as constructed under an artificial mound); sb 12 (Langben Rises Dysse). In 1975 the long dolmen was surrounded by 32 kerbstones, of which 4 were to the east, 3 to the west. The middle one of these was the highest. Towards the west end was a chamber under a mound, constructed of 4 supporting stones and one capstone. The chamber is said to have contained human bones and a clay vessel, and stone implements near the kerbstones); sb 45 (the dolmen "Lindebjerg"). Also Veksø parish, sb 19 (Skadedyssen, a low mound surrounded by kerbstones and with 3–5 large stones in the centre). The other two skeletons from the wet area are no. 90 in Stenløse parish (NM I j. 632/44) and no. 42 in Veksø parish (NM I j. 589/46, a woman of 20–30 years, lying on her back with her head to the northeast).

Fig. 17 (sb = parish inventory number)
The hoard from Sigersdal, Stenløse parish (sb 88). NM A 40.250–61. Kunwald 1949, 3 ff; Nielsen 1975, list I no. 14. The find was made during peat cutting in 1942. The axes lay close together, about 1.5 m deep, near the northern edge of the bog. It was not observed how they lay. The find originally consisted of 13 axes, of which only 12 were handed over: 1) a heavy flint axe, polished on all surfaces, with a sharp butt. The edge shows traces of use, and there is a "gringing error" on one of the broad surfaces. The edge is secondarily reworked, maybe after being damaged. Length 16.5 cm, edge width 7.8, butt index 6.0 × 2.4 cm, greatest thickness 3.3/9.5 (2.6) cm, weight 625 g. 2) a heavy flint axe, polished on all surfaces, with unworked butt. There is an area of cortex on one of the broad surfaces. Length 24.5 cm, edge width 6.9 cm, butt index 4.7 × 2.0

cm, greatest thickness 3.0/13.2 (1.5) cm, weight 700 g. 3) a heavy flint axe, polished on all sides, with a sharp butt. Length 26.8 cm, edge width 6.7 cm, butt index 4.4 × 2.5 cm, greatest thickness 3.4/13.0 (1.5) cm, weight 875 g. 4) a heavy thin butted flint axe with sharp butt, polished on all surfaces. One broad surface has large unpolished areas. The corners of the edge have been damaged, probably in recent times. Length 24.6 cm, edge width 7.0 cm, butt index 3.7 × 2.5 cm, greatest thickness 3.3/12.3 (1.6) cm, weight 810 g. 5) a heavy thin butted axe with sharp, worked butt, polished on all surfaces. It seems unused. Length 29.2 cm, edge width 6.6 cm, butt index 4.3 × 2.2 cm, greatest thickness 3.3/14.5 (1.8) cm, weight 975 g. 6) a heavy thin butted flint axe with partially worked butt, polished on all surfaces. It seems unused. Length 33.1 cm, edge width 5.5 cm, butt index 4.1 × 2.6 cm, greatest thickness 3.5/16.5 (2.0) cm, weight 1200 g. 7) a heavy thin butted flint axe with sharply worked butt, polished on all surfaces. It seems unused. Length 31.5 cm, edge width 7.1 cm, butt index 4.8 × 2.2 cm, greatest thickness 3.3/16.0 (1.6) cm. 8) a heavy thin butted flint axe with sharply worked butt. The piece is polished on all surfaces, but not at the base near the butt. Length 28.8 cm, edge width 6.8 cm, butt index 4.3 × 2.1 cm, greatest thickness 3.5/19.3 (1.6) cm, weight 975 g. 9) a heavy thin butted axe with sharp butt, polished on all surfaces. There is a little cortex at the butt. One corner of the edge has been removed by retouch. Length 32.7 cm, edge width 6.4 cm, butt index 4.7 × 2.1 cm, greatest thickness 3.7/17.5 (2.1) cm. 10) a heavy thin butted axe with sharp butt, polished on all surfaces. There is a patch of cortex on one of the broad surfaces. It appears to be new; one corner of the edge has been damaged in recent times. Length 26.2, edge width 6.6 cm, butt index 4.7 × 2.3 cm, greatest thickness 3.6/14.7 (1.8) cm, weight 800 g. 11) a heavy thin butted axe with sharply worked butt, polished on all surfaces. It seems new. Length 29.4 cm, edge width 6.8 cm, butt index 5.0 × 2.4 cm, greatest thickness 3.3/15.6 (1.6) cm, weight 1000 g. 12) a heavy thin butted flint axe with flat, worked neck, polished on all four surfaces. There is a patch of cortex on one broad surface. The piece seems new. Length 28.9 cm, edge width 7.3 cm, butt index 5.6 × 2.3 cm, greatest thickness 3.2 × 15.0 (1.6) cm, weight 1025 g.

Figs. 23–24. Pots found in bogs.

1. Rudegård, Munkebjergby parish. NM A 50.623. Reference: below, list I, 49. Most of a shouldered hanging vessel with only one lug preserved. There are 4 or 5 stamped chevrons under the rim, and under these rows of vertical double chevrons on the upper part of the neck. The same is found on the lug. On the shoulder and at the base of the neck is a row of 3 standing triangles, surrounded by short stokes to the sides. The upper part of the belly is decorated with groups of vertical incised lines. Rim diameter 12.5 cm, height 18 cm.
2. Torbenfeldt Mose, Tømmerup II, Undløse parish. NM A 39.666. Reference: Becker 1947, no. 36.2. Sherd of undecorated lugged beaker with one lug preserved at the transition from neck to belly. Repair hole under the rim. Rim diameter c. 22 cm.
3. Magleby Lyng I, Magleby parish. NM A 39.329 c. Reference: Becker 1947, no. 80.7. Sherd of lugged funnel beaker (type C). On the belly are broad groups of vertical lines, interspersed with narrow smooth areas or rows of vertical incisions. On the neck is a design probably consisting of hanging triangles on one side, bounded by a row of round impressions. The decoration is carried out with whipped cord.
4. Sperrestrup, Ølstykke parish. NM A 41.674. Reference: below, list I, 13. A nearly complete funnel beaker with short, offset neck and high rounded belly. There are oblique incisions on the outer part of the rim. On the belly are vertical strips, interrupted in five places by vertical rows of oblique strokes. Height c. 9.7 cm, rim diameter 9.2 cm, basal diameter 3.5 cm.
5. Salpetermosen, Frederiksborg Slots parish. NM A 41.161. Reference: Becker 1947, no. 10.3. A nearly complete miniature funnel beaker (type B). The neck is funnel shaped, with marked transition to the round belly. Under the rim is a horizontal row of faint seicircular impressions. Height 8.5 cm, rim diameter c. 8.0 cm.
6. Jordløse Mose V, Jordløse parish. NM A 40.215. Reference: Becker 1947, no. 59.4. Two sherds of a funnel beaker (type C). There is a lip around the rim, with nail impressions in it. On the upper part of the belly are spaced, vertical three-dimensional mouldings, and between them vertical incised lines to cover the spaces. Rim diameter c. 23 cm.
7. Tømmerup Mose III, Undløse parish. NM A 42.049. Reference: below, list I, 28. A complete funnel beaker, with a hint of a lip on the funnel shaped neck, the transition to the rounded belly being not strongly marked (type C). On the upper part of the belly is a decoration of coarse vertical lines. Height 27.5–28.5 cm, rim diameter 30–31 cm, basal diameter 10.0 cm.
8. Maglelyng III, Stenmagle parish. NM A 47.408. Reference: below, list I, 52. Most of an undecorated lugged beaker with flat base and originally 6 lugs c. 9.0 cm above the base. Height 28.0 cm, basal diameter about 8.0 cm.
9. Rørlykke Mose I, Tryggelev parish. NM A 8231. Reference: Becker 1947, no. 123. Parts of a Troldebjerg bowl, originally with two double lugs opposite each other on the upper part of the belly. The neck is slightly concave, the transition to the belly abrupt. On the neck are 8–9 horizontal rows of crescentic incisions. On the belly is a repetitive design of vertical triple bands, the middle filled with zipper motif, the outer ones with cross hatching. The decoration continues up over the lugs. Rim diameter c. 29–30 cm, height 21 cm.
10. Salpetermosen, Frederiksborg Slots parish. NM A 41.161. Reference: Becker 1947, no. 10,3. Fragments of a funnel bowl with smoothed surface, short funnel shaped neck, and with its maximum diameter at a point high on the belly. Under the rim and on the upper part of the belly are respectively 2 and 1 rows of horizontal, stamped chevrons. On the neck are alternating areas of smoothed surface and cross hatching. On the inside are two horizontal

rows of vertical, stamped strokes. The belly is decorated with alternating zones of vertical cross hatching, zipper motif and smoothing. One of the cross hatched zones is topped by a smoothed hanging triangle. Rim diameter 27.5 cm, height 17 cm.

11. Jordløse Mose XXI, Jordløse parish. NM A 40.220. Reference: Becker 1947, no. 75. Sherd of an open bowl with evenly convex sides and rounded base. Height c. 7.2 cm, rim diameter 26.0 cm.
12. Sølperup Mose I, Snesere parish. NM A 39.654. Reference: Becker 1947, no. 92. Most of an undecorated collared flask, with the neck broken off. The belly is nearly biconical, the upper part being higher, and with a flat base. There is a collar on the lowest part of the neck. Height 13.0 cm, basal diameter 3.0 cm, greatest diameter 11.0 cm, collar diameter 6.0–6.8 cm.
13. Gerrild, Gerrild parish. NM A 39.154. Reference: Becker 1947, no. 34. A nearly complete undecorated collared flask, with nearly globular belly and cylindrical neck, in the middle of which is the collar. The belly/neck transition is gentle. Rim diameter c. 3.2 cm, height 15.0 cm, collar diameter 6.0 cm.
14. Jordløse Mose III, Jordløse parish. NM A 40.626. Reference: Becker 1947, no. 57. Most of a funnel beaker with smoothed surface, flat base, and evenly curved transition from neck to belly (type B). Under the rim are 1–3 skilfully executed horizontal lines of whipped cord impression. Height 26–27 cm, rim diameter c. 25.0 cm.
15. Magleø, Stenlille parish. NM A 49.256. Reference: below, list I, 25. A slightly crooked funnel beaker (type A), almost complete. The short neck is considerably offset from the belly. The base is flat. There are two horizontal rows of finger impressions under the rim. Rim diameter c. 39–40 cm, basal diameter c. 11 cm, height c. 32 cm.

Catalogue II

Early and middle neolithic pottery found in wet areas

A review of the finds up to 1946–47 is given by Becker (1947, 10 ff). This can still be used, although as mentioned pot nos. 25; 62,2; 95,1; 137; 142, 3–4; and 149 date to later parts of the neolithic, and nos. 55,3; 61,1; 95,3–4; and 142,5 (in part) can only be dated to the neolithic in general. More recent work on pottery also means that a few finds must be redated and a few other changes made to Becker's list. Thus nos. 74,6–7; 88,2–3; and 135,4–5 represent only a single pot, the latter two respectively a hanging vessel and a lugged bowl. No. 125 represents 2 different lugged beakers, while no. 142 also includes fragments of two funnel beakers, one dated to early neolithic C. Find no. 7 comprises 12 different pots in all, one an undecorated lugged vessel.

Nos. 4,2; 36,2 and 37,2 are lugged beakers, as are nos. 110 and 152 which Becker called lugged vessels. Nos. 145 and 151 are funnel beakers, while no. 130 is a cylindrically necked beaker; no. 108 is however a funnel bowl. Nos. 66,9 and 83,6 are Troldebjerg bowls; no. 54 is a lugged bowl; no. 80.1 is a hanging vessel; no. 83,2 a middle neolithic II beaker with concave neck; no. 62,6 a bucket-shaped pot; and no. 102,2 an undeterminable pot.

Nos. 41,46 and 122,1 must belong to the A group; 10,1–2; 35; and 127 to the B group; nos. 12; 44,1; 102; 124,2; 141; and 159,4 to the C group. No. 122,2 can be dated to early neolithic C/middle neolithic Ia; nos. 1,3; 28,2; and 59,2 to early neolithic C/middle neolithic I. Nos. 93, 104, 108 and 131 can be dated to middle neolithic I, and no. 62,6 to MN V. Nos. 20; 37,2; 40; 43; 48,2; 51,4; 52,3; 59,5; 62,3–5; 63; 66,3; 68,2; 69,2; 70,1–2; 72,1; 73; 75; 76,2; 79; 83,3–4; 90; 101; 110; 120; 135,2; 145; and 151 are so uncharacteristic as to be dated to any of the period's styles or phases.

A number of other finds have appeared. Some from Åmosen have been published by Troels-Smith (1953, figs. 10–14). 110 other finds were also made up to 1980. (In the following sb = parish inventory).

1. Øverup Mose, Esbønderup parish (GIM O 1320). Funnel beaker with vertical bands on the belly (type C). Bog find.
2. Øverupgård, Esbønderup parish (GIM O 1252). Funnel beaker with pricked decoration at the neck/ belly transition (type C/D). Bog find.
3. Tisvilde Bymose, Tibirke parish (GIM O 1022). Undecorated funnel beaker (type B). Found in the bog with two other pots. They stood upright, 10–15 cm apart.
4. Manderup Søgård, Skibby parish (sb 60 – NM A 35.562–65 and A 41.169).
(a) undecorated collared flask (early neolithic A?).
(b) funnel beaker with pricked decoration under the rim (type A or Svaleklint group). Found in a natural shell bank at different times. Animal bones and a fragment of amber were found with (a).
5. Manderup Søgård II, Skibby parish (sb 58, – NM A 44.483–84). Two undecorated funnel beakers (type A). Found during shell digging.
6. Salpetermosen II, Frederiksborg rural parish (private ownership, NM j. 453/61). Funnel beaker with vertical bands on the belly, and lines of chevrons under the neck (type D). Found in bog.
7. Roskilde Fjord, near Krp. Frederiks Bro, Frederiksund (NM A 49.576). Undecorated lower part of pot (undated). Found during shell digging.
8. Sperrestrup Mose, Jørlunde parish (NM A 42.168). Fragments of a funnel/lugged beaker, decorated with wound cord impressions (type C/D). Found in a bog, which has also yielded human bones.
9. Roskilde Fjord I–II, off Kølholmen or Marbæk, Oppe-Sundby parish (sb 15–16 and 23. NM A 44.730–37, A 44.729, A 49.680, A 50.419, A 50.438).
(a) a small, undecorated funnel beaker (type A).
(b) a magnum funnel beaker, with horizontal chevrons on the neck, groups of vertical lines on the belly, and a three-dimensional moulding on the neck/belly transition (type D).

(c) a funnel beaker with horizontal chevrons on the neck and vertical bands on the belly (type D).
(d) similar funnel beaker (type D).
(e) neck fragment of a funnel beaker with horizontal chevrons under the rim and at the bottom of the neck (type D).
(f) Cylinder neck beaker (?), decorated on the neck and belly with identical designs of alternating vertical and horizontal lines (Svaleklint group).
(g) Undecorated lugged beaker with 4 lugs at the neck/belly transition (type B).
These pots were found at various times during shell digging in a quite large area of the fjord, along with 3 flint axes, a chisel and a blade. The find is in private hands. Reference: Davidsen 1983, 127 f.

10. Gl. Strandvej 440, Egesbækvang parish (FLE not numbered). Funnel beaker with vertical bands on the belly (type C). Found in a layer of peat near 12 blades and a thick butted axe. Reference: Anon. 1962, 4 (illustration).
11. Stenlille Mose, Stenløse Parish (sb 97, privately owned, not seen). Fragments of a funnel beaker with vertical bands on the belly and pits under the rim (type D?). Found in bog.
12. Sigersdal Mose, Stenløse parish (sb 110, – NM A 44.101). Undecorated lugged vessel (type C). Found during peat digging. Animal bones were found in the vicinity, and two human skeletons, see the present article.
13. Sperrestrup, Ølstykke parish (NM A 41.673–74).
(a) fragments of a magnum funnel beaker with pricked decoration below the rim (type A).
(b) small funnel beaker with strokes on the rim and vertical bands on the belly, interrupted in places by vertical lines with transverse strokes. Found in peat digging together with a thick butted axe and the handle of a dagger. The objects were found c. 2.5 m deep, spread over an area about 10 m across. Reference: Ebbesen and Larsen 1978, fig. 13.1, note 7. – above, fig. 23.4.
14. Ejby Mose, Ejby parish (sb 3 – NM A 42.050). Sherd of undecorated magnum lugged beaker (undated). Found by itself, about 2 m down in the bog. Reference: Ebbesen and Larsen 1978, note 20, fig. 13.2.
15. Toftegård, Ørsted parish (sb 5 – NM A 47.391). Two undecorated body sherds (undated). Found 1 m deep in a bog.
16. Søndersø Mose, Værløse parish (private ownership, NM j. 692/42, not seen). Funnel beaker with vertical bands on the belly and chevrons under the rim (type D). Found during peat cutting.
17. Skatholm, Værløse parish (NM A 38.869). 22 undecorated body sherds (undated). Found in peat from the farm.
18. Posemandens Hus, Gentofte parish (NM A 33.817a). Fragment of funnel beaker with vertical bands on the belly and pricked decoration under the rim and at the neck/belly transition (type D). Found together with some animal bones in spoil removed from a ditch through a bog.
19. Harrestrup River, Vigerslev parish (NM A 39.280). Fragmentary funnel beaker with vertical bands on the belly (type C/D). Found during cleaning of the river.
20. Fællesskovgård, Buerup parish (sb 101, NM A 46.136–39).
(a) fragment of a lugged flask with vertical bands on the belly.
(b) belly sherd with vertical three dimensional mouldings.
(c) lug with three dimensional mouldings, possibly from the same pot as (b).
Found in a small bog together with an unpolished flint axe.
21. Langedamsgård, Ulstrup, Gørlev parish (KAM 10.931).
(a) an undecorated neck sherd.
(b) a fragment of an undecorated lugged bowl (type B).
Both found during digging in the bog.
22. Sønderød Mose, Rerslev parish (sb 55, – NM A 43.327). Funnel beaker with two horizontal lines of cording under the rim (Svaleklint group). Found during peat digging. Reference: Becker 1949, 11).
23. St. Åmose, Nidløse parish (NM A 39.855). Neck/belly sherd decorated with horizontal rows of round impressions (Svaleklint group?). The pot was complete when removed from the bog.
24. Skuerup Mose, Stenlille parish (sb 35, – NM A 43.009). Lugged vessel, with whipped cord decoration under the rim and on most of the belly. Found during peat cutting, over 1 m deep. Reference: Ebbesen and Mahler 1979, note 74, fig. 19.1).
25. Magleø, Stenlille parish (NM A 49.256–57).
(a) magnum funnel beaker with two horizontal rows of finger impressions under the rim (type A).
(b) undecorated, crudely made open bowl (undated).
Found during peat cutting close to each other. Reference: above, fig. 24.15.
26. Øgårde, Undløse parish (sb 57, – NM A 42.704–5).
(a) funnel beaker with vertical bands on the belly and chevrons under the rim (type D).
(b) fragment of a Troldebjerg bowl, with horizontal lines below the rim, and under these zones of cross hatching and crescentic impressions (middle neolithic Ib).
Found c. 7 m from each other in the spoil thrown up from a drainage ditch.
27. St. Åmose, Undløse parish (sb 59, – NM A 43.320–26).
(a) fragmentary funnel beaker with horizontal lines of cording under the rim (Svaleklint group).
(b) undecorated beaker with concave neck.
(c) sherds of undecorated open bowl with convex sides.
(d) undecorated sherds of pot with concave neck.
Found during digging of drainage ditches, together with an axe haft and a human skeleton. Reference: Becker 1949, fig. 7–8.
28. Tømmerup Mose III, Undløse parish (NM A 42.049). A magnum funnel beaker with vertical bands on the belly (type C). Found during peat digging, standing close to several other pots, not preserved.

29. Asnæs, Asnæs parish (sb 393 – NM j. 1003–75 not seen). An early funnel beaker found during peat digging.
30. Veddinge Mose, Fårevejle parish (sb 496, NM A 49.458). A funnel beaker with strokes on the rim and vertical bands on the belly (type C). Found on the surface of the bog, at a spot where peat had been dug earlier.
31. Holte, Grevinge parish (sb. 284 – NM A 46.310). Rim sherd of funnel beaker with vertical three dimensional mouldings under the rim (undated).
32. Føllenslev, Føllenslev parish (sb 99 – NM A 42.166–67). About 30 undecorated sherds, probably from a funnel beaker. Found in a small bog; 30 m away a heap of bones was found, consisting of human bones and the skull of a goat.
33. Sandhuse Mose, Jordløse parish (sb 105 – NM A 42.026–27a).
(a) fragment of a funnel beaker with vertical bands on the belly (undated).
(b) fragment of a funnel beaker with undulating beading under the neck and vertical bands on the belly (type D).
(c) sherd of funnel beaker with groups of vertical lines and three dimensional mouldings on the belly (undated).
Found together with a few pieces of flint, including a blade, within an area 10 m across which contained many sherds.
34. Jordløse Mose XXIII, Jordløse parish (sb 84 – NM A 41.714). Body sherds of funnel beaker (?) with vertical bands (undated). Found about 2 m deep, during peat digging.
35. Jordløse Mose XXIV, Jordløse parish (sb 85 – NM A 42.023). Sherd of undecorated pot (early neolithic). Found c. 2 m dow, during peat digging.
36. Jordløse Mose XXV, Jordløse parish (sb 93 – NM A 41.896). Fragment of undecorated funnel beaker (undated). Collected from a 5 m^2 area in the bog.
37. Jordløse Mose XXVI, Jordløse parish (sb 97 – NM A 42.031). Two undecorated body sherds from different pots. Found during peat cutting.
38. Jordløse Mose XXVII, Jordløse parish (sb 99 – NM A 42.030). Fragment of pot with applied boss under the rim, with a finger impression in it (undated). Found about 0.7 m down in the bog.
39. Jordløse Mose XXVIII, Jordløse parish (sb 100 – NM A 42.028–29).
(a) most of an undecorated lugged beaker (early neolithic).
(b) sherd of pot with round impressions below the rim (middle neolithic I/II?).
Found in a restricted area during harrowing.
40. Jordløse Mose XXIX, Jordløse parish (sb 116 – NM A 42.835). Undecorated pot base. Found during peat digging.
41. Jordløse Mose XXX, Jordløse parish (KAM, not numbered). Fragmentary funnel beaker with pricked decoration under the rim (early neolithic A). Bog find.
42. Jordløse Mose XXXI, Jordløse parish (NM A 42.706–7).
(a) funnel beaker with chevrons below the rim, and vertical bands of the belly (type D).
(b) fragmentary funnel beaker with horizontal oblique strokes below the rim and vertical groups of lines on the belly (type D).
(c) rim sherd of funnel beaker with vertical strokes under the rim (undated).
Found during peat digging, with an animal bone said to have been inside (a). The pots were near the base of the peat, in a layer with small mussel shells.
43. Jordløse Mose XXXII, Jordløse parish (NM A 45.889). Rim sherd of funnel beaker with horizontal lines of cording under the rim (undated). Found during peat digging.
44. Jordløse XXXIII, Jordløse parish (NM A 49.258). Funnel beaker with oblique strokes under the rim and groups of vertical lines on the belly (type D). Found during peat digging together with a large number of other pots, all now lost.
45. Kundby Mose, Kundby parish (NM A 47.959). Fragment of cylinder neck beaker with round impressions under the rim and vertical bands on the belly (middle neolithic I). Found during harrowing.
46. Arnakkegård, Svinninge parish (NM A 41.670–72).
(a) undecorated funnel beaker (type B).
(b) neck sherds of funnel beaker with pricked decoration under the rim (undated).
Found during digging for shells, about 15 m apart. Reference: Becker 1949, fig. 4.
47. Svinninge Vejle, Svinninge parish (private collection, to be published by K. Davidsen, to whom thanks are due for the information). Sherd of lugged beaker (?), decorated with horizontal rows of vertical strokes and rectangular impressions (Svaleklint group). Found during shell digging.
48. Suserup, Lynge parish (sb 63 – NM j. 627/53 not seen). A collared flask, found in peat cutting.
49. Rudegård, Munke-Bjergby parish (NM A 50.623). Hanging vessel (middle neolithic III). Found in peat during ploughing of a patch of bog. Reference: above, fig. 23,1.
50. Maglelyng I, Stenmagle parish (sb 221 – NM A 49.818–20).
(a) funnel beaker, decorated with a horizontal row of pricked decoration under the rim (type A).
(b) funnel beaker, decorated with two horizontal rows of faint pricked decoration under the rim (type A).
(c) Most of an undecorated lugged vessel with four lugs, opposite each other at the height of maximum diameter (type B).
Found in peat digging. (b) and (c) were about 1 m down and c. 4–5 m apart, with the funnel beaker on one end of a split piece of wood. At its other end were some goat bones. (a) was found where harrowing had been carried out.
51. Maglelyng II, Stenmagle parish (sb 216 – NM A 44.340–43).
(a) funnel beaker with vertical bands on the belly (type C).

(b) funnel beaker with horizontal rows of vertical strokes under the rim (type B).
(c) funnel beaker decorated with cord impressions; crescents under the rim, vertical lines on the belly (type C).
(d) sherd of undecorated lugged beaker (undated).
(e) sherd of lugged flask (?) with three dimensional mouldings on the upper part of the belly.
(f) sherd of an undecorated lugged vessel (undated).
(g-h) three undecorated body sherds of at least two vessels. Traces of lugs are visible on two of them.
The near complete pots were standing close together, with the sherds a few metres away. Reference: Ebbesen and Mahler 1979, note 78, fig. 20–22.

52. Maglelyng III, Stenmagle parish (sb 216 – NM A 47.408–13).
(a) lower part of an undecorated lugged vessel.
(b) c. 13 sherds of a funnel beaker with three dimensional mouldings under the rim.
(c) rim sherds of a pot with a horizontal row of pricked ornamentation under the rim (undated).
(d) two sherds, possibly from a funnel beaker with two horizontal lines of cording under the rim (undated).
(e) three sherds, possibly of a funnel beaker. Under the rim are two rows of pricked impressions, under which are vertical rows of the same (undated).
(f) sherds, including a rim sherd, possibly of an undecorated funnel beaker (undated).
(g) undecorated neck/belly sherd from a pot with concave neck (undated).
(h) undecorated rim sherd of (?) funnel beaker (undated).
(i) neck/belly sherd of a (?) funnel beaker (undated).
(j–k) a rim sherd, 3 base sherds and about 140 undecorated body sherds, representing at least two more pots.
Found dispersed in a restricted area of peat litter.

53. Maglelyng IV, Stenmagle parish (sb 216 – NM A 44.344–47).
(a) undecorated fragment of a lugged vessel (undated).
(b) rim sherds of a funnel/cylinder necked beaker with short strokes under the rim.
(c) fragments of undecorated pottery.
Found during harrowing, together with a stone axe and a flake axe, on the surface.

54. Maglelyng V, Stenmagle parish (sb 240 – NM A 45.154). Rim sherds of a funnel beaker; under the rim is a horizontal row of beading with finger impressions (undated). From the bog.

55. Broby Mose, V. Broby parish (NM A 34.513–16). A lugged beaker, with horizontal and vertical lines under the rim, only vertical ones on the belly, all in whipped cord (type C). Found in a bog together with a thick butted axe and two axe roughouts.

56. Hørsø Mose, Jystrup parish (sb 7 – private collection, NM j. 713/56). A undecorated lugged beaker (type A). Reference: Ebbesen and Mahler 1979, note 45, fig. 16. Found during peat digging.

57. Sørbylille Mose III, Sludstrup parish (SAM 400). Funnel bowl, decorated under the rim with a band of chevrons, and below this chevrons in stab-and-drag technique. On the belly are vertical groups of lines, alternating with vertical rows of pricked decoration (middle neolithic I). Found lying on its side at the bottom of the peat layer. Reference: Ebbesen 1971, 19 ff, fig. 1 (the drawing shows the reconstructed pot, and is not precisely accurate as it was one of the first drawings of an artifact I ever did).

58. Nr. Mern, Mern parish (sb 60 – NM A 42.696). Funnel beaker, decorated on both neck and belly with a design of horizontal and vertical lines in stab-and-drag (Svaleklint group). Found by itself in a bog, although c. 10 m away 4 sheep skulls were found.

59. Kulsø, Vordingborg rural parish (sb 89 – NM A 42.697–703).
(a) lugged beaker with lugs under the rim. Decorated with cord impressions under the rim and on the upper part of the belly, mainly in the form of vertical lines (type C).
(b) fragment of a funnel/lugged beaker, decorated on the belly with vertical lines and on the neck with a row of chevrons, formed with whipped cord (type C).
(c) three neck sherds, decorated with shipped cord impressions.
(d) neck/belly sherd of a pot decorated with vertical lines of stab-and-drag.
Found together with a bone point, spread out over a patch of bog which had earlier yielded an unpolished thin butted axe and a thick butted hollow ground axe. Reference: Ebbesen and Mahler 1979, note 79, fig. 23.

60. Lilliendal, Ø. Egesborg parish (NM A 39.974). 4 undecorated body sherds of a (?) funnel beaker. Found together with some animal bones in a small bog.

61. Havnelev, Havnelev parish (sb 14 a – NM 50.348). Funnel beaker with pricked decoration in the rim, and vertical bands on the belly (type C). Found in a depression.

62. Sigerslev Mose, St. Hedinge parish (sb 36 – NM A 42.051–57).
(a) lugged flask with vertical three dimensional mouldings on the belly (type C).
(b) fragment of a lugged flask with vertical three dimensional mouldings on the belly (type C).
(c) fragment of lugged beaker, decorated on the neck with horizontal zones of vertical strokes alternating with round pricked decoration (Svaleklint group).
(d) body sherd of a vessel decorated on the belly with vertical lines of whipped cord impression (early neolithic C).
(e) fragment of undecorated lugged vessel (undated).
(f) undecorated rim sherd.
(g) body sherd (of lugged beaker?) decorated with whipped cord impressions (early neolithic C).
(h) 2 sherds, possibly from an undecorated lugged vessel (undated).
(i) undecorated rim sherd.
(j) 3 undecorated neck sherds from one pot.

(k) 2 undecorated basal sherds, 2 undecorated neck sherds, one body sherd, 1 ribbon shaped lug and 18 undecorated body sherds, from at least one more pot.
Found near the northern edge of the bog. There was a dug out canoe surrounded by branches, stones and pot sherds.

63. Tryggevælde River, Præstø county (KØM, not numbered). Fragment of funnel beaker with vertical bands on the belly (type C). Found in the river.
64. Ravnstrup, Glumsø parish (NM A 44.769). Fragment of a funnel beaker (type A). Found in a small bog.
65. Skørringe Lyng, Falkerslev parish (sb 4 – NM A 42.063–64).
(a) fragment of lugged beaker, decorated on the neck and belly with double cord impressions (type C).
(b) fragment of funnel beaker, decorated on the belly with vertical rows of whipped cord impressions (type C).
Found during peat digging. Reference: Ebbesen and Mahler 1979, 81, fig. 25.
66. Sørup Mose, Østofte parish (LSM 859–61).
(a) funnel beaker with vertical bands on the belly (type C).
(b) funnel beaker with finger impressions on the lip and groups of vertical lines on the belly (type C).
(c) fragment of funnel beaker with vertical bands on the belly (type C).
Found at the bottom of the bog. Reference: Boyhus 1972, 11, fig.
67. Humblemosen, Slemminge parish (sb 25 – NM A 45.190). Funnel beaker, decorated on the belly with whipped cord impressions (type C). Found during peat digging together with the sherds of another pot. Reference: Ebbesen and Mahler 1979, fig. 24, note 80.
68. Slemminge, Slemminge parish (LSM 23.191). An undecorated cylinder necked beaker/bowl (type B). Found during peat digging in a bog.
69. Rødby Fjord, Maribo county (LSM 1992). Fragment of collared flask with vertical bands on the belly (type C). Found in a drained area of the fjord.
70. Anderup, Lumby parish (sb 27 – NSM 9776). Funnel beaker with round pits under the rim, and groups of vertical lines on the belly (type D). Found at the base of a drained bog. Reference: Albrectsen 1974 fig. 10.
71. Klinte Strand, Klinte parish (FSM, K. Ehlers' collection nos. 1360 and 2026–28).
(a) neck/belly sherd of a funnel beaker with vertical lines of twisted cord impressions (type C).
(b) belly sherd of vessel decorated with groups of vertical lines and feather patterns in stab-and-drag, and horizontal chevrons below (middle neolithic II?).
72. Gamborg, Gamborg parish (sb 12 – private ownership, not seen). Small undecorated funnel beaker. Found in a bog.
73. Bogø Nor, Humble parish (LMR A 7591). Beaker with concave neck, decorated under the neck with a horizontal row of round impressions (middle neolithic II). Found at the upper edge of the peat.
74. Dagsmose II, Tryggelev parish (LMR A 7799). Lugged beaker decorated on neck and belly with groups of vertical lines. Dug up out of the bog. Reference: Winther 1935, 59.
75. Valdemars Slot, Bregninge parish (SOM, not numbered, not seen). Magnum funnel beaker with round pits below the rim, and vertical bands on the belly. Found in peat under 3–4 fathoms of water.
76. Åmose, Ollerup parish (SOM 17.014). Lugged vessel, decorated with whipped cord impressions (type C). From near the bottom of a peat bog. Reference: Ebbesen and Mahler 1979, fig. 26, note 87.
77. Sludegårds Sømose, Frørup parish (sb 37 and 37 a – FSM 8466–86, 8615–29, 8632–36 and 8696–8705).
(a) funnel beaker, decorated with chevrons under the rim and vertical chevrons on the belly (type D).
(b) undecorated lugged flask (early neolithic A?).
(c) funnel beaker with round pricked decoration under the rim and groups of vertical lines on the belly (type D).
(d) undecorated lugged vessel (type C).
(e) sherds of Troldebjerg bowl (middle neolithic I).
The pots are part of a large votive offering, also containing axes handles and other wooden objects, many flint tools, and remains of meals consisting mainly of domestic cattle, but also of human bones. In one place 10 mandibles of domestic pigs were found, 9 from sows, 1 from a boar. Reference: Albrectsen 1954, 4 ff.
78. Svendborg Fjord, Svendborg County (FSM 7792). Funnel beaker with vertical bands on the belly (type C). Found on a bank of oyster shells.
79. Løkken, Furreby parish (VHM 1954/36). Fragment of a pot decorated with vertical and horizontal lines of cord impressions (early neolithic C). Found in a peat bog.
80. Mostrup Mose, Bindslev parish (VHM 9/1952). Most of a magnum lugged beaker, decorated on neck and belly with identical designs of alternating vertical and horizontal strokes and *Cardium* impressions (Volling group). Found in the bog.
81. Studbjerggård, Skærum parish (VHM 1948/90). Funnel beaker with cord impressions under the rim (type B). Reference: Ebbesen and Mahler 1978, fig. 14, note 41. Found during peat digging in the bog.
82. Skærum River, Åsted parish (VHM 1954/390–91). Magnum funnel beaker with 3 rows of pricked impressions under the rim (type B). From a bog near the river.
83. Hundborg Mose, Hundborg parish (private ownership).
(a) rim sherd of funnel beaker with crescentic impressions under the rim.
(b) rim sherd of funnel beaker with three dimensional mouldings applied under the rim and horizontal rows of chevrons (early neolithic C). Found in the bog.
84. Landlyst, Thisted rural parish (private ownership). Fragment of undecorated funnel beaker (type B). Found in a bog.
85. Lundby Mose, Gunderup parish (ÅHM j. 404).
(a) magnum beaker with cylindrical neck, and round pricked impressions under the rim (middle neolithic I).

(b) funnel beaker with round pricked impressions under the rim and at the neck/belly transition (middle neolithic I/IV).
(c) magnum funnel beaker with round pricked impressions under the rim and groups of vertical lines on the upper part of the belly (type D).
(d) fragment of undecorated funnel beaker (type D).
(e) neck sherd of collared flask with pricked decoration on the collar (early neolithic).
(f) belly sherd (of lugged beaker?) decorated with vertical lines of stab-and-drag and crescentic pricked impressions (Volling group).
(g) rim sherd of (?) funnel beaker, with a three dimensional moulding with horizontal *Cardium* impressions applied below the rim, and horizontal cord impressions below this (Volling group).
(h) a sherd with fir tree motif (middle neolithic II/IV).
These are part of a large votive find from the bog. Reference: Davidsen 1978, 122 ff, fig. 85.

87. Højslev Mose, Højslev parish (sb 119 – NM A 43.923, from Reffgård's second collection). Fragment of funnel beaker with chevrons under the rim and vertical bands on the belly (type D). Found in the bog.
88. Klosterlund, Engesvang parish (SIM 19/1962 and 448/64).
(a) a magnum funnel beaker.
(b) magnum bucket shaped vessel with finger impressions (middle neolithic V).
References: Ebbesen 1972, 58 f; Davidsen 1975, 66 f; 1978, 80 f, pl. 105).
89. Moselund, Funder parish (sb 21 – NM A 44.849–50). Fragment of an undecorated funnel beaker (type B?). Found in peat digging in the bog, c. ½ m from a fragmentary late neolithic storage vessel.
90. Hemmersvej, Skive (sb 129 – SMS 51A). Cylinder necked beaker, decorated with stab-and-drag ornamentation (Volling group). Found during sewerage work. Reference: Ebbesen and Mahler 1979, fig. 15 note 41.
91. Rimsø Kær, Rimsø parish (sb 51 – A 48.056). Lower part of a pot, decorated with alternating vertical and oblique stab-and-drag lines (Volling group). Found near an old peat cutting.
92. Albøge Mose I, Albøge parish (NM A 42.515). Most of a magnum Hagebrogård bowl (middle neolithic II). Found in a small bog. Reference: Ebbesen 1978, fig. 48.2, note 10a.
93. Albøge Mose II, Albøge parish (sb 59 – NM C 25.248). Fragments of an indeterminate vessel (undated). Reference: Simonsen 1953, 64 ff.
94. Randlev Mose, Randlev parish (sb 7 – NM A 42.065). Neck/belly sherd of a funnel beaker with vertical lines (undated). Found at the base of the peat in a water meadow.
95. Bedinge Mose, Tilst parish (FHM, not numbered). Funnel beaker, decorated under the rim with horizontal cord impressions, on the belly with similar groups of vertical lines. Found in the bog.
96. Smedrup Mose, Århus county (OOM 2058–59).
(a) fragment of Troldebjerg bowl (middle neolithic I).
(b) sherd with whipped cord decoration.
Bog finds.
97. Boring Mose, Hvirring parish (HOM A 424). Rim sherd of a funnel beaker, decorated under the rim with vertical lines of whipped cord (type B). Found in the bog.
98. Egebjerg Kær, Hansted parish (HOM A 281). Fragment of funnel beaker with pricked decoration under the rim and vertical bands on the body (type C). Found during peat digging.
99. Nørrestrand, Nebel parish (NM A 45.287–90). Fragment of funnel beaker (undated). Found during shell digging with other neolithic objects.
100. Tvingstrup, Ørridslev parish (HOM 1646). Fragment of undecorated collared flask (early neolithic B?). Found during drainage work.
101. Horsens Fjord I, Vejle county (HOM A 959). Fragment of funnel beaker with vertical bands on the belly (type C). Found under 1.5 m of water.
102. Snaptun, Horsens Fjord, Vejle county (GLM not numbered).
(a) funnel beaker with chevrons under the rim and vertical bands on the belly (type D).
(b) funnel beaker with oblique whipped cord impressions under the rim, and vertical ones on the belly.
Recovered from Horsens Fjord. Reference: Stürup 1963, illustration p. 67).
103. Bygebjerg Mose, Hejls parish (NM A 49.689). Troldbjerg bowl (middle neolithic I). Found during peat digging. Reference: Ebbesen 1978, fig. 48,1, note 10.
104. Fåruphus, Jelling parish (NM A 44.568–71).
(a) rim sherd of cylinder necked beaker with horizontal cord impressions under the rim (type B).
(b) neck/belly sherd of funnel beaker with vertical bands on the belly (type C).
(c) rim sherd of funnel beaker with pricked decoration under the rim (undated).
(d) rim sherd of pot with applied three dimensional mouldings under the rim, and horizontal chevrons in the same area (type C).
Found during peat digging.
105. Estvadsgårds Enge, Estvad parish (SMS S 193). Most of a lugged beaker, with area stab-and-drag decoration and faint impressions (Volling group). Found during canalisation of Skive-Karup River. Reference: Knöll 1976: 1 ff.
106. Tarp, Sdr. Felding parish (HEM 216/29). Funnel beaker with pricked decoration at the neck/belly transition (middle neolithic V). Found in a bog. Reference: Davidsen 1973/74, fig. 2; 1978, 81.
107. Rousthøje, Grimstrup parish (sb 520 – NM A 42.165). Neck/belly sherd of a funnel beaker with vertical bands on the belly (early neolithic C/middle neolithic I). Found during the cleaning of a stream.
108. Simmersted Mose, Magstrup parish (sb 54 – HAM 10.421). Undecorated rim sherd of funnel beaker (undated). From a bog.

109. Elsholm, Barsmark, Egvad parish (NM j. 584/40, private ownership, not seen). Early neolithic pot, found in a bog.
110. Sjellerup Mose, Nordborg parish (private ownership). Lower part of a collared flask with three dimensional mouldings on the belly (type C). Found in the bog.

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Evidence for a Natural Deposition of Fish in the Middle Neolithic Site, Kainsbakke, East Jutland

by JANE RICHTER

INTRODUCTION

In evaluating the food economy on a site, it is necessary to distinguish between two types of thanatocoenoses resulting from natural deposition and deposition made by man. This is especially so when fish bones constitute a major part of the material.

Fish as part of the diet at Danish prehistoric sites is well documented (e.g. Rosenlund 1976; Aaris-Sørensen 1980; Noe-Nygaard 1983; Enghoff 1983). Carbon-13 investigations have increased the comprehension of the importance of marine food in relation to terrestrial food items (Tauber 1981).

If not elevated, the Danish kitchen middens and other refuse layers at the coastal settlements have been exposed to inundation caused by tide and storm with a resulting deposition of sediment and various organic material. This organic material, including zoological remains, is often incorporated in the discharge from the site and might cause misinterpretations of the bone assemblage, particularly if the deposition is caused by a short term flooding with only minor deposition of sediment.

The dimensions of the fish fauna, by measuring the vertebrae, and the gastropod fauna have been studied. A combination of these factors together with an investigation of the fish bone collagen might be useful when an attempt is made to separate fish bone assemblages of possibly mixed origin, partly caused by human activity and partly by a natural deposition.

The submergence of the middle Neolithic site, Kainsbakke by the Subboreal transgression is indicated by the population structure of the fish bone accumulations. Independent investigations of the gastropod fauna show alternating terrestrial and marine assemblages. The sediment covering the site after or contemporary with the termination of human occupation are clearly dominated by a marine snail fauna thus confirming the conclusion reached by the fish investigations.

Experiments with heated and non heated fish bone collagen lead to the conclusion that the structure of the collagen fibers changed at temperatures above 60°C. These observations were applied to the subfossil bone material and indicated that part of the fish bone material had not been subjected to any heating and a natural way of deposition was thus more likely.

THE KAINSBAKKE SITE

The excavation of the Kainsbakke site took place 1980–1982. Kainsbakke is situated on the north-eastern part of Djursland, close to Skærvad Å, Ginnerup sogn, Djurs Nørre-Herred, Jylland. The settlement was originally located on a small island (Rasmussen and Boas 1982). The bone material was refuse from the settlement, which had been thrown into pits. The one dealt with here is A47. It is placed at the 7 m contour. Beach deposits were observed at about 4,5 m (Rasmussen 1984). Radiocarbon dating of bone material from A47 have been obtained. Bone of aurochs (K4465) is dated 4030 ± 80 before 1950 (Rasmussen, in press).

The pit is $4 \times 5 \times 1$ m^3, only half of which has been excavated. The concentration of finds is enormous. Apart from the archaeological material, consisting of flint and ceramics, the pit contained bones and mollusk. An estimated number of mammal bones is 10.000 and of fish bones at least 50.000. The bones cannot have been exposed for very long, since they bear little sign of physical destruction and weathering. The mammals i Kainsbakke are partly game and partly domesticated animals.

		x 2148	x 2243	x 2279	x 2393	x 2846
MARINE/BRACKISH						
Littorina obtusata L.	Littoral zone. Fucus	3	–	1	1	1
Littorina littorea L.	Littoral zone. Stones, sand, mud flats etc.	29	–	11	3	7
Littorina saxatilis Olivi	Littoral zone. Shallow brackish water	5	–	1	7	2
Hydrobia ulvae Pennant	Littoral zone. Shallow mud flats.	25	28	1	20	3
Cingula semicostata Montagu	Hard bottom or shell gravel	1	–	–	–	–
Rissoa sp.		1	–	–	–	–
Bittium reticulatum da Costa	Muddy sand slopes under Zostera	221	108	10	45	1
Nassarius reticulatus L.	Muddy sand. Zostera	16	2	4	–	11
Odostomia sp.		–	5	–	–	–
Indet.		3	–	–	–	–
		304	144	28	76	25

		x 2148	x 2243	x 2279	x 2393	x 2846
TERRESTRIAL						
Cochlicopa lubrica Müller	Moderately damp places.	4	30	1	33	–
Vertigo alpestris Alder	Moderately dry places. e.g. open woods	–	–	–	8	–
Pupilla muscorum L.	Dry calcareous places	1	34	–	135	–
Sphyradium edentulum Charpentier	Damp shady places	–	8	–	–	–
Vallonia costata Müller	Exposed calcareous places	16	206	–	916	1
Vallonia excentrica Sterki	Open calcareous places	1	–	–	–	–
Clausilia sp.		–	3	–	24	3
Clausilia parvula Studer	Damp calcareous places	–	–	–	6	–
Retinella nitidula Drapernaud	Damp places	30	298	7	216	19
Hyalinia sp.		–	–	–	–	8
Hyalinia alliaria Miller	Unsheltered places	–	8	–	–	–
Hyalinia nitidula Drapernaud	Moist places, e.g. rubbish heaps.	–	1	–	–	–
Euconulus fulvus Müller	Woodland, marshes etc.	–	4	–	91	–
Indet.		–	92	–	97	–
		52	689	8	1526	31

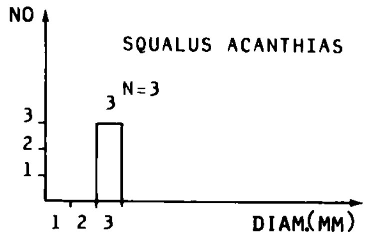
Table 1. Census of gastropods from five samples. The preferred habitat of each sample is recorded. Marine and terrestrial species are differentiated. – Data from Rasmussen (1973), McMillan (1968) and Thiele (1931).

MATERIAL

The fish bones have primarily been retrieved through sieving soil samples with 1 mm meshes. Although this contributed with tiny bone elements and fragments, it did not add to the number of species found through sieving samples to 3 mm.

The preliminary results presented are based on app. 12% of the material. Only vertebrae have been examined, as these are the best preserved skeletal elements. The cranial elements are generally broken into small pieces, obviously due to post-depositional compactional destruction. This also seems to be the cause of the deformation of the vertebrae of the mackerel, Scomber scombrus. The remaining vertebrae are, however, in an excellent state of preservation.

6048 fish vertebrae have been examined, 5416 of which could be determined. Twelve species are represented: spurdog *Squalus acanthias L.*, herring *Clupea harengus L.*, trout *Salmo trutta L.*, common eel *Anguilla anguilla L.*, garfish *Belone belone L.*, cod *Gadus morhua L.*, whiting *Merlangius merlangus L.*, horse mackerel *Trachu-*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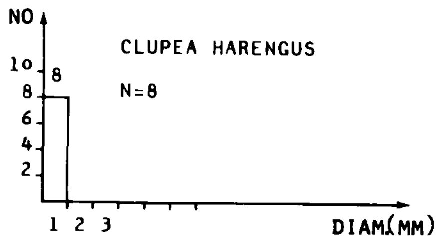
DIAM(MM)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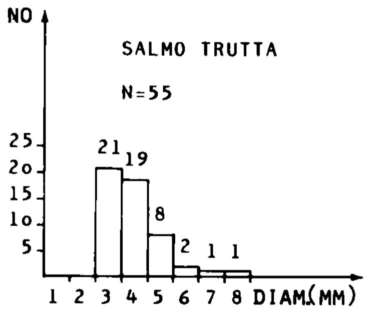
DIAM(MM)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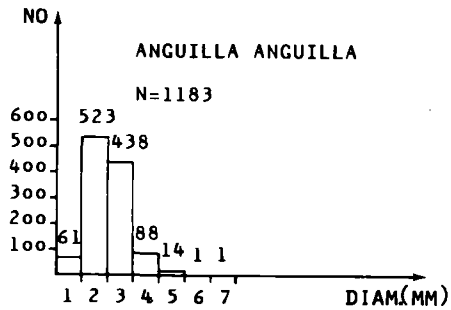
DIAM(MM)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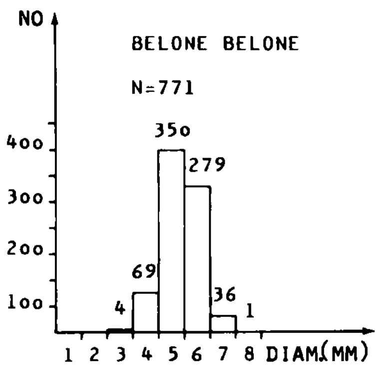
ANGUILLA ANGUILLA
N=1183
DIAM(MM)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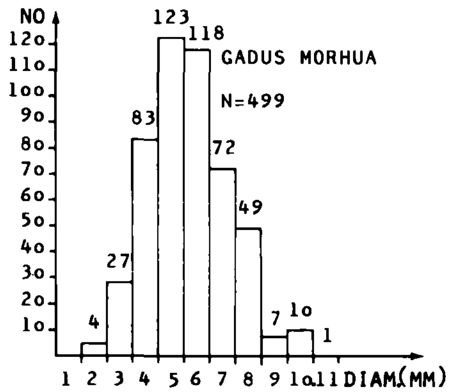
DIAM(MM)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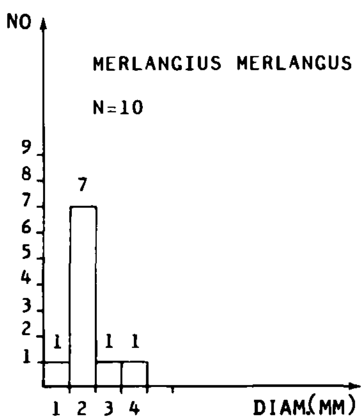
DIAM(MM)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MERLANGIUS MERLANGUS
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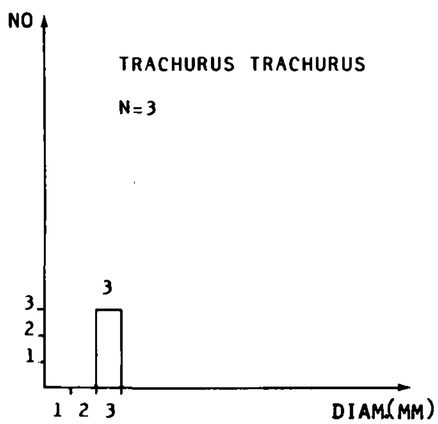
DIAM(MM)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TRACHURUS TRACHURUS
N=3
DIAM(MM)

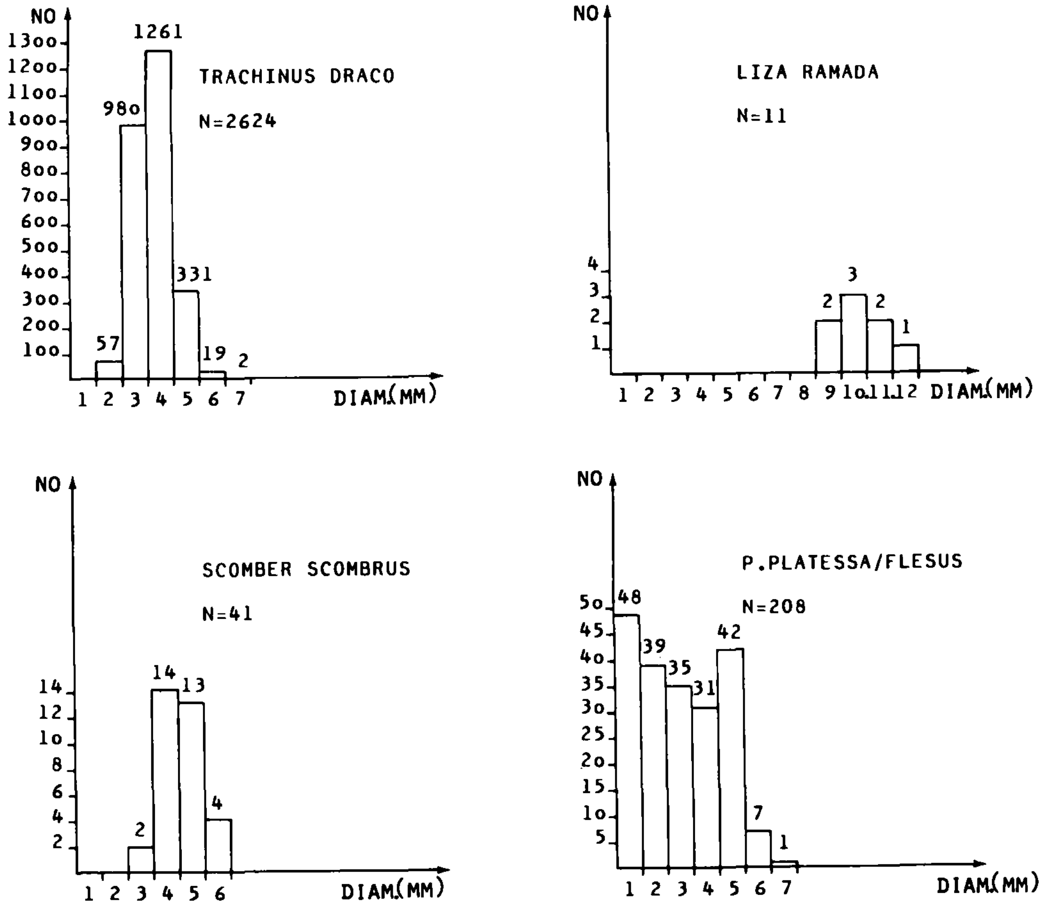

Fig. 1. Size distribution and number of vertebrae of the represented fish species in Kainsbakke.

rus trachurus L., greater weever *Trachinus draco L.*, thinlipped mullet *Liza ramada Risso*, mackerel *Scomber scombrus L.* and plaice/flounder *P. platessa/flesus*. Fig. 1 shows the distribution of the fish vertebrae of the various species. – Traces of burning could be seen on 32 vertebrae.

The vertebrae of thinlipped mullet seem to have belonged to one individual. There are only three other Danish finds of this species: Vejleby (Ertebølle ?), Ordrup Næs (Ertebølle) and Kolind (Ertebølle) (Rosenlund, pers. comm. 1984).

The greatest medio-lateral breadth of the centrum on the anterior articular face of all vertebrae have been measured according to Morales and Rosenlund (1979).

It must be emphasized that the investigated vertebrae derive from all parts of the vertebral column. The terminal part is, however, scarcely represented.

This midden contains thousands of mollusk, bivalves and gastropods. The bivalve fauna is dominated by oysters *Ostrea edulis L.*, mussels *Mytilus edulis L.*, and cockels *Cerastoderma edulis L.*

Eleven samples of gastopods have been studied. Each sample represents ¼ m^2. Table 1 is a systematic listing of the species found and summarizes their biotopes.

DISCUSSION

The majority of the fish bones derives from human activity. At the time of occupation Kainsbakke was a coastal site having access to brackish and marine areas. Therefore marine food constituted part of the diet. Carbon-13 values, however, confirms that Kainsbakke was a typical Neolithic coastal site, based on a mixed food source, consisting of hunting – fishing – gathering and agricultural food. In fact, it is estimated that the

Fig. 2. Electron micrograph of a collagen fiber of x3076-I, vertebra of plaice/flounder. Note the native state of the collagen. Contrasted. App. x17000.

terrestrial food constituted around 50% of the diet (Noe-Nygaard, in prep.). In Kainsbakke the marine portion not only consists of fish but also bivalves and seals. Thus fish contributed to the food, but was not the major food item.

In Kainsbakke several different fishing techniques must have been applied in order to catch surface swimming pelagic fish such as garfish and mackerel and demersal fish such as plaice and flounder. The greater weever, which according to the number of vertebrae is the most dominant species of the material, could, however, easily have been collected by hand. During summer they live in very shallow water, buried in the sand (Muus and Dahlstrøm 1968).

The total length of cod from Kainsbakke have been estimated on the basis of atlas widths according to Enghoff (1983). 15 cod atlas are represented and the estimated total length varies between 36 and 53 cm. This small size correspond to the dimensions of cod found at the Mesolithic settlements. Enghoff (1983) suggests that the cod were caught in traps, placed in shallow water during spring, perhaps summer, and autumn. Such traps could have been placed in the inlet to Kainsbakke or off the coast.

Eel and trout can be caught in freshwater, brackish and marine areas, all of which the Kainsbakke people had access to. The fish species found at Kainsbakke suggest fishing not far from the coast. Even spurdog, which is the most common Danish shark, can be caught in shallow water (Poulsen 1946).

The presence of garfish and mackerel indicate that fishing in any case took place during summer. Both are summer visitors. Today mackerel arrives in April or May and leaves in September or October, while garfish arrives in April and leaves in the autumn (Jensen 1946).

The entire collection of fish bones from archaeological excavations are normally interpreted as having been part of the feeding economy of a site. In some cases, however, the deposits may have a mixed origin. But it can be very difficult to separate a natural deposition from a deposition of human origin.

Size distribution. In Kainsbakke twelve species of fish have been recovered (fig. 1), all of which are eatable. The dimensions of the vertebrae are, however, remarkable, especially in the case of plaice/flounder, common eel, herring and whiting (fig. 1). The diameter of some of these vertebrae are as small as 1 and 2 mm. This bias could be the result of several taphonomic processes such as excavation technique, non-selective catch, fish offal or natural deposition.

The small individuals can hardly be meal remnants, as bones of this size are so soft they would be eaten along with the rest of the fish.

Histology. In order to evaluate whether this subfossil bone material has been subjected to heating (and are therefore possible meal remnants), morphological changes of collagen fibers of modern material of plaice have been studied after thermal and hydrothermal denaturation (Richter 1986). Intact vertebrae either scraped free of adhering tissue or with tissue still attached were subjected to thermal and hydrothermal denaturation. Not until after heating were the fibers isolated. The collagen of the untreated control bone material appeared as long fibrils with a normal band spacing. Thermal denaturation of the bone at 60°C caused melting of the collagen in local areas both at the

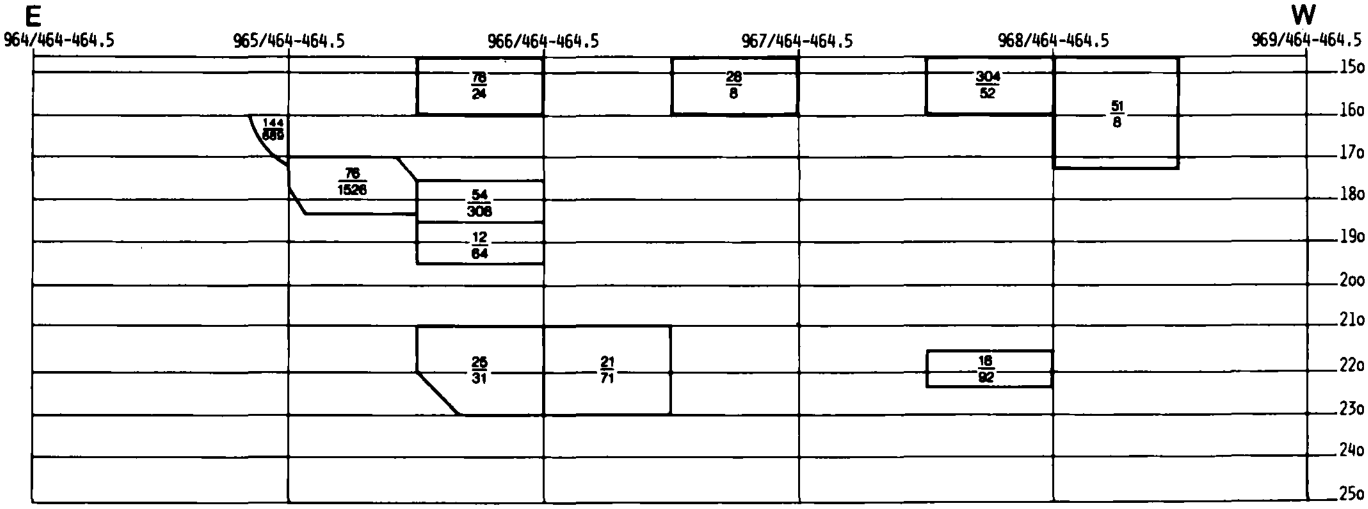

Fig. 3. The stratigrafic position of eleven gastropod samples from Kainsbakke. For each sample the number of marine gastropods (numerator) and terrestrial gastropods (denominator) is recorded. – Vertical scale in cm.

ends and along the fibril. The melted regions appear to be amorphous while the rest of the fibril resembled native collagen.

Melting progresses with higher temperature and a decreasing fraction of the fibrils is native collagen so that at 80°C only small fragments of collagen fibrils with melted (swollen) ends can be seen. Vertebrae heated to 100°C showed no signs of any fibers which could be identified as collagen, neither when it was heated with nor without tissue attached.

Seven subfossil vertebrae of plaice/flounder have been examined, none of which showed any superficial signs of heating of burning. Of the seven vertebrae six were small with a diameter of 1 mm (x3076-I, x3076-II, x3076-III, x3076-IV, x3073-I and x3073-II) and one had a diameter of 5 mm (x2148). In the case of x3076 and x3073 the collagen appeared as long fibrils with a normal band spacing and no melted areas (fig. 2). The collagen of these vertebrae is in an excellent condition. They have neither been subjected to heating in connection with meal preparation, nor have they been exposed to diagenetic factors such as high ion concentration, low acidity or microorganisms which might influence the morphology of the fibrils.

Examination of x2148 did not present anything which could be identified as collagen fibrils. This lack of identifiable collagen fibrils is not likely to have been caused by diagenetic factors as the primary cause. The excavated area is very limited ($4 \times 2{,}5 \times 1$ m^3) and homogeneous with no signs of local variation in preservation.

With x3076 and x2148 being found within app. 2 m of each other, the decomposition of the collagen was therefore most likely initiated before burial, possibly caused by heating in connection with meal preparations. The study of the collagen indicates that the very small fishes found at Kainsbakke were not meal remnants.

The gastropod fauna is represented by marine (or brackish) and terrestrial species. The gastropods preferred habitat is recorded (table 1) together with the stratigrafic position of the samples in the pit (fig. 3). All of the samples from the uppermost layer show dominance of marine species, while the remaining samples are dominated by terrestrial species (fig. 3).

Only *Littorina littorea* might have been collected for human consumption, being the only eatable gastropod present. The accumulation of the remaining marine species could hardly have been due to human activity as they are very small and thus have very little nutritional value, although they occur in great numbers. The small marine gastropods present in this shell accumulation are usually found in shallow water on a hard substratum (Rasmussen, 1973). The preferred habitat of the two most common species *Bittium reticulatum* and *Hydrobia ulvae* are similar. *B. reticulatum* lives on muddy sand under Zostera beds on slopes along the shore and *H. ulvae* prefers to live on the bottom of shallow mud flats (Rasmussen, 1973). This evidence would seem to

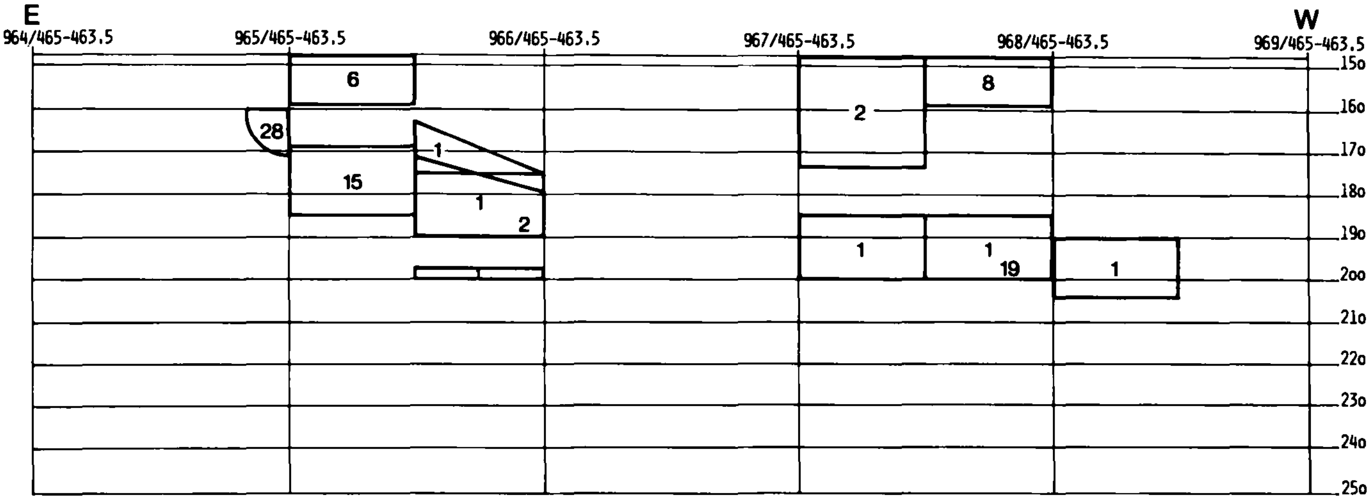

Fig. 4. The stratigrafic position of the small vertebrae of plaice/flounder. Number in each sample indicate number of vertebrae having a diameter of 1 mm (middle) and 2 mm (right). – Vertical scale in cm.

contradict the suggestion put forward by Petersen (1980) that small marine snails were introduced to sites attached to the byssal threads of mussels. The presence of the small snails is much better explained, however, by inundation of the site when they could have invaded the area and some empty shells might as well have accumulated.

Terrestrial gastropods are known to invade middens (e.g. Petersen, 1980 and Jensen, 1981). The preferred habitat of the terrestrial fauna represented here is dry to moderately damp, often calcareous places (Kerney and Cameron, 1979).

A meticulous excavation technique was applied at Kainsbakke and all samples sieved to 1 mm. This has reduced collecting bias to a minimum.

The very small fish individuals and the marine gastropods on the site might be accounted for by an inundation of the area, whereby they could have been naturally deposited.

Non-selective catch associated with the use of a beach seine could be an alternative possibility for introduction of the small fish and marine gastropods to the site. However, if this was the case, the mesh size must have been unrealistically small and the whole net and its entire content must have been brought to the site instead of being sorted on the beach. This process would have caused considerable damage to the net.

The investigation of the collagen confirms that the small fishes were not meal remmants from heated dishes. However, fish can be dried, salted and smoked or even eaten raw. In any case, the dimensions of these vertebrae make it unlikely that they should not have been eaten along with the dish. If the vertebrae were in fact separated from the dish, it would seem even more unlikely that an effort would be made to transport vertebrae the size of one and two millimeters from the settlement to the dump. They could have been fish offal, sorted out because of size or as stomach content of larger individuals. Fish offal is, however, readily removed by animals e.g. gulls, dogs and foxes.

The dominance of marine gastropods in the uppermost layer and the presence of the small fish indicate a transgression of the area. The stratigraphic position of the small vertebrae of e.g. plaice/flounder is, however not as firmly based as the gastropods (fig. 4), although the majority has been found in the upper half of the pit. As the majority of these vertebrae are considerably smaller than the smallest gastropods present, *Bittium reticulatum* (fig. 5), and as the vertebral processes are damaged or lacking, they could easily have been transported through this extremely permeable shell accumulation. Bones of microvertebrates do possess a considerable potential for dispersal in moving water (Dodson, 1973) and in the present case even rainwater could have aided dispersal of the very small vertebrae.

At the time of occupation the IV. Littorina-transgression was at its maximum. The area could have been temporarily flooded in connection with a spring-tide combined with an easterly wind. The presence of the small fish and the marine gastropods in the uppermost layer is more logically explained as the result of a natural deposition, perhaps caused by a temporary flooding, rather than being brought to the site by man.

CONCLUSIONS

The fish bone assemblage includes vertebrae of very small individuals, which did not belong to the refuse of the settlement. Their deposition was contemporary with the termination of the human utilization of the midden.

The pattern of the distribution of marine and terrestrial gastropods confirms this. In the uppermost layer of the shell pit the small marine gastropods outnumber the terrestrial, unlike the rest of the shell accumulation, which is dominated by terrestrial gastropods.

Analysis of the bone collagen demonstrates that the small fish have not been heated, confirming that they are not meal remnants.

It is thus suggested that a temporary flooding of the site occured associated with the maximum of the IV. Littorina-transgression and that the small fish and marine gastropods could have been deposited naturally at this occasion.

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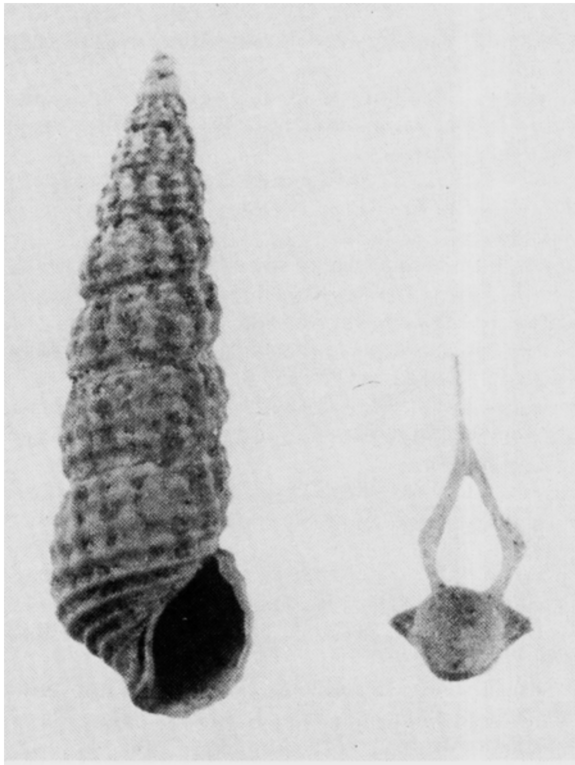

Fig. 5. Bittium reticulatum (left) and vertebra of plaice/flounder, diameter 1 mm (right). App. x9.

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Brown Bear (Ursus arctos) *from Kainsbakke, East Jutland*

by JANE RICHTER

INTRODUCTION

Brown Bear bones from Kainsbakke demonstrate exploitation by Neolithic man. Various cut marks on the bones are definitely of human origin and illustrate utilization of bears for both food and raw material. This bone material represents the largest Danish settlement find of Brown Bear.

Brown Bear appears sporadically in the Danish subfossil record as single bog finds as well as from settlements. It appears that the bear was most common on inland sites from east Denmark in the Boreal and early Atlantic periods, after which there is a decline in the standing crop. The finds from late Atlantic and the Subboreal are mainly from coastal sites in Jylland. This seems to be caused by the development of the dense Atlantic forest combined with eustatic sea level rise caused by the Littorina transgression. This restricted the preferred habitats of Brown Bear (Noe-Nygaard, 1983). The species disappears from eastern Denmark during the Atlantic period (Degerbøl, 1933) but it survives in Jylland into the Subboreal (Spärck, 1928), probably due to immigration from the South.

The Kainsbakke settlement belongs to the Pitted Ware Culture and is located on the north-eastern part of Djursland (Rasmussen and Boas, 1982). The bear bones are retrieved from A47 (Rasmussen, 1984). The settlement is radiocarbon-dated to 2200 ± 70 b.c., uncalibrated (K-4463) (Rasmussen, in press).

NEOLITHIC FINDS

Brown Bear's first appearance is from the Allerød period (Jessen, 1924) and the youngest find is from the Germanic Iron Age. The latter is, however, represented by distal phalanges from funeral urns and therefore gives no indication of the presence of Brown Bear in Denmark as they might derive from imported skins (Winge, 1904; Møhl, 1977).

Six finds of Brown Bear have been recorded from the Danish Neolithic, Bundsø (Degerbøl, 1939), Lindø (Degerbøl, 1939), Spodsbjerg (Nyegaard, 1985), Holme Skanse (Andersen, 1983), Ørum Aa (Degerbøl, 1939) and Dræby Mark (Degerbøl, 1939). In Lindø, Spodsbjerg and Dræby Mark the finds consist of distal parts of the limb bones or canines which most likely derive

Fig. 1. Skull of Brown Bear, *Ursus arctos* (x2549). Note the injury at the back of the head. Size app. 1/3.

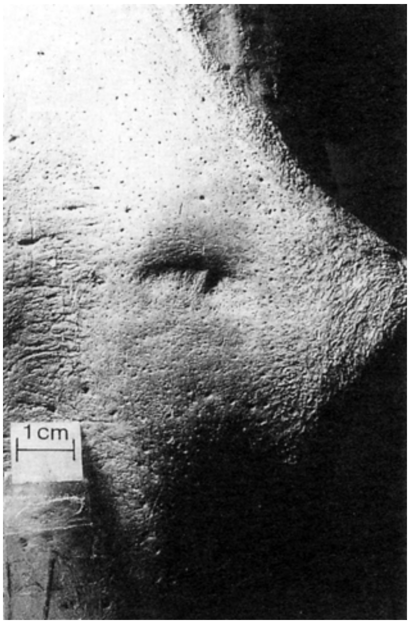

Fig. 2. Healed lesion in the forehead of skull x2549.

from imported skins and raw material. In Bundsø, Ørum Aa and Holme Skanse other parts of the skeleton are also represented and therefore establish the presence of the species in Denmark. Bundsø and Ørum Aa are however older than Kainsbakke. Holme Skanse is located in the South-eastern part of Mols. It has not been radiocarbon-dated but belongs to the Single Grave Culture and is contemporary with or perhaps slightly younger than Kainsbakke (S. Andersen, pers. comm. 1985). In Holme Skanse four fragments were retrieved. Two metacarpals, one phalanx and one fibula.

This means that Kainsbakke and Holme Skanse are the youngest records which confirm the presence of Brown Bear in Denmark. Incidentally these two localities are situated fairly close to each other.

MATERIAL

Thirty-two bones and teeth of Brown Bear were retrieved from Kainsbakke A47. They represent an estimated minimum number of individuals (EMNI) of four. The measurements taken are in accordance with von den Driesch (1976).

X 2249. An almost complete skull, broken in the median part of *os zygomaticus dextral*, the median part of *os parietale dextral* through the posterior part of *os frontale sinistral* and back to the *os occipetale sinistral*. M1 *dextral*, M2 *dextral* and P4 *sinistral in situ* (fig. 1). The three cusps of P4 show wear. M1 and M2 are moderately worn, no cusps can be recognized. Even the aboral part of M2 shows wear and folded enamel has disappeared.

The alveoli for the remaining teeth are preserved, showing that premolars P1, P3 and P4 have been present.

The sutures are obliterated except for the suture between the *os zygomaticus* and *os temporale*.

The buccal wall of the alveolus of the *sinistral* canine has been artificially broken.

The skull has a healed lesion in the *os frontale sinistral* (fig. 2).

X 2288. An almost complete skull. *Ossa zygomaticus*, anterior parts of *ossa temporalia*, *os nasale dextral* and the aboral part of *os maxilla dextral* are lacking (fig. 3). P4 *dextral* and M2 *sin. et dex. in situ*. Only the cusp of P4 show signs of wear. The meta- and paracones of the molars can be recognized. The teeth are moderately worn.

The alveoli of the remaining teeth are preserved, showing that premolars P1, P2, P3 and P4 have been present.

The following sutures are visible: *ossa premaxillare*, os *parietale – os frontale*, *os basioccipetale – os basisphenoideum*, *os squamosum – os alisphenoideum* and partly *ossa intermaxillaria*.

Distinct cutting-marks on the median part of *os frontale* (fig. 4), on *os pterygoideum dextral* and on the median part of *os basioccipetale*, just in front of *ossa exoccipetalia*.

X 2184. A skull fragment consisting of the anterior *dextral* part. *Os nasale*, *os maxillare*, *os zygomaticus* and the lateral part of *os frontale* are present together with parts of the nasal septum and nasal conchae (fig. 5).

P3, P4, M1 and M2 *in situ*. P3 shows no signs of wear. In P4 the enamel of the protocone is slightly damaged. But apparantly there is no signs of wear, while the trito- and tetracones show the very first signs of wear. In M1 the lingual part shows wear, while the para- and metacones only recently started to wear. The lingual and aboral parts of M2 are moderately worn, while meta- and paracones are slightly worn. Folded enamel is present.

The alveoli of C and P1 are preserved. M1 shows changes caused by caries in the oral part.

The following sutures are visible: *os nasale – os maxillare, os maxillare – os zygomaticus, os lacrymale – os frontale*. The sutures of the palate are difficult to interpret because of damage.

X 2552–15. A skull fragment consisting of part of *os frontale dextra* close to the orbita. – The fragment is artificially broken.

X2146–45. A skull fragment consisting of part of *pars squamosa of os temporale sinistra*. – The fragment is artificially broken.

X 2052–6. A skull fragment consisting of the aboral part of *maxilla*, *os zygomaticum* and the oral part of *os palatinum sinistra*. P4, M1 and M2 *in situ*. The fragment is artificially broken.

X 2052–127. A skull fragment covering the major part of *os frontale sinistra*. – Cutting-marks are present.

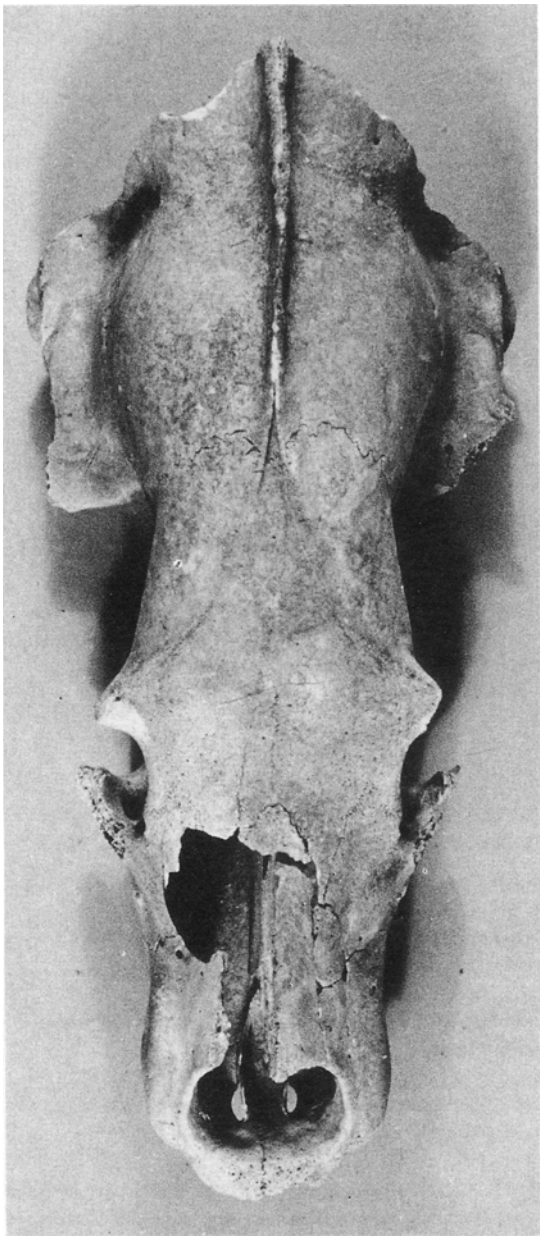

Fig. 3. Skull of Brown Bear, *Ursus arctos* (x2288). Note the injury on the forehead. Size app. 1/2.

Fig. 4. Cutting marks on the forehead of skull x2288.

Fig. 5. Skull fragment of Brown Bear, *Ursus arctos* (x2184). Size app. 1/3.

X 2269–27. A fragment of *os maxillare dextra* having P4 *in situ*.

X 2898. *Mandibula dextra*, having C, P4 and M2 *in situ* (fig. 6). The canine is moderately worn. The protoconids of P4 shows wear and all of M2 is moderately worn. No cusps can be recognized. The alveoli of the incissors, M1 and M3 are preserved. The aboral and lateral walls of the alveolus of the canine are missing.

Distinct cutting-marks on the median, basal part of the mandible, buccal side, below the position of M1 (fig. 7).

X 2765. *Mandibula sinistra*, having M1, M2 and M3 *in situ* (fig. 6). The alveoli for the incissors and the canine are slightly damaged, while P1's and P4's are preserved.

The para-, proto- and metaconids of M1 show a slight wear, while ento- and hypoconids have disappeared. In M2 meta- and entoconids can be seen. M3 is moderately worn.

The basal aboral part is missing.

X 2295. *Mandibula dextra*, having P4, M2 and M3 *in situ* (fig. 6). The

Fig. 6. Mandibles of Brown Bear, *Ursus arctos*. Above x2898 (left) and x2151 (right). Below x2595 (left) and x2765 (right). Size app. 1/3.

alveoli for the incissors and the canine are slightly damaged, while P1's and P3's are preserved.

The protoconids of P4 recently started to war. In M2 the metaconid is visible, the entoconids can be recognized, while the lingual part is moderately worn. Folded enamel is present.

The mandible was broken into three pieces, behind M3 and through the vertical ramus.

X 2151-a. *Mandibula sinistra* lacking the part oral to M1 and the most basal part of the vertical ramus (fig. 6). The molar row *in situ*. The teeth are moderately worn, only entoconids can be recognized.

Distinct cutting-marks on the oral side of the vertical ramus. *Proc. condylaris* have been cut off and the fragment show signs of burning.

X 2428–14. One isolated incissor *sup., sinistra.*

X 1932–11. One isolated incissor *inf., sinistra.*

X 1939–39. One isolated premolar not assignable to either side.

X. One isolated fourth premolar *sup., dextra*. Moderately worn.
Dimensions: length: 14 mm, breadth: 13 mm.

XX. One isolated first molar *inf., dextra*. Moderately worn.
Dimensions: length: 24 mm, breadth: 11,5 mm.

X 1915-a. One isolated first molar *sup., sinistral.* Moderately worn.
Dimensions: length: 22 mm, breadth: 17 mm.

XXX. One isolated first molar *inf., sinistra*. Moderately worn.
Dimensions: length: 24 mm, breadth: 12 mm.

X 1915-b. One isolated second molar *sup., dextra*. Moderately worn.
Dimensions: length: 21,5 mm, breadth: 16,5 mm.

X 2823–23. *Scapula dextra* consisting of the distal part including the majority of *cavitas glenoidales* and the distal part of *spina scapulae*. – *Cavitas glenoidales* has been artificially broken. Cutting-marks are present.

X 2823–14. *Scapula dextra*. A fragment of *spina scapulae*. Possibly from the same element as 2823–23. – Cutting-marks are present.

X 2552–6. *Humerus dextra* consisting of the major part of the diaphysis (fig. 8). – Cutting-marks are present. The only measurement, which could be taken is SD: 42 mm.

X 2146–5 + 2146–22. *Humerus sinistra*. A fragment of the cranial part of the diaphysis. – The fragment is artificially broken and shows cutting-marks in the proximal end.

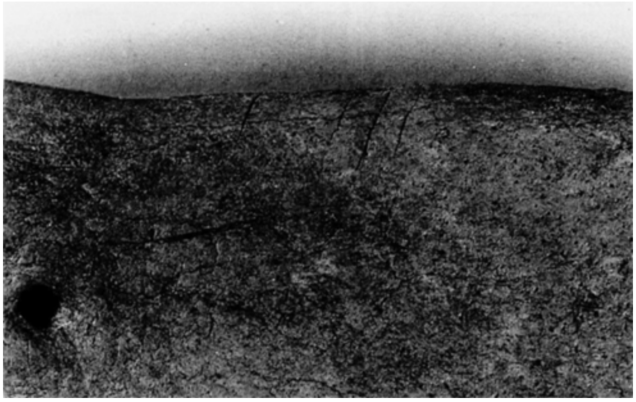

Fig. 7. Cutting marks on mandible x2898.

X 2314–5. *Humerus dextra.* A fragment of the cranial part of the diaphysis. – The fragment is artificially broken.

X 2361–33. *Humerus sinistra.* A fragment of the caudal part of the diaphysis. – The fragment is artificially broken.

X 1965–30. *Ulna dextra.* The distal part of the element. – The fragment is artificially broken.

X 3027–1. *Ilium dextra.*

X 2552–1. *Ilium sinistra.* A fragment of the acetabulum. – The fragment is artificially broken.

X 2823–34. *Os sacrum.* A fragment of the median part. – The fragment is artificially broken.

X 2552–2 *Femur dextra.* Proximal part of the diaphysis. – The fragment is artificially broken.

DISCUSSION

It is a well established fact that the Danish subfossil bone record of Brown Bear derives from individuals of a considerable size, the dimensions of which were much greater than the present population of Scandinavian Brown Bear (Degerbøl, 1933).

The dimensions of the Kainsbakke bones are compared to that of the entire Danish subfossil record of Brown Bear (Hundsø mose, Skalkendrup mose, Sværdborg, Jebjerg, Virksund, Almind mose, Mullerup, Fyns stiftsmuseum, Brabrand (Degerbøl, 1933) and Dyrhøjgaards mose (Nordmann, 1944) (table 1 and 2)).

The bones from Kainsbakke and Dyrhøjgaards mose together with a remeasurement of the dated bear skulls

Fig. 8. Humerus of Brown Bear, *Ursus arctos* (x2552–6). 1/2.

published by Degerbøl (1933) have been measured according to the definitions given by von den Driesch (1976).

The dimensions of Kainsbakke skull x 2549 are at the upper limits of the range of measurements of the earlier subfossil finds. The skull belonged to a very large individual. Kainsbakke skull x 2288 belonged to a small individual of a similar size as the Jebjerg skull. In Kainsbakke x 2184 only few measurements could be

Pollenzones	Zone IV	Zone V	Zone VI		Zone VII		Zone VIII		
	Hundsø mose	Skalkendrup mose	Sværdborg	Dyrhøjgårds mose	Jøbjerg mose	Virksund	Kainsbakke X 2549	Kainsbakke X 2288	Kainsbakke X 2184
Total Length	400	390	–	395	337	–	–	343	–
Condylobasal Length	363	365	–	365	315	–	–	319	–
Basal Length	342	345	–	345	304	–	–	302	–
Basicranial Axis	96	93	–	101	78	–	–	84	–
Basifacial Axis	251	252	–	247	226	–	244	219	–
Upper Neurocranium Length	225	211	–	222	184	–	–	188	–
Facial Length	199	199	–	195	171	–	190	164	–
Snout Length	145	150	–	143	110	–	137	–	–
Median Palatal Length	196	189	–	187	174	–	182	170	–
Aboral Border of the Alveolus of M2 - Oral Border of C's Alveolus	134	142	–	133	102	–	138	123	(126)
Length of the Molar Row	63	63	–	55	56	–	60	–	56*
Length of P4	16	19	–	16	16	16	17	14	15
Breadth of P4	12	16	–	12	14	12	14	13	12
Length of M1	24	24	23	–	21	24	23	–	23
Breadth of M1	18	20	17	16	18	18	18	–	18
Length of M2	40	39	38	34	36	39	39	36	(34)
Breadth of M2	21	21	19	19	19	19	21	19	19
Greatest Breadth of the Occipetal Condyles	72	76	–	67	–	–	–	64	–
Greatest Breadth of the Bases of the Paraoccipetal Processes	175	(166)	–	(181)	–	–	–	152	–
Greatest Breadth of the Foramen Magnum	32	35	–	31	34	–	–	34	–
Height of the Foramen Magnum	26	27	–	25	29	–	–	28	–
Greatest Neurocranium Breadth	105	102	–	99	94	–	–	97	–
Least Breadth of the Skull	78	78	–	72	70	–	75	67	–
Frontal Breadth	123	139	–	123	107	–	132	96	–
Least Breadth between the Orbits	83	90	–	81	72	–	93	75	–
Greatest Palatal Breadth	94	107	–	90	89	–	101	88	–
Least Palatal Breadth	69	74	–	62	73	–	71	(68)	–
Breadth of the Canine Alveoli	(85)	(92)	–	81	(75)	–	–	76*	–
Greatest Inner Height of the Orbit	53	53	–	56	50	–	57	–	–
Skull Height	118	115	–	121	–	–	–	100	–
Height of the Occipetal Triangle	93	89	–	96	–	–	–	83	–

Table 1. Measurements of Danish subfossil skulls of Brown Bear. The measurements in the brackets are estimated, because the bones are slightly damaged. The measurements marked by an asterisk are measured along the alveolus. All measurements are in mm.

taken, but it seems to have been greater than x 2288.

Obviously the three skulls of the youngest Danish find at Kainsbakke are at the lower, the middle and the upper limits of the variation range of Danish subfossil bear.

The dimensions of the mandibles are in the middle of the range of measurements of the earlier subfossil finds and in some measurements near the upper limits. The Kainsbakke mandible x 2898 belonged to a very large individual.

In order to test whether a size gradient should exist between the oldest and the youngest Danish subfossil material of Brown Bear, teeth have been measured. The size of the teeth are independant of ontogenetic age (Degerbøl, 1933), therefore they can be directly compared. Fig. 9 shows diagrams of teeth arranged according to pollen zones. None of these diagrams show any convincing gradients, although they represent a time span of app. 6000 years. Therefore decrease in size in the Danish subfossil record cannot be verified from the present material.

Zachrisson and Iregren (1974) however find a decrease in size between modern Scandinavian Brown Bear compared with bears from 200 years old Lappish Bear Graves in Northern Sweden. They suggest that the small size of modern Brown Bear is caused by living in a suboptimal environment, to which they have been driven by intensive hunting.

ESTIMATION OF AGE

All of the skulls and mandibles from Kainsbakke have their permanent dentition. According to Couturier (1954) this happens at app. 2 years of age. If degree of tooth-wear is applied, a relative estimate of age can be given. Erdbrink (1953) mentions that the tooth-wear in the cheek-tooth row begins in the third molar, followed

Pollenzones	Zone IV	Zone V		Zone VI			Zone VII	Zone VIII			
	Almind mose	Mullerup	Skalkendrup	Sværdborg	Dyrhøjgårds mose	Fyns stiftmuseum	Brabrand	Kainsbakke X 2898	Kainsbakke X 2295	Kainsbakke X 2765	Kainsbakke X 2151
Total length	-	-	268	-	254	220	-	253	244	-	-
The Condyle Process - Aboral Border of Canine Alveolus	-	-	231	-	221	195	-	210	208	-	-
Aboral Border of Alveolus of M3 – Aboral Border of Canine Alveolus	127	-	131	123	127	113	117	117	116	120	-
Length of Molar Row	78	-	77	-	67	64	70	72	66	67	67
Length of P4	-	-	15	-	12	11	13	14	13	14*	-
Breadth of P4	-	-	9	-	7	7	-	8	7	-	-
Length of M1	(24)	24	26	26	(23)	24	25	25*	21*	24	(20)
Breadth of M1	-	10	12	12	12	11	-	-	-	12	11
Length of M2	(28)	25	27	27	(24)	23	25	25	24	24	24
Breadth of M2	-	-	17	17	15	14	14	18	14	15	14
Length of M3	(25)	23	22	22	20	18	20	20*	21	21	22
Breadth of M3	-	-	18	18	16	15	-	-	15	16	16

Table 2. Measurements of Danish subfossil mandibulae of Brown Bear. The measurements in the brackets are estimated, because the bones are slightly damaged. The measurements marked by an asterisk are measured along the alveolus. All measurements are in mm.

by the superior second molar, inferior second molar, superior first molar, inferior first molar and superior fourth premolar. The lingual cusps of the superior molars and the buccal cusps of the inferior molars start to wear. In the superior fourth molar the tetracone starts to show signs of wear, while proto- and tritocone wear much later. In the inferior fourth premolar it is only possible to recognize wear in very old individuals (Couturier, 1954). If these informations are applied to the present material their order is as follows, from the youngest to the oldest: x 2295 – x 2765, x 2184, x 2288, x 2151, x 2249 – x 2898.

Kainsbakke x 2295 and 2765 are probably left and right mandibles from the same individual. The mandibular symphyses fit together and they show the same degree of tooth-wear.

Whether skull x 2249 or mandible x 2298 is the oldest cannot be decided on tooth-wear. No cusps can be recognized in any of the molars of these two elements.

Suture closure of the skull could elucidate the age determination. However, on account of its fragmentary condition x 2184 is difficult to interpret. In x 2288 the basioccipetale – basisphenoideum is not obliterated, while the intermaxillare suture is partly closed. According to Giles (in: Zachrisson and Iregren, 1974) the former coalesces in males at the end of the sixth year, while the latter closes between the age of six to eight years. So this individual is probably between six and eight years old. In x 2249 all of the sutures are closed, except for zygomaticum – temporale. Couturier (1954) states that most of the sutures are obliterated at the age of 18 to 20 years, except for zygomaticum – temporale, which never closes.

From the present material it can only be stated that it belonged to adult individuals of more than two years and that the oldest was more than eighteen years old.

INTERPRETATION

From the record of Danish subfossil Brown Bear it has not been possible to establish if the bears were utilized for consumption and raw material. It is suggested that phalanges found in funeral urns from the Germanic Iron Age come from hole skins, possibly imported (Møhl, 1977). The present material from Kainsbakke, however, has several traces of human origin which might give a clue as to the purpose.

Evidence of how the bears were killed is not obvious in the Kainsbakke material. In one skull (X 2288) there is a hole in the dextral maxilla and the dextral nasale is missing (fig. 3), an injury which could have been inflicted by a blunt instrument. This could not have been fatal, but perhaps left the bear unconscious, after which it would have been easy to stab it to death. However, it cannot be discounted that the injury reflects post-depositional damage.

From Swedish bear hunting a few hundred years ago there is evidence that the bears were killed during winter by awaking them in the winter dens, inflict a blow on the head of the bear and thereafter stab them to death or shoot them (Zachrisson and Iregren, 1974).

A similar technique is possible at Kainsbakke, regarding the fact that the site (also) was used during the winter season (Richter, in prep.) and that even Danish Brown Bear must have been denning due to their feeding strategy, based partly on vegetable food.

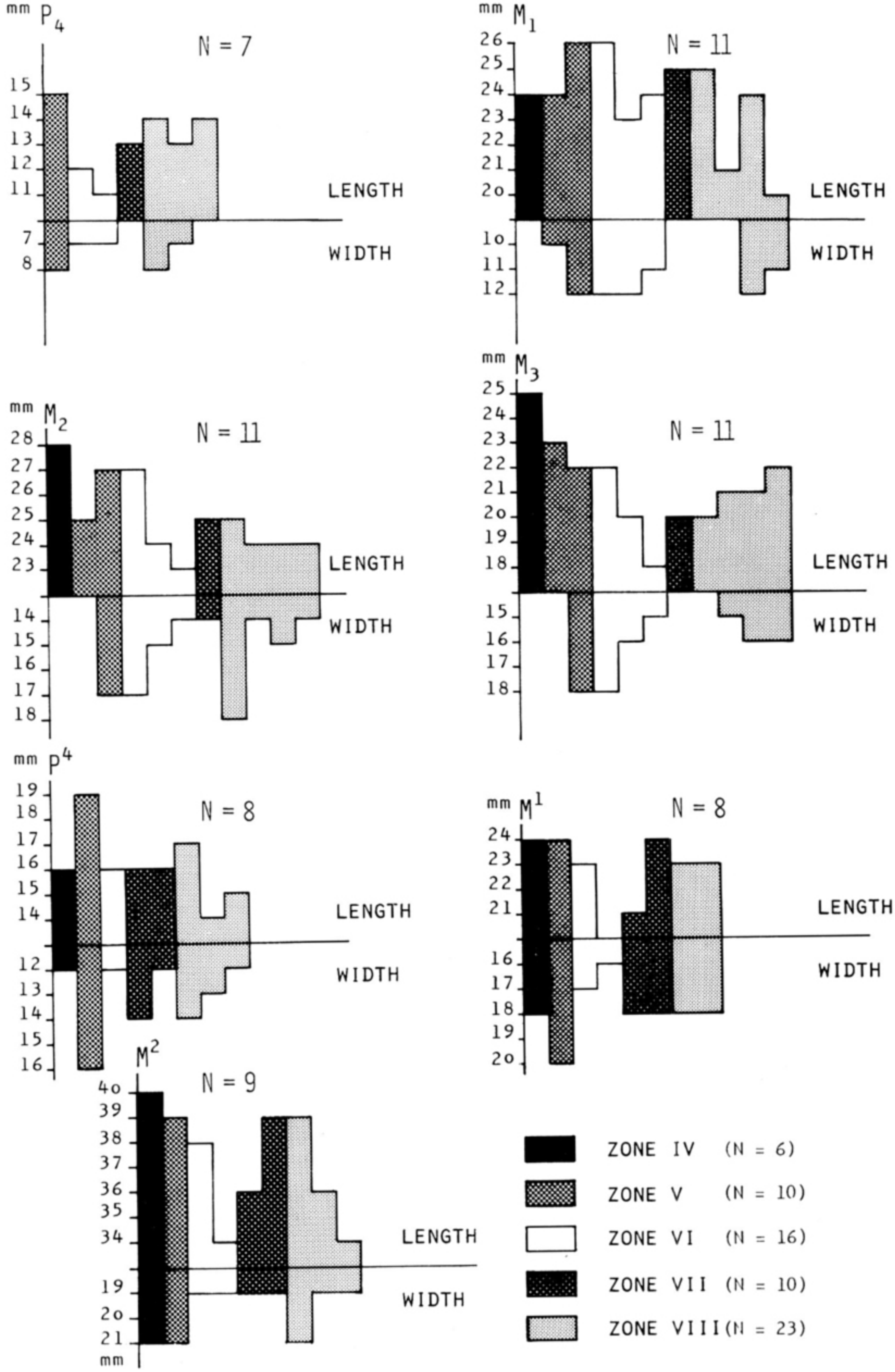

Fig. 9. Dimensions of teeth of Danish subfossil Brown Bear arranged according to pollen zones. The upper portion of the diagram shows the lengths of the teeth measured in mm, while the lower portion of the diagram shows the width of the teeth. The diagrams do not show any convincing gradients which could verify a decrease in size in the Danish subfossil record.

Fig. 10. Canine alveolus of skull x2249. The alveolus has been deliberately broken in order to remove the tooth.

The injury at the back of the head of skull x 2549 (fig. 1) seems to have been inflicted by a series of blows. This does not seem to be the cause of death. The systematic nature of the blows indicate that the damage is more likely to be post-mortem in order to get access to the brain. Further, this skull has a healed lesion in the forehead. Whether it was caused by an earlier hunting injury, intraspecific strifes or by accident is not obvious. Radiographs of the lesion did not give any further clues as to the cause of the lesion.

Cutting-marks in connection with skinning are seen on skull x 2288 (fig. 4) and mandibles x 2898 (fig. 7) and 2151. These individuals have undoubtedly been skinned. No phalanges are found at the site. This could be a further indication for skinning as these elements usually are left in the skin.

Canines seem to have been used as raw material or pendants. In skull x 2549 the alveolus has been deliberately broken in order to remove the canine tooth (fig. 10). Whether other teeth have been used is not obvious in the present material. No incissors are *in situ*, but they are usually lost during burial and /or diagenesis. However, premolars and molars *in situ* are so numerous together with one canine that they cannot have been regarded as valuable.

Only few bones of the post-cranial skeleton are represented (fig. 11). The limb bones are marrow fractured and the fracture of one of the humeri (upper arm) (x 2552–6) having very sharp edges, indicates that the bone was divided before removal of the meat (Noe-Nygaard, pers. comm. 1983). Post-depositional fragmentation can be excluded in this case. Due to the meticulous excavation, fragments caused by post-depositional fragmentation are retrieved within the same square and can be reassembled. Cutting-marks are scattered on several of the fragments e.g. the scapula (shoulder blade), suggesting that the meat was scraped off. The nature of the fragments definitely indicates that they are meal remnants.

The evidence from Kainsbakke would suggest that the bears have been treated in a similar manner as other game animals. The bear bones have even been deposited in the dump together with the rest of the refuse from the settlement. Throughout the circumpolar region rites associated with bears have been found e.g. a special grave for the bear, often with the bones placed in their anatomically correct position (Zachrisson and Iregren, 1974). However, the treatment of the bone material from Kainsbakke has no similarities with the bones from these rites and the bones show no signs of having been used in any form of ritual.

CONCLUSIONS

The bone material of Brown Bear from Kainsbakke represents the largest Danish settlement find of the species. Together with Holme Skanse it is the youngest find, which establishes the presence of the species in Denmark up to 2500 B.C. (calendar years).

It is suggested that the bears were hunted during the winter season, in connection with denning. Human-

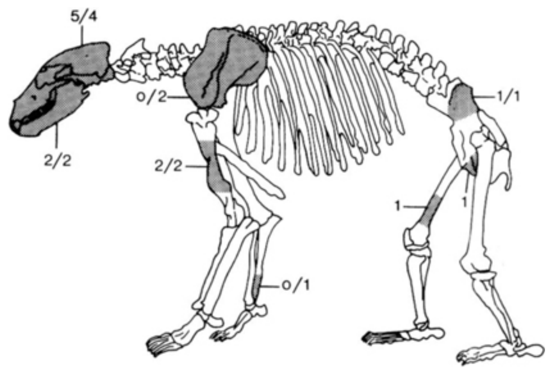

Fig. 11. Skeleton of Brown Bear showing the type (dots) and number of bones found at the Kainsbakke site. White areas indicate bones or fragments which have not been found at the site. The figures to the left of the dividing line indicate number of fragments found from the left side and the figures to the right indicate fragments found from the right side of the animal. Redrawn from Kurtén (1976).

made marks on the bones show that the animals were extensively utilized for skin, teeth and food. The bones show no indication of bear rituals.

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Settlements from the Single Grave Culture in NW-Jutland

A Preliminary Survey

by JOHN SIMONSEN

The Single Grave Culture (EGK) was originally defined on the basis of the grave material when it was described by Sophus Müller in 1898. It was particularly the low barrows on the heaths in parts of Jutland, that called the attention of the archaeologists and several excavation campaigns were done, especially in the 1890's. These fundamental investigations of the Single Graves were not followed up by an equivalent search for the settlements.

Nearly half a century later, when P.V. Glob published his intensive study of the Jutish Single Grave Culture still only a few settlements were known. It was realized, however, that the mould in the gravemounds was often mixed with settlement material, indicating that settlements were likely to be found in the neighborhood (Glob 1944: 245).

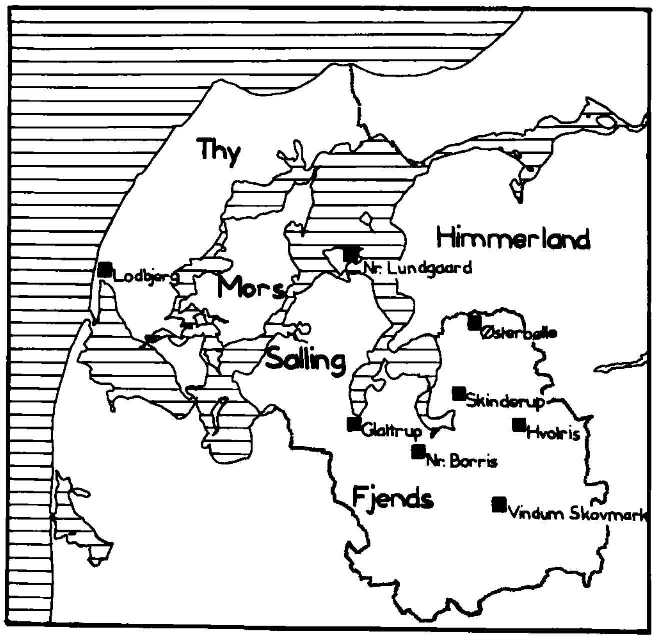

Fig. 1. Settlements from the Single Grave Culture in Viborg County. Drawn by Mette Nielsen.

In his "Studies of the Prehistoric settlement of West Jutland" (1948) Therkel Mathiassen mentioned several settlements from the period. He enumerated 46 settlements from the Single Grave Culture. At all the localities flint tools were found: thick butted axes (at almost all localities), chisels, borers, round flake-scrapers, blade knives and firestones etc. In addition there were stone tools at many localities: Granite clubs, tongued wedges and battle axes. It was mostly surface finds and characteristically only a few potsherds were found, restricted to 4 localities.

During the last decades a few regular settlements from the Single Grave Culture in Jutland have been systematically investigated. Thus O. Marseen in 1953 published a coastal settlement at *Selbjerg*, and in the publication of *Myrhøj* in 1972 J.Aa. Jensen briefly discussed a few localities. Steen Hvass in 1977 published a small settlement at *Vorbasse* with a house from the Upper Grave Period. Finally S.H. Andersen in 1983 published a costal settlement at *Kalvø* from the Ground/Upper Grave Period.

Some recent excavations of settlements from the Single Grave Culture in NW-Jutland (Viborg County) will be the subject of this article (Fig. 1). This is done in order to shed further light on the nature of the Single Grave Culture not least with regard to the chronology of the pottery and the regional development.

GLATTRUP

In 1983 a small EGK-settlement was excavated as part of a larger rescue excavation by the author, Skive Museum, with assistance from H. Holck, O. Jensen and

A.N. Jensen at a building site in Glattrup. The locality is near the end of a sandy headland, delimited to the north by Skive Fjord and to the west and south west by a brooklet. The ground is flat, sloping slightly to the north. At this locality some settlement-pits and some postholes were found (Fig. 2). Some of the postholes seem to be traces of a structure, possibly a house or fence. The postholes are not very deep, most of them ranging from 8 to 15 cm. It is likely that they were deeper, before the area was cultivated. Some postholes had been destroyed by the removal of the topsoil before excavation. Only one of the postholes contained a tiny unornamented potsherd, which cannot be dated with certainty. Beside the postholes three settlement-pits were found.

The settlement pits are thought to be the remains of a small settlement. It is doubtful, whether all the postholes should be connected with the EGK-settlement. One of the postholes (no. 101) contained a potsherd belonging to a beaker from pit no. 100. A typical EGK-flint axe (no. 129) was found under the topsoil 15 cm east of the posthole no. 96.

The finds (Fig. 3)

Pit no. 113 was 2.5 m long, 0.8 m broad and 0.4 m deep. Its fill consisted of a greyish mould with charcoal-dust and a piece of burned flint. The pit cannot be dated.

Pit no. 100 was 1.3 m long, 1 m broad and 0.32 m deep, in section crescent-shaped. Its fill consisted of a greyish mould with charcoal-dust. The pit contained a saddle quern of granite. Also of granite are an 8 cm long, oval stone with two hollows, one on each side (presumably used with a bow drill), and a hammerstone. There were about 130 pieces of worked flint, but only a few artifacts: 12 scrapers/fragments of scrapers, a borer, a burin-like piece. Among the 219 potsherds were many small or unornamented pieces and fragments of at least 8 pots, 6 of them belonging to the curved-profile beaker type (the rest cannot be reconstructed). Three of the beakers are decorated at the neck with horizontal two-strand cord lines. One beaker has at the neck and under the rim horizontal rows of incisions consisting of two small crescents. Another beaker has triangular incisions on the rim and at the neck. Finally, the pit contained small pieces of charcoal and burned bones (not identified).

Pit. no. 99 was 0.7 m long, 0.5 m broad, 0.12 m deep. The mould was greyish. It contained 12 pieces of worked flint. There were no tools apart from a blade with retouch along the edges. There were 32 potsherds in the pit. A potsherd, prob-

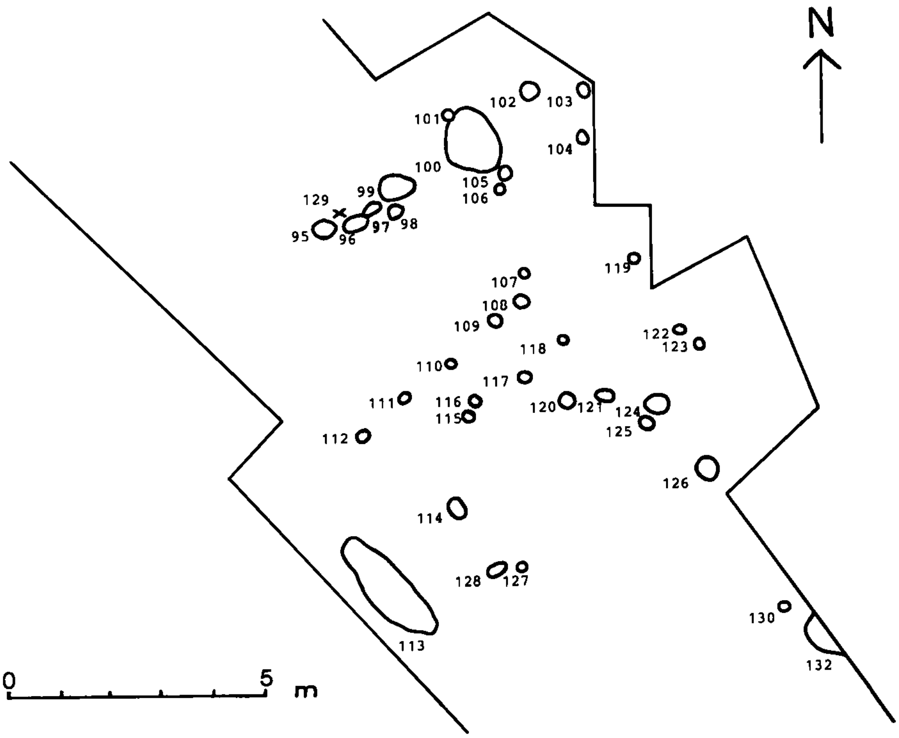

Fig. 2. Glattrup. Plan of the Settlement site.

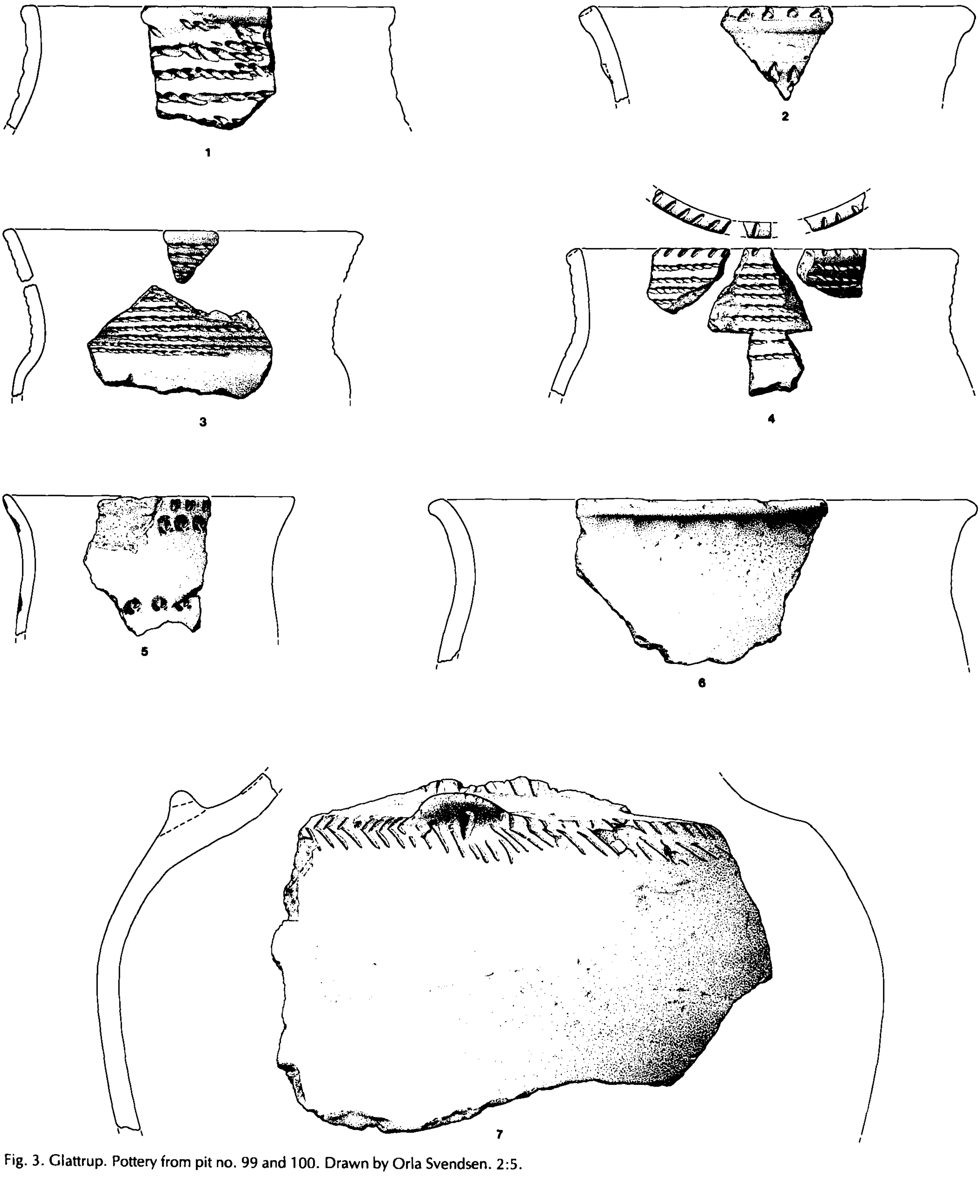

Fig. 3. Glattrup. Pottery from pit no. 99 and 100. Drawn by Orla Svendsen. 2:5.

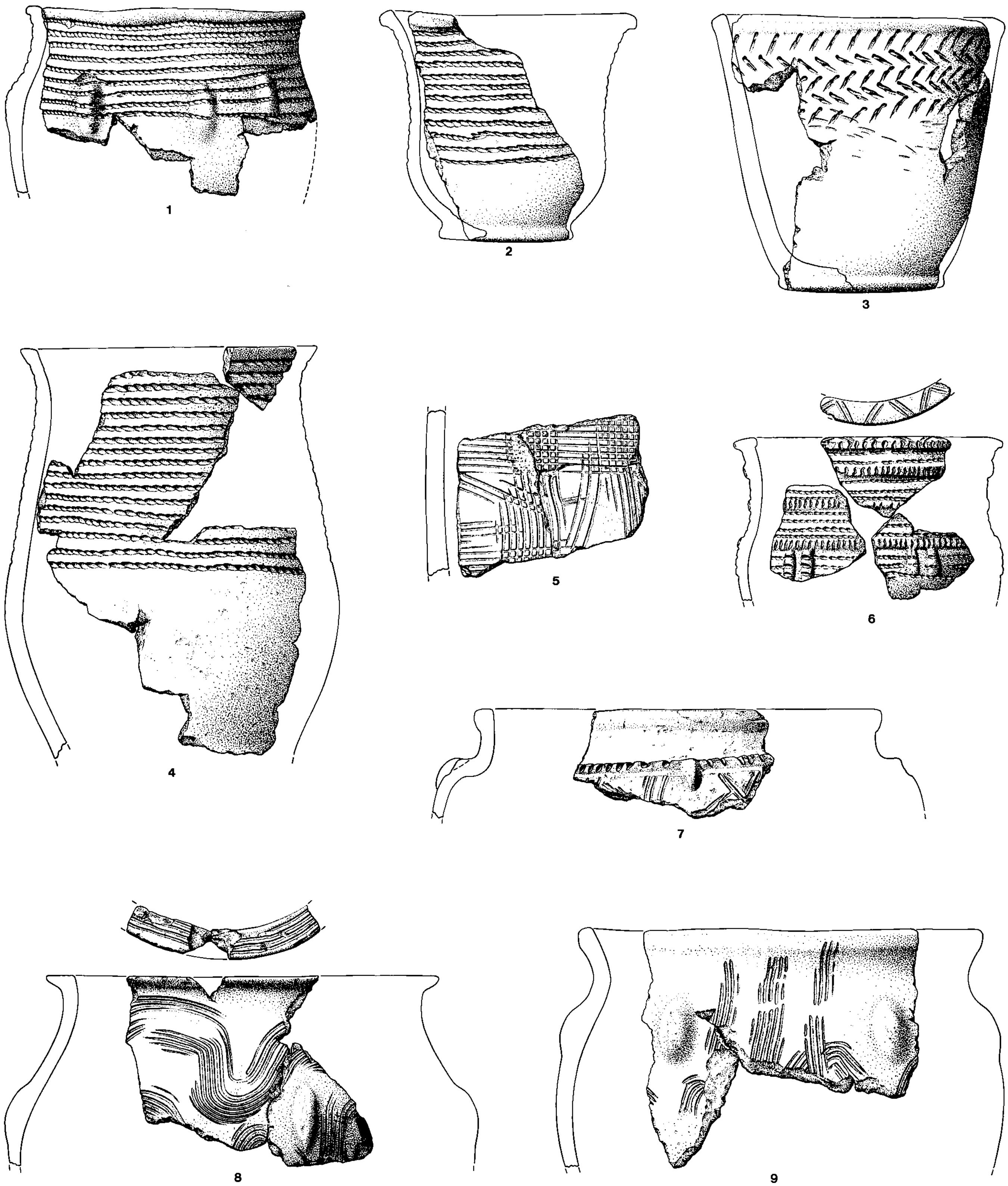

Fig. 4. Hvolris. Pottery. Drawn by Orla Svendsen. 2:5.

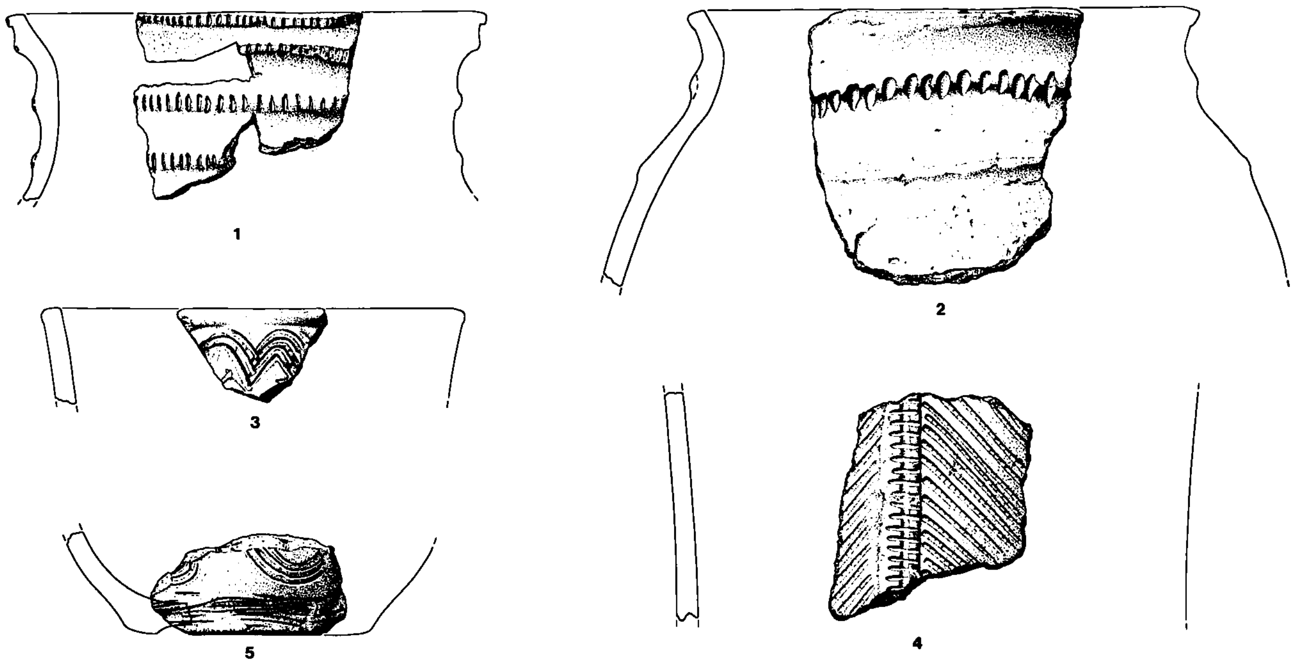

Fig. 5. Hvolris. Pottery. Drawn by Orla Svendsen. 2:5.

ably from a curved profiled beaker, has remains of incised cord lines. Another potsherd has deep vertical grooves. Fragments of a large round-bellied jar can be partly reconstructed. At the shoulder there is a horizontal herring-bone motive left and right of and partly under the lug. On the neck there are traces of a horizontal row of vertical furrows.

HVOLRIS

In 1962 an excavation at Hvolris was initiated by Peter Seeberg, Viborg Stiftsmuseum, and continued during the 60's and 70's (in the later years headed by Hans Langballe). Besides an EGK-settlement there were also settlements from other Neolithic periods and the Bronze Age and not least the Iron Age (Seeberg 1968). The starting point here is a new interpretation of the find. In the view of the author the site is a regular settlement with fragments of pottery, flint and stone tools. The locality is situated on sandy ground on a terrace near a brooklet.

The excavators operate with an upper culture layer and a lower culture layer. These layers are separated by other layers (1). All is covered by a sandy topsoil. The Neolithic finds are from the lower layer.

The finds (Figs. 4–5)

For artifacts of flint and stone reference may be made to Seebergs publication (2). The pottery from campaigns of excavation over many years is quite voluminous and in the attempt to sort out the potsherds from the Single Grave Culture it has sometimes been difficult visually to distinguish unornamented neolithic from Iron Age ware. Common for both groups is a finegrained ware.

Three ceramic forms are prevailing: round-bellied, curved-profile and straight-walled beakers. Ornamentation with two-stranded cord is common. One curved-profiled beaker has 17 horizontal cord lines from the middle of the belly to the rim. Another beaker has nine horizontal cord lines from the middle of the belly to the rim combined with short vertical projections at the shoulder.

Another technique of ornamentation is incised straight or waving lines. These lines are found in sets of from 3 to 10. A round-bellied pot has a combination of such waving lines and short vertical projections. A potsherd shows sets of nearly straight parallel lines crossing at almost right angles.

A straight-walled beaker has a herringbone motive on the upper part below the rim. This beaker has a fine-grained ware mixed with coarse granite-grains.

A group of beakers has horizontal cordons at the shoulder and neck. In profile some of these beakers are quite close to those found at the *Tastum* site (Simonsen 1982). A beaker has three horizontal cordons with small vertical incisions. Another beaker has two horizontal cordons, one of them with

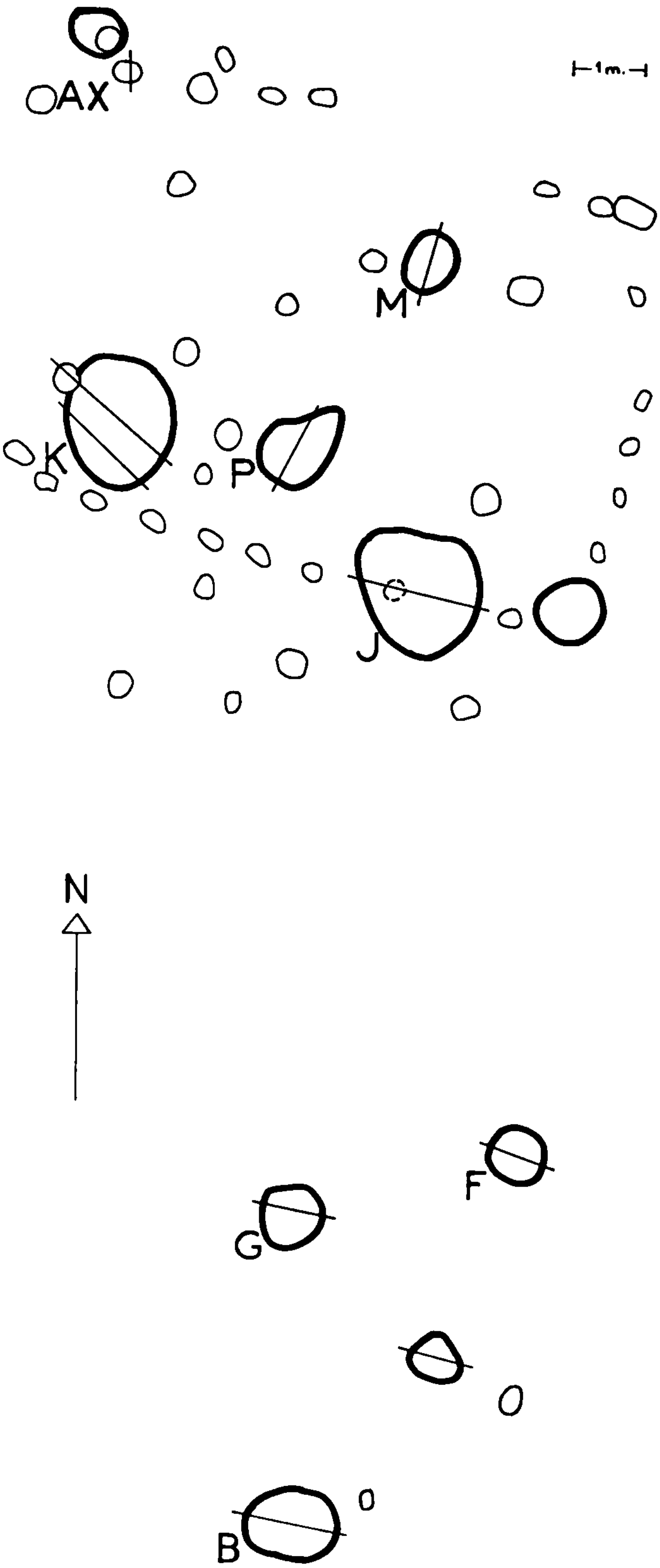

Fig. 6. Skinderup. Plan of the settlement site. 1:100.

short vertical incisions. A beaker with a horizontal cordon has a very complex design. The top of the rim is decorated with short lines meeting nearly at right angles. The outer part of the rim and the horizontal ribs have a dense pattern of vertical incisions. The space between and under the cordons is filled up with horizontal two-stranded cordlines. Pairs of vertical projections are placed below the lower cordon.

Potsherds with dentated spatula incisions are almost absent. On a straight-walled beaker this ornament is divided by a vertical list with horizontal incisions.

LODBJERG

An EGK-settlement has recently (1985) been excavated by David Liversage, the National Museum, Copenhagen. The settlement is preliminarily dated to the Ground Grave period. It will later be published by the excavator.

SKINDERUP

In 1985 an EGK-settlement was excavated by Jytte Nielsen, Viborg Stiftsmuseum, as a rescue excavation before laying down a gas pipeline. The locality is situated on sandy ground south of Skinderup brooklet. The terrain is slightly sloping to the west. Near the eastern end of a long-house from the Late Bronze Age, four pits were found (K, M, J, P) with EGK-pottery and worked flint (Fig. 6). Some meters south of the house three other pits with EGK-potsherds and worked flint were found. The pits are more or less round in plan. In section they have different shapes. Some (J and K) are quite deep (about 1 m deep) while others (G and F) are quite shallow, about 0.15 m. In diameter the pits vary from 1.6 m (J) to 0.6 m (F).

The finds (Fig. 7)

According to the excavator the 8 pits together contained 339 pieces of worked flint including a possible flake scraper and a few other pieces with retouch. Quernstones of granite, clubs of granite and a grind stone are also represented in the pits.

85 EGK-potsherds were found in the pits. Straight-walled and round-bellied pots are represented. Decoration with furrows, spatula impressions, and two-stranded cord lines is common.

A possibly straight-walled beaker has a flat, thickened rim with furrows and dentated spatula impressions under it. A round-bellied beaker has an oblique row of spatula incisions under the thickened rim.

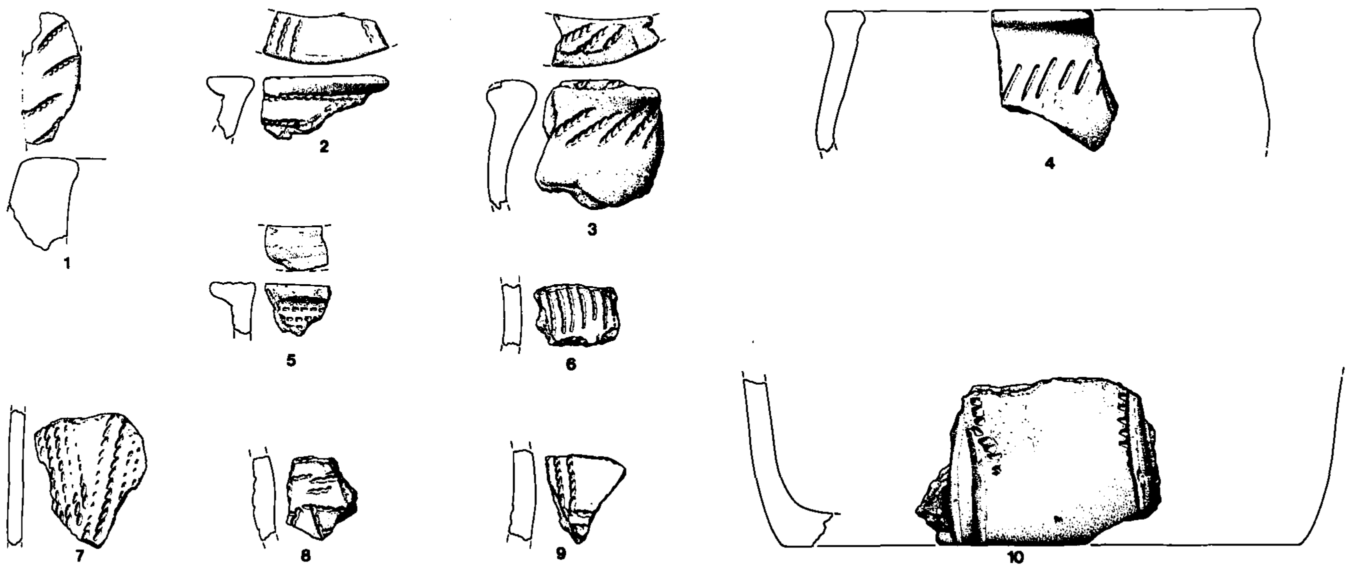

Fig. 7. Skinderup. Pottery. Drawn by Orla Svendsen. 2:5.

NR. BORRIS

In 1984 an EGK-settlement was excavated by Jesper Hjermind and the author, Skive Museum, as a rescue operation before laying down a gas pipeline. The locality is situated on sandy ground east of the river Fiskbæk Å. The terrain is flat, sloping a little to the east and south. A large pit 5.4 m long, 4.8 m broad and 0.2 m deep was excavated. Within the pit there were a few postholes and shallow depressions. Whether the postholes had a connection with the construction is unclear. The bottom of the pit is quite level and it seems likely that it should be interpreted as a small house with sunken floor (Figs. 8–9).

It is possible that further traces of the Single Grave Culture may survive in the same field, as the pit (the house) was found in an only 20 m broad excavation area. Surface finds east and south of the excavation area indicate so.

The finds (Fig. 10)

The pit contained greyish mould and some stones, worked flint and potsherds. There were a few hammerstones of flint and quartzite and some so-called cooking stones of granite. Most of the worked flint is waste, including 92 flakes. There was a borer, a possible strike-a-light and 4 pieces with retouch.

112 potsherds were found in the pit. Two profiles could be party reconstructed. They are both of a round-bellied type with marked shoulder, concave neck and outfalling rim. One of them is ornamented with a horizontal row of oblique cardium stamps. Under the shoulder the other is ornamented with hanging triangles with lines of dentated spatula. At the rim there are short oblique lines also. Most of the other potsherds seem to belong to the round-bellied type. Beside ornamentation with cardium and dentated spatula there are a few sherds with two-stranded cordlines.

NR. LUNDGAARD

In 1970 a trial excavation was made by Jens Aarup Jensen, Forhistorisk Museum. The settlement is located in the bottom of a valley of the island Fur about 300 m from the Northern coast (Jensen 1973). The settlement was found in connection with quarrying work. Some postholes of varying size and depth and some areas with a mould colored by charcoal-dust were found (3). The postholes did not seem to form a regular pattern.

The finds (Fig. 11)

Only some of the potsherds belong to the Single Grave Culture, others being clearly Late Neolithic. This accords well with the information that Late Neolithic flint tools are found immediately north of the valley. The pottery forms are straight-walled and round-bellied beakers. A straight-walled beaker has a combination of multiple chevrons and short obli-

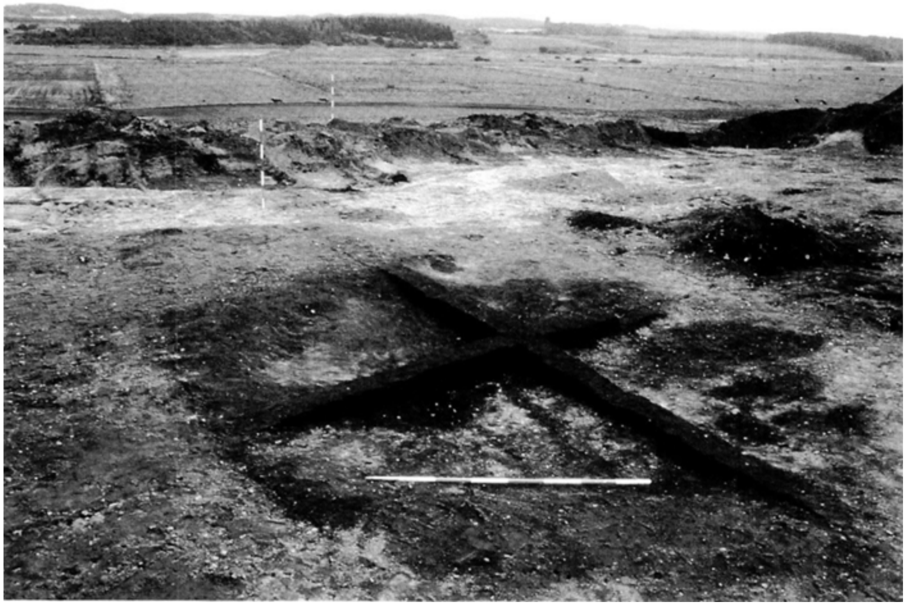

Fig. 8. Nr. Borris. Excavation of the house, seen from NW. In the background the valley with Fiskbæk å (river). Photo by the author.

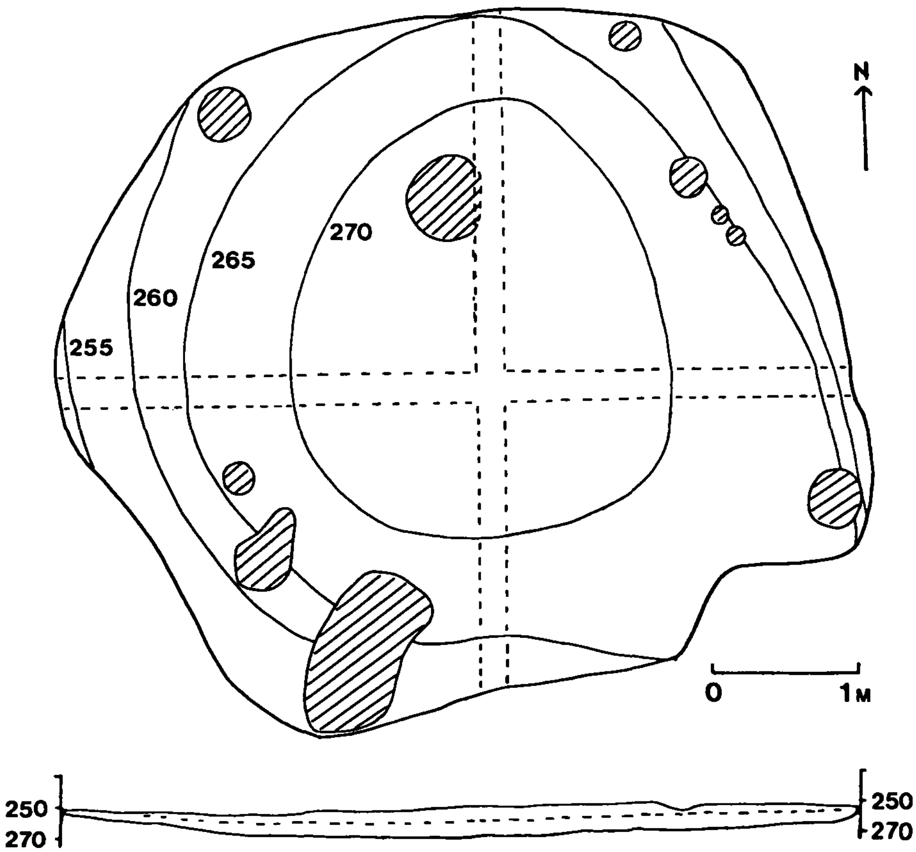

Fig. 9. Nr. Borris. Plan of the house. Drawn by the author.

que cardium lines a bit below the rim. Another straight-walled beaker is ornamented with oblique dentated spatula lines below horizontal dentated spatula lines. A round-bellied pot is ornamented with spatula incisions at the shoulder and at the outer side and at the rim. Another beaker has dentated spatula incisions at the neck (horizontal) and at the shoulder (oblique).

Sherds of other straight-walled beakers are ornamented with short cardium lines or comb-lines. A possible straight-walled beaker has below the rim a decoration of lines crossing each other. A round-bellied pot is decorated with short horizontal comb-lines on the neck a bit below the rim. This ornamentation seems to be continued at the shoulder with oblique comb-lines. Another round-bellied pot has short vertical incisions at the outer side of the rim and at the shoulder. On another beaker, probably of the same form, this ornamentaton is varied at the shoulder with cardium lines. From the shoulder of a possibly round-bellied pot is a sherd with two horizontal cordons with short vertical incisions.

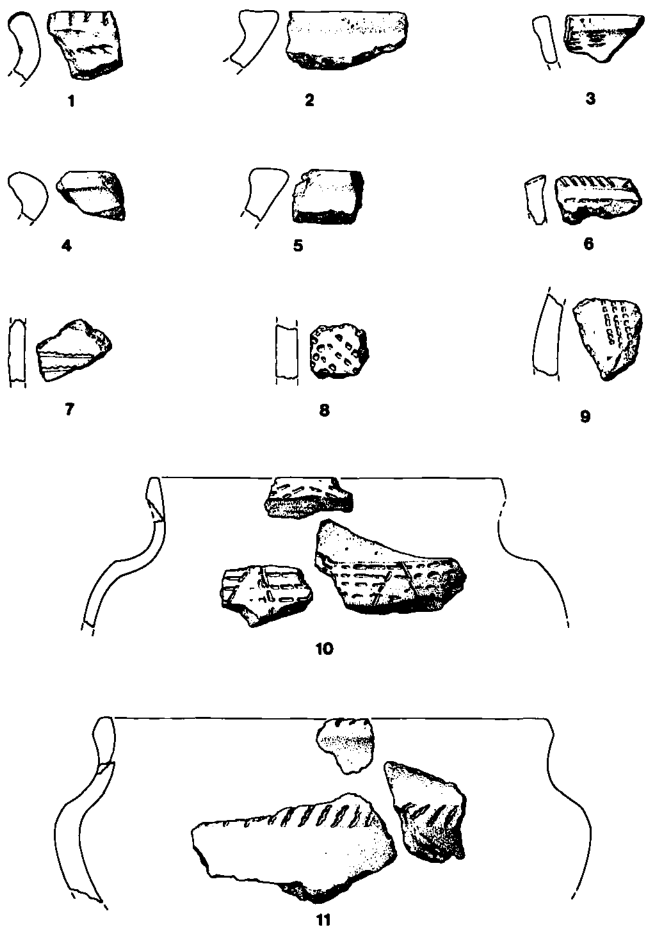

Fig. 10. Nr. Borris. Pottery. Drawn by Orla Svendsen. 2:5.

VINDUM SKOVMARK

In 1973 Viborg Stiftsmuseum made a small trial excavation at a locality where some stones were found by ploughing. The excavation showed that there was an irregular cluster of granite stones under the topsoil. Under the stones was found a culture layer with worked flint and EGK-potsherds. The locality is at the highest point of an almost plane, sandy area delimited to the north and east by a valley and its brooklet. To the south there is a bog. It is likely that the culture layer extends over a somewhat larger area than the 12 square meters investigated during the trial excavation.

The finds (Fig. 12)

About 40 uncharacteristic flakes of flint and a supposed roughout for a flint axe were found in the culture layer.

About 1400 potsherds were found including many small or unornamented pieces. Apart from sherds of a few possible straight-walled beakers, the round-bellied form dominates. Generally, they have a marked shoulder, concave neck and thickened outfalling or T-shaped rim. Decoration with dentated spatula is common. On top of the rims there are several examples of oblique dentated spatula lines. Also the shoulders are decorated with dentated spatula. One round-bellied pot has a combination of oblique dentated spatula lines on the top of the T-shaped rim, 4–6 horizontal similar lines at the shoulder, and oblique bands of the same in combination with unornamented areas in a metope-like arrangement below. Short oblique lines are another ornamental motive. It occurs on the top of a T-shaped rim and at the shoulder. One round-bellied pot has groups of oblique incisions separated by raised vertical ribs with horizontal crosslines. Two-stranded cord-lines appear as ornament on top of the rim and on the belly of another potsherd.

ØSTERBØLLE

During the excavation of a locality with graves from the Roman Iron Age under the direction of Gudmund Hatt in 1933 a pit (no. VII) with granite stones, a saddle quern, and some EGK-potsherds was found. The pit was 2.6 m long, 2.3 m broad and 0.6 m deep. As there were also potsherds from the Iron Age the excavator regards it as a Stone Age grave disturbed in the Iron Age (Hatt 1938: 203). More correct is probably the interpretation by C.J. Becker (1957), who suggests that it was a stone Age settlement-pit disturbed in the Iron Age.

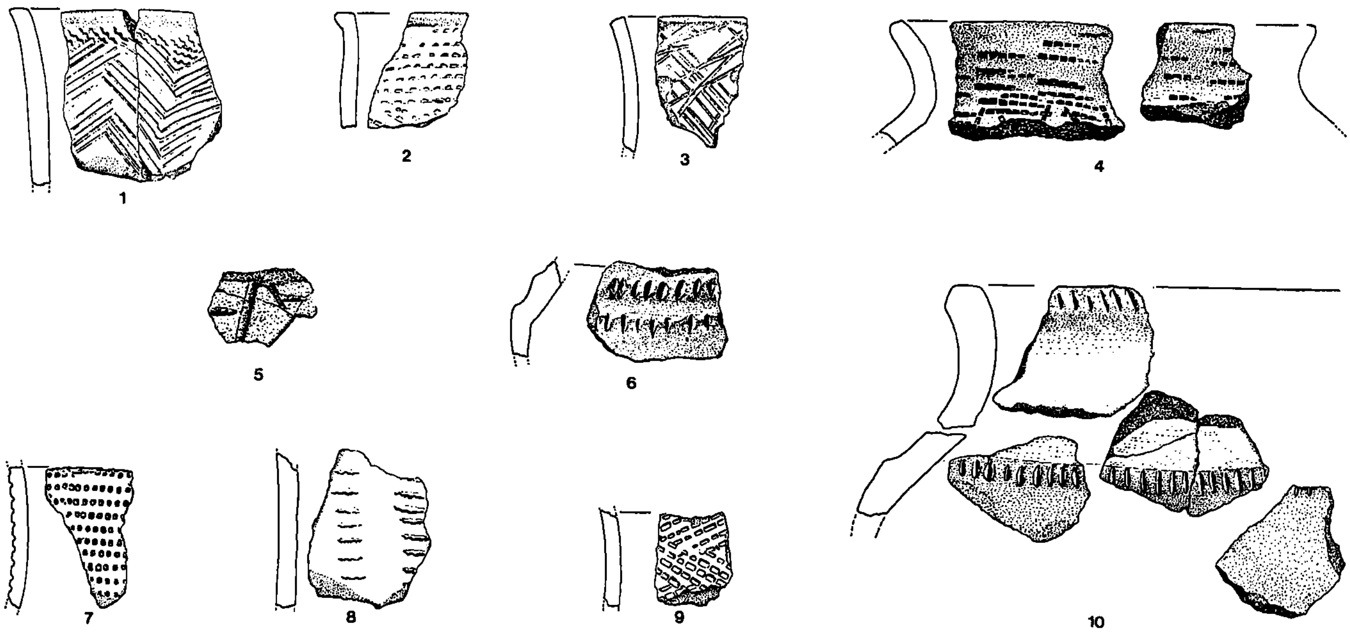

Fig. 11. Nr. Lundgaard. Pottery. Drawn by Jens Aarup Jensen. 2:5.

The finds (Fig. 13)

Sherds belonging to 3 round-bellied pots and a probably straight-walled beaker were found. Two round-bellied pots have the same ornamentation with two-stranded cordlines at the top of the rim and respectively 6 and 7 horizontal lines of the same ornament at the neck and the shoulder. Below that short vertical cordlines on the shoulder. Sherds of the third round-bellied pot have an ornamentation with dentated spatula lines, which are oblique at the top of the rim, horizontal on the neck below the thickened rim, and vertical at the shoulder. The straight-walled beaker has dentated spatula lines on the top of the rim.

THE SETTLEMENTS AND THEIR DATING

The settlement sites from Viborg county described in the foregoing have some topographical features in common. They have been placed on naturally well-drained, sandy ground (apart from *Nr. Lundgaard*) near fresh water (rivers, brooklets etc.). Pits, postholes, (thin) culture layers and, possibly, a small house at one of the localities constitute the traces left at the settlements. Compared to many localities from the Funnel Beaker Culture the EGK-settlements are relative small in respect of quantity of finds. The scanty material consists of fragments of pottery, worked flint with few tools, clubs of granite or flint, and saddle querns of granite. Organic material has decayed (apart from small pieces of burned bone and charcoal).

The dating of the settlements is dependant mainly on the pottery. Fine-dating the settlement pottery, however, is a difficult task and for the moment it seems appropriate to deal with datings in more general terms and not to be too specific. It must be stressed that the datings suggested in the following are preliminary.

The earliest settlement is *Glattrup*. It probably belongs to the younger Under Grave Period. This dating – on typological grounds – is based on the form of the beakers and their ornamentation with two-stranded cordlines and spatula incisions. This accords well with the herringbone motive at the shoulder of the large round-bellied pot (and also with the flint axe in the find).

The *Hvolris* find seems to be constituted of more than one occupation in the EGK-Period, possibly two occupations. To the older settlement belong the cord-ornamented beakers and probably also the round-bellied pots with wavey scoring. A dating to the Ground Grave Period seems reasonable.

The *Lodbjerg* settlement is also preliminarily dated by the excavator to the Ground Grave Period.

The pottery from *Glattrup* and the older *Hvolris* settle-

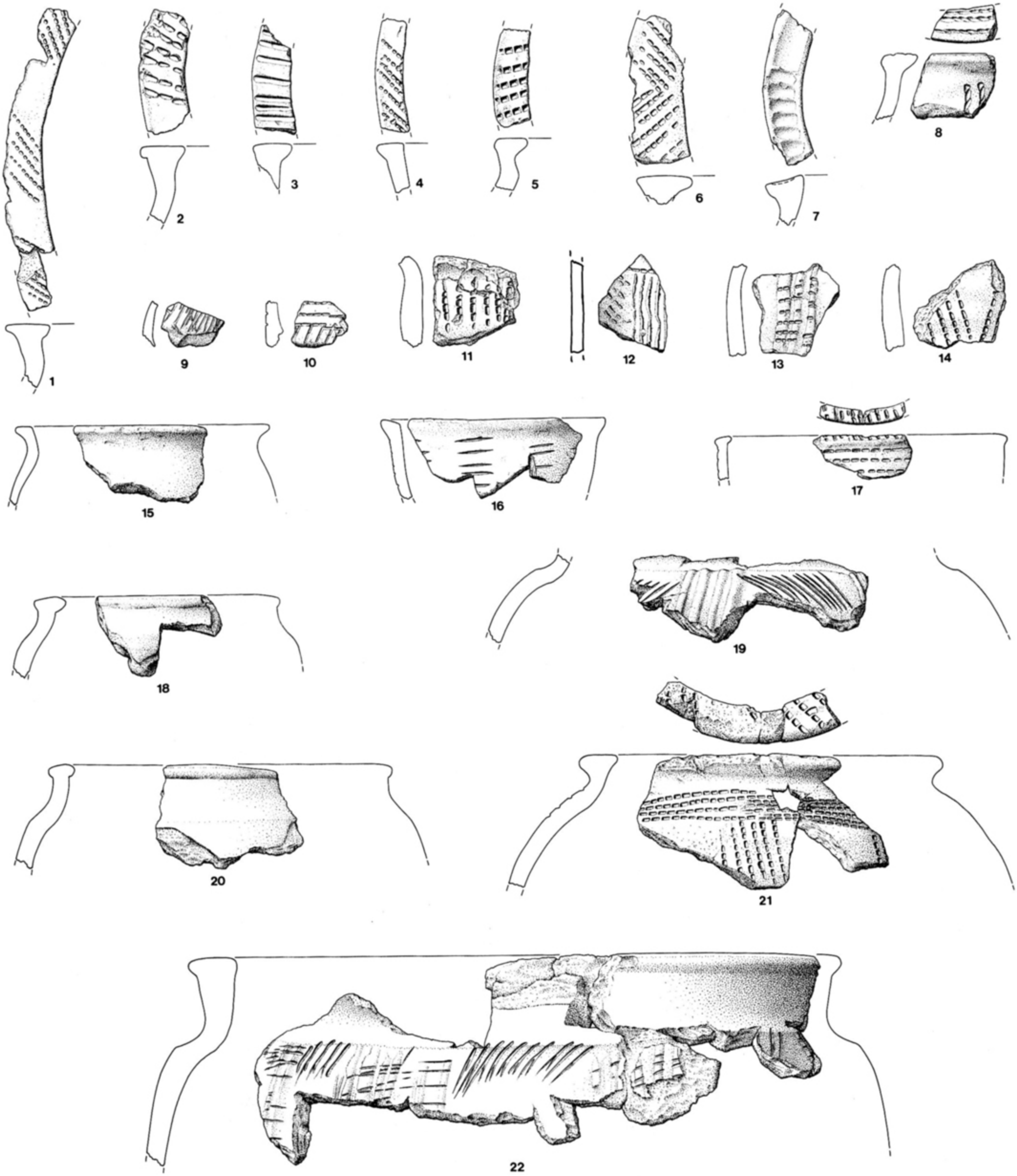

Fig. 12. Vindum Skovmark. Pottery. Drawn by Orla Svendsen. 2:5.

ment have the curved-profiled beakers with cordlines in common. The rest of the settlements (*Skinderup*, *Vindum Skovmark*, *Nr. Lundgaard*, *Nr. Borris*, *Hvolris* (the younger settlement), *Østerbølle*) belong to the time of the straight-walled beaker, that means the second part of the Ground Grave Period and the Upper Grave Period (the type continues in LN).

Curved-profiled beakers, straight-walled beakers and round-bellied beakers known from the graves also constitute important pottery-types at the settlements. It is worth noting, however, that while the curved-profiled beakers and not least the straight-walled beakers seem to dominate in the grave finds, the round-bellied pots are generally very common at the settlements.

There are relatively many sherds of straight-walled beakers represented at *Nr. Lundgaard*, while the round-bellied beakers are prevailing at *Vindum Skovmark*. Whether this has a chronological significance is unclear.

Thickened rims are present in all six finds. In some finds, like *Vindum Skovmark*, the T-formed rim is a dominating feature. For the moment it is not possible to define the time of T-formed rims more precisely than to the Upper Grave Period (and the beginning of LN).

Ornamentation in dentated spatula technique is present in all six finds belonging to the time of the straight-walled beaker. Decoration in different techniques like cardium impressions, applied bands, plain spatula incisions, and cordlines is present at some of the settlements, but apparently not at all of them. The relative frequency of the patterns may have some chronological significance, which for the moment is unclear.

The pattern on the round-bellied beaker with dentated spatula impressions from *Østerbølle* probably suggests a late dating since almost the same motive seems to be present at the LN-settlement at *Tastum* (Simonsen 1982, fig. 7,1). This may give a late dating also for the *Vindum Skovmark* find, where this motive also is represented. (This accords also well with a probable source of inspiration in beakers like the Dutch Veluwe beakers with metopes, see below). As a late feature in *Vindum Skovmark* a beaker (probably belonging to the straight-walled type) with vertical rows of short horizontal lines a bit below the rim should also be mentioned. A round-bellied beaker with fragments of a characteristic hanging triangle motive (dentated spatula technique) probably suggests a dating to the middle or the later part of the Upper Grave Period for the *Nr. Borris* settlement.

It is worth noting that settlements from the older Under Grave Period were not represented. Regular settlements from this phase have so far not been found in other parts of Jutland either. A recent find, however, must be mentioned. A circular house found beneath a barrow at *Lustrup* dated to the very early Single Grave Culture has recently been excavated (Rostholm 1982). It was about 11 m in diameter and a dark culture layer containing worked flint, potsherds and charcoal was partially preserved. This find is from an area of Central Jutland where some of the oldest battle axes in EGK-graves are found.

In *Glattrup*, about 60 km North of Lustrup, the situation is already different. Apart from finds from *Kobberup* (Becker 1954: 73) it is the time of the D/E axes, which constitute the first clear period of the Single Grave Culture in the area. In *Salling*, the peninsula North of Glattrup, no battle axes of type A–D are recorded by Glob, while the E-type is well represented. The number of battle axes of EGK-type is so large that it does not seem probable that the distribution will be changed significantly by future finds (4).

Probably the Funnel Beaker Culture (TRB) existed in this area until the gradual take-over by the Single Grave Culture. In certain coastal regions the TRB-settlements seem to contain some tools of the north-eastern so-called Pitted Ware Culture as an integrated part: flint arrowheads of type A–C and cylindrical cores (Becker 1982). This is documented by the *Kainsbakke* settlement (Rasmussen 1984) which has several arrowheads of type A, cylindrical cores, and a pottery which is based on a TRB tradition both in the shape and in the ornamentation of the pottery (5). Radiocarbon dates from another settlement (*Kirial Bro*) in the same area show that it is contemporaneous with the Under Grave Period (Rasmussen and Boas 1982: 113).

POTTERY DEVELOPMENT AND FOREIGN INFLUENCES

The absence of an elaborately documented, pottery-based chronology is an obstacle for a detailed dating of the settlements. However, the classification and chronology of the pottery suggested by P.V. Glob still has a value on the general level. The EGK-pottery was divided into 15 groups: A–E curved profiled beakers, F globular pots, G bowl-shaped pots, H Beakers (many

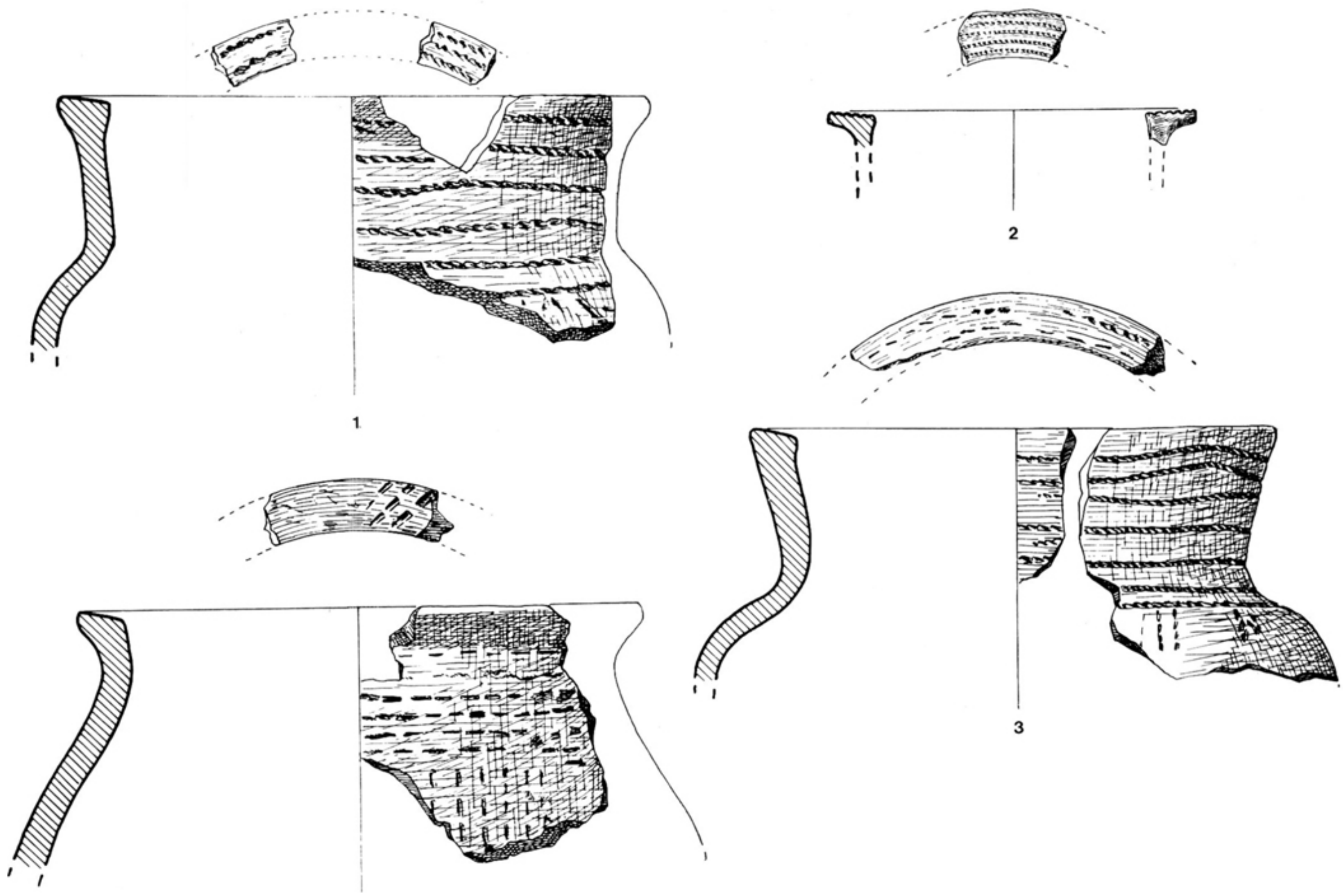

Fig. 13. Østerbølle. Pottery. After Becker 1957, drawings by Henning Ørsnes. 2:5.

straight-walled) with hollow collar, I round-bellied beakers, K–P (except K_{1-2}) straight-walled beakers. Even though the study was carried out more than 40 years ago, only minor modifications have been made in Glob's chronology.

It is noteworthy, however, that the beakers of type B3 have found their correct context in a Late Neolithic milieu (Becker 1957). Recently it has been suggested that also beakers of types E_2 – E_3, K_1 – K_5 and some beakers of the P group should be dated to the Late Neolithic Period (Lomborg 1977; Ebbesen 1978).

It is not the idea here to discuss the views of pottery development and foreign contacts presented in classical works about the Battle Axe/Corded Ware Cultures by authors like Glob (1944), Struwe (1955), Malmer (1967), and Clarke (1970). The aim is only to give a brief survey of the recent studies of importance for understanding of the chronological development of EGK-pottery in Jutland and to stress the fact that the European pottery may be of great value in establishing an EGK-chronology.

The development of the beakers in the central and north European continent and in the British Isles is interesting in relation to the Jutland pottery. According to the radiocarbon dates, the phenomenon "Bell Beaker Culture" (now considered by some archaeologists not as a separate culture but constituted by a cross-cultural movement connected with social status (Harrison 1980: 14) was introduced after the first third of the lifetime of the Corded Ware Cultures and chronologically covers the last two thirds (Pape 1979). There is no doubt that several changes in the shape and ornamentation of the Jutland pottery have a connection with the development in the areas mentioned.

After the first relatively uniform horizon of the cord-ornamented beakers, many later changes in pottery forms and ornament seem more or less to follow similar lines of development, most likely due to a well established network of contacts in these parts of Europe. In Jutland the introduction of the herringbone pattern (apparently in the late Under Grave Period), and later of dentated spatula decoration (apparently in the late Ground Grave Period) seem to be in close contact with the Continent.

The publication "Beaker Culture relations in the Lower Rhine Basin" by J.D. van der Waals (1976) offers a good comparative working basis from a chronological point of view. It is important that the grave forms and the grave rituals and not least the pottery and axes have proved to be to some degree related in the Netherlands and Jutland. It is also important that some of the types of battle axes and flint daggers known from Jutland are found in combination with pottery in the Lower Rhine Basin and that some elements of the Dutch beakers occur on the Danish pottery.

The protruding foot beakers (PFB) seem to be contemporary with the Under Grave Period and a part of the Ground Grave Period (PFB-graves in combination with battle axes of Glob's type A–H). The All Over Ornamented beakers (AOO) seem to be contemporary with the Ground Grave Period (AOO beaker in combination with a battle axe of Glob's type H). The partly later Maritime Beakers seem to be contemporary with later parts of the Ground Grave Period and parts of the

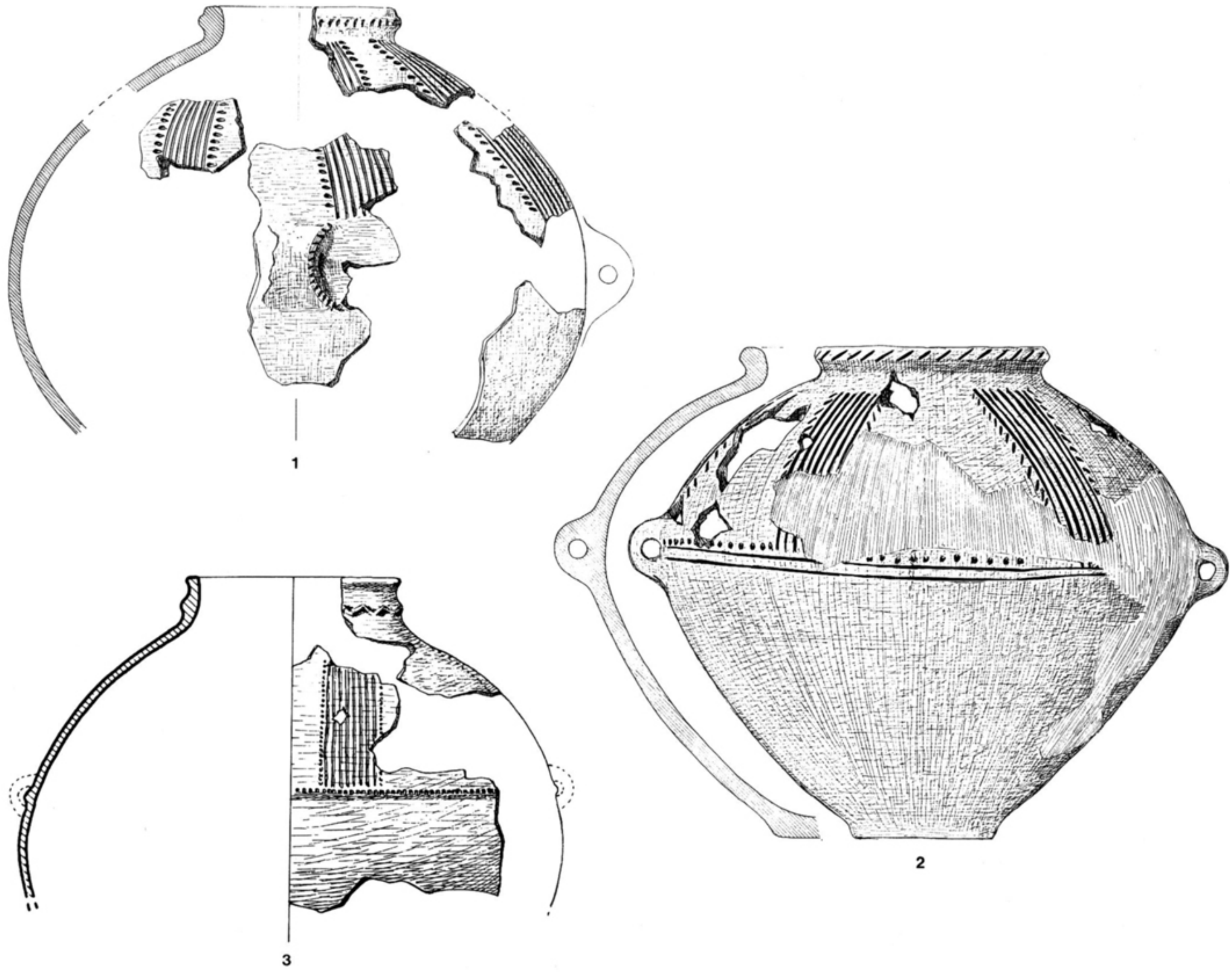

Fig. 14. Amphorae from Vroue (1), Kokholm (2), and Dollerup (3). After Jørgensen, 1977; Davidsen, 1976; Becker, 1957; drawings Henning Ørsnes. 1:5.

Upper Grave Period (combination with a Glob type K_1 axe).

The later stages of the beaker-development, Veluwe Beakers, take place during the Upper Grave period and the Late Neolithic Period A (LN A) and maybe LN B (Veluwe Beakers in combination with battle axes of Glob's type K_4, flint daggers of type 1 (Lomborg), and maybe type 2 (Lanting and van der Waals 1976: 12 ff).

In an article about influences of Bell Beakers and later beakers it has been suggested, that there are two horizons with beaker influence in Denmark (Lomborg 1977). The first horizon brings influences from the true beakers (and maybe the partly older AOO beakers) in the Ground Grave and Upper Grave Period. The second horizon brings influence from later beaker developments.

The straight-walled beaker has a characteristic development in Jutland from about the middle of the Ground Grave Period through the Upper Grave Period to the beginning of the Late Neolithic Period. It has been suggested that this beaker maybe has its origin in the lower Oder areas (Brøndsted 1957: 306 f.). It has also been suggested that the straight-walled beaker is generated from pots of bark. The ornamentation of these beakers, however, seems to have contact with the continent both in style and technique.

The development of the straight-walled beakers in SW-Jutland has recently been studied by M. Hansen (1986). Their development is divided into 3 phases (OI, OII, OIII) based upon falling index values between length and height of the vertical angle ornaments. Also straight-walled beakers with horizontal angles can be attributed to each of these phases. In each phase there are dominating additional features like unthickened rim (OI), thickened rim (OII), furrow technique (OI) and dentated spatula technique (OII and OIII). The phases are documented through combinations with pottery, battle axes and through stratigraphical finds. M. Hansen mentions that this development is in accordance with the changes of angle-motives both in the Swedish-Norwegian Battle Axe Culture and in Central Germany.

An example of the European contact in the ornamentation of straight-walled beakers is mentioned by L. Hvass (1986). The very common motive (horizon III see below), horizontal lines under the rim combined with zig-zags below, is referred to as a parallel to the Central German Mansfelder Style.

In her study of the pottery chronology L. Hvass has established 5 pottery horizons (I, IIa, IIb, III, IV) independant of Glob's system and occupying to the entire Single Grave Culture (and the beginning of the Late Neolithic). This paper represents the first serious step in establishing a pottery-based chronology. Methodologically, the horizons are based on the combination of selected ornamental details with different shapes of pots, and supported by combinations with pottery and battle axes, and through stratigraphical evidence.

The bowls which have a rich development, especially in the Ground Grave Period, have been carefully studied by L. Hvass. As an Example (horizon III) a bowl from Viborg County, ornamented with rows of spatula incisions under the rim and with some wavey lines on the side, is compared with the Central German Schönfelder-Ammensleben group.

Two characteristic types of EGK-pottery are the amphorae and the beakers with short-wave moulding. They have not been found at the settlements from Viborg County. When found elsewhere, they are often considered to belong to the settlement-pottery. The amphorae (fig. 14) (possibly belonging to the Under Grave Period) also have European counterparts, with nearest geographical parallels in Lower Saxony (Davidsen 1976). The beakers with Short-Wave Moulding, which for the moment are difficult to date precisely (Becker 1956, Andersen 1983, L. Hvass 1986), have European parallels too.

CONCLUSION: REGIONAL POTTERY CHRONOLOGIES

Within the Danish or Jutish area it is not possible to speak of a common development. Within the Single Grave Culture it is evident that some areas in Jutland quite readily adopted the new influences from the continent while some other areas in the initial period were more conservative and maintained traditions from the preceeding cultures in contact with northern/eastern areas of Scandinavia. Parts of NW-Jutland seem to be a sphere of interest for both the Single Grave Culture and the Pitted Ware/Funnel Beaker Culture in this period. The tendency that Jutland can be divided into ceramic regions continues in the later phases of the Single Grave Culture; thus for instance the pottery of the Viborg area has its own character compared with neighbouring regions.

To cope with these problems it will be necessary to work out regional chronological systems. The basis for such systems would be to work out chronologies in which the pottery development is paramount. The pottery from the settlements, which are more representative of the total variation in pottery than the grave finds are, is important. In order to follow up this line of argument it would be necessary to publish already existing material from museums and private collections.

In the examples mentioned above it has been shown that there is reason to believe that the development of EGK-pottery in Jutland should not be considered as an isolated phenomenon, but as a part of a European development, and that this may be a valuable help when working out pottery-based chronologies.

Also the excavation of new settlement-finds should be given priority. Many settlements with finds belonging to the Single Grave Culture have been recorded, and it seems to be very common that the settlements are on sandy ground on terraces near fresh water (lakes, rivers, brooklets). The excavator will very often have to face another typical characteristic of the Single Grave Culture: that the settlements are usually small and very few remains of things like pits and postholes survive.

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NOTES

1. See for instance Seeberg 1968, the section fig. 3, top, where a dark layer without potsherds separates the upper culture layer from the lower culture layer. For details of the excavation see this publication.
2. Among the finds from the settlement is an triangular arrowhead probably of D-type.
3. J.Aa. Jensen points out that it may possibly be interpreted as a kind of dump-layer (pers. comm.). Notice that "Nr. Lundgaard" is identical with the settlement "Fur" in Jensen 1972.
4. In some areas the distribution of the EGK-graves does not seem to be geographically representative. Thus in Salling the grave-finds with battle axes seem to be over-represented on former heath areas (Simonsen 1982).
5. The question of cultural identity of "The Pitted Ware Culture" in Denmark has recently been discussed in several articles after the paper by C. Malmros (1979). He suggests that the term Single Grave Culture should also comprise the Pitted Ware Culture. It is not possible to agree with this view, see for instance the argumentation by S. Nielsen 1982.

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Early Bronze Age Houses at Højgård, Southern Jutland

by PER ETHELBERG

West of Gram, the elevated plain emerges as a wedge between the streams Gels and Gram. Like a river terrace the plain is slightly elevated above the streams. Above the terrain rises steeply, then to slope more gently into a plateau with a wide view of the four corners of the world. The subsoil consists of varying oblique layers of more or less sandy gravel and sand.

During the last thirty years Haderslev Museum has undertaken a series of investigations in this area covering some 10 km², ranging in time from the Early Neolithic period to the Late Iron Age.

In August 1984 it was reported that pottery sometimes rolled down from the edge of a gravel pit. The gravel pit is located some 400 m north of Saint Thøger's chapel on the Gram-Ribe road and approx. 300 m west of the large Enderupskov burial ground near the farmstead Højgård.

After the initial inspection of the location a small investigation of an area covering 5 to 10 × 60 m close to the edge of the gravel pit was carried out towards the end of August 1984 (1). Eleven urn graves, 2 cremation graves, and one inhumation grave appeared. Three of the graves contained weaponry, a.o. double-edged La Tene swords and Hannovarian fibulae. These graves must thus be dated to the Pre-Roman Iron Age period IIIb and should be seen in the context of the many other graves containing weaponry in Jutland (Jørgensen 1968). Some of the urns likewise contained fibulae from the Late Pre-Roman Iron Age and the beginning of the Early Roman Period. So there is hardly much difference in time between the separate graves.

In mid-November the investigation was revived with the purpose of establishing the boundaries of the burial ground. A series of trial ditches were dug at right angles to the edge of the gravel pit and with a distance of 10 m between them around the supposed centre of the burial ground and at 15 m's intervals towards the periphery. No graves were found. However, a number of post-holes and pits were found. Though no particular pattern could be recognized. Where the concentration of post-holes was densest the area of investigation was extended to cover approx. 300 m². Thus parts of three unusual three-aisled longhouses were discovered, which of course gave rise to a larger investigation. This was continued in April 1985. The investigation cannot be considered terminated yet.

So far an area of almost 5500 m² has been investigated (fig. 2). Inside this area 2 houses with sunken floors (VIII–IX) have been found, 2 possible framehouses (VII–XI), and 7 three-aisled longhouses. Furthermore, there were a number of pits of various kinds, a.o fire-

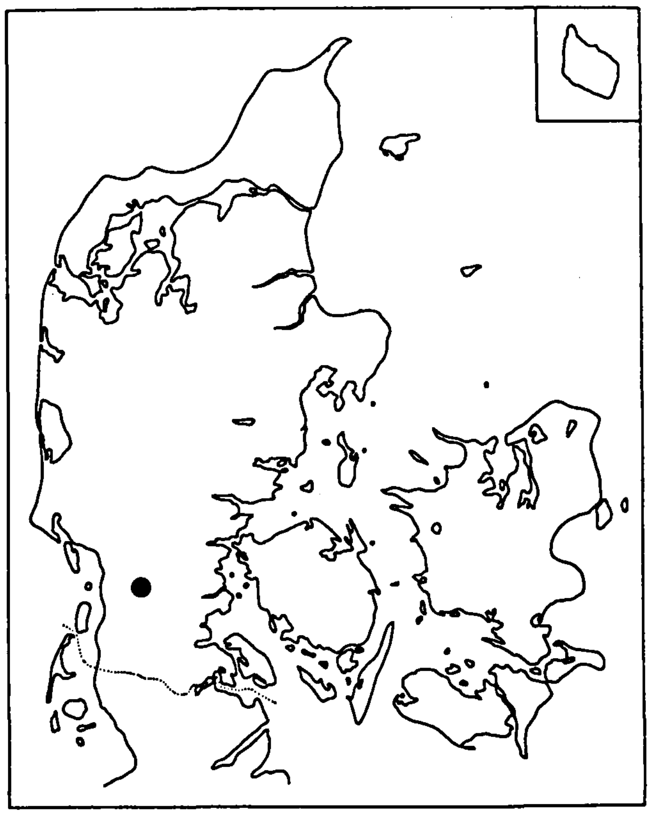

Fig. 1. Geographical position of the site.

Fig. 2. Højgård. Plan of the excavation.

pits and refuse-pits. During the 1985 campaign a further 2 inhumation graves were found. They were contemporaneous with the graves mentioned above. See survey map fig. 2. The present article will concentrate on the houses, especially the three-aisled long-houses found.

HOUSES WITH SUNKEN FLOORS (fig. 4)

House VIII (fig. 3). The house appeared as a large, roughly east-west aligned, rectangular depression measuring 6.15 × 4.1 m. Five post-holes were covered by fill from the depression. A few of these appeared before the excavation of the sunken floor, which has thus been slightly larger than originally recorded. Three post-holes appeared immediately outside the sunken floor. The fill in all the holes consisted of yellowish brown sand mixed with topsoil.

There were no further features in the immediate vicinity of the depression. So everything suggests that the post-holes should be connected with the depression. Together they form a rectangle measuring 8.5 × 4.45 m around the depression. There were no traces of a fireplace or interior roof-supporting posts. The sides of the depression sloped gently down to the centre, where the depth was 31 cm. The fill consisted of dark, yellowish brown sand and gravel mixed with topsoil and fist-sized and larger stones. These were mostly found in the south-western corner of the fill; but none were burned or placed according to any pattern. The fill was not stratified.

Scattered in the fill was a good deal of flint waste, and near the bottom towards the south-east was a large cluster of sherds. The depression was intersected by a pit with fire-shattered stones.

House IX (fig. 3). The house appeared as a large north-west-southeast aligned depression measuring 5.4 × 4.5 m. The depression was intersected by rows of a number of post-holes, among which were 3 belonging to house VI. The sides were sloping to almost level, and the bottom was flat. The depth was approx. 20 cm. Unlike in the case of house VIII it seems that the floor has been regularly dug into the subsoil.

Around the feature there were 7 post-holes that differed markedly, both as regards fill and diameter, from the rest of the surrounding post-holes. So it is natural to connect these holes with the depression. They form a rectangle measuring 8.5 × 4.3 m.

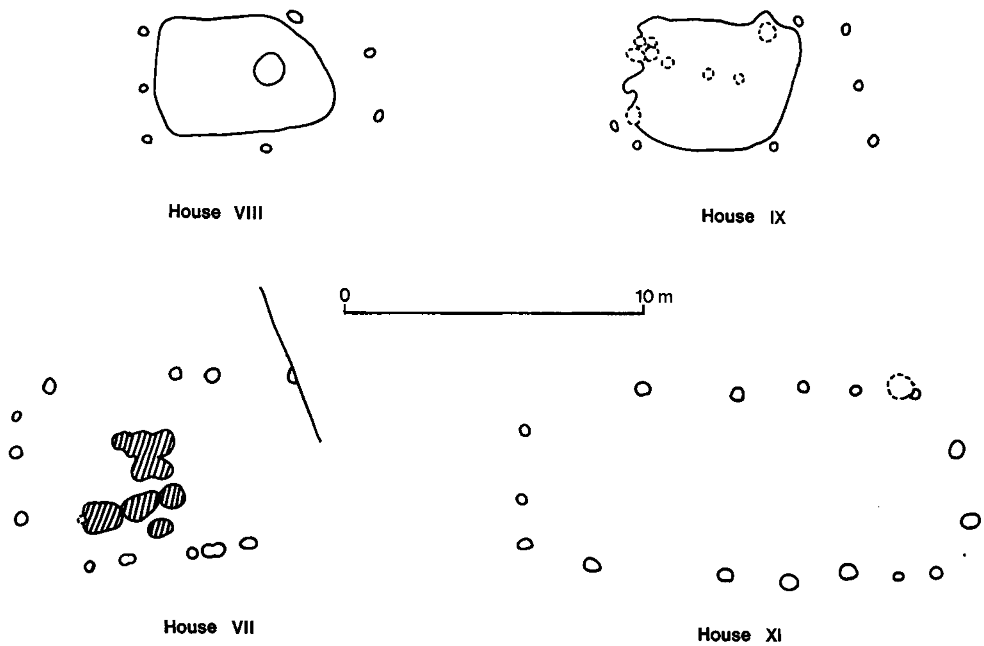

Fig. 3. Højgård. Houses with sunken floors (nos. VIII and IX) and framehouses (nos. VII and XI). 1:250.

The fill in this feature consists of brown sand and gravel mixed with topsoil and a few fist-sized and larger stones and a little charcoal. Scattered among the fill was some pottery and flint waste.

Houses with sunken or partly sunken floor have gradually become known from several locations ranging in time from the Single Grave Culture to the beginning of the Early Bronze Age (Aarup Jensen 1972, Hvass 1978, Skov 1982, Boas 1980 and 1983, Jæger and Laursen 1983, Simonsen 1983, and Jeppesen 1984). Some are completely without post-holes and others only have wall-posts. However, most of them have rows of internal roof-supporting posts and are considerably larger.

So it is reasonable to interpret the two structures at Højgård as houses although neither internal roof-supporting posts nor fireplaces have been recorded.

The two Højgård houses mostly resemble the Single Grave Culture house at Vorbasse (Hvass 1978), both as regards size and post lay-out, though the Vorbasse house is somewhat closer to a square in shape. However, the respective materials of artefacts differ greatly. Along with the houses from the Single Grave Culture and the Late Neolithic Period large numbers of ornamented sherds were found. Though the pottery material from Højgård was relatively large, none of it is ornamented.

The sherds from house VIII were found inside a clearly delimited area and can be assembled into two largish flakes probably deriving from the same vessel, though they do not fit together (fig. 5). One reaches from the bottom onto the lower half of the vessel. It consists of a bottom, and an even, slightly outward-curving bottom half. The fragment is coarse-grained with granite and quartz grains, and the surface is smoothed. The burning is poor displaying redish-brown surfaces and a greyish-black middle. Comparable bottom-profiles are known from both Vejlby (Jeppesen 1984, p. 102), and Egehøj (Boas 1983, p. 98), the former being dated to the transition between the Late Neolithic Period and the Early Bronze Age (1470±80 b.c., recalibrated c. 1800 B.C.), and the latter to the Early Bronze Age period I (1390–1210±100 b.c., recalibrated c. 1610–1420 B.C.).

The other fragment reaches from the rim to the transition from the mid- and bottom-sections. The rim is heavy, outward-curving, and slightly thickened. The neck is short, outward-curving, and smoothly continued into the rounded top-section. Quality and burning are of the same description as above. Vessels with this kind of rim-profile are known from both Røjle Mose (Jæger & Laursen 1983, p. 113), Tastum (Simonsen 1983, p. 84), and Myrhøj (Aarup Jensen 1972, p. 102). Timewise this means from the Late Neolithic Period to the beginning of the Early Bronze Age.

Furthermore, there are a few rim-sherds from a dish found in house VIII. In both structures a good deal of flint was found, a.o. blades and flakes, but no tools. A few pieces show that pressure flaking was known. However, the flint material cannot contribute to the dating of the houses.

On this background the most probable dating of the houses would be to the transition between the Late Neolithic Period and the Early Bronze Age. However, this means that these are the earliest documented house-sites in Southern Jutland.

FRAMEHOUSES (fig. 6)

A framehouse is here defined as a longhouse without interior roof-supporting posts.

House VII (fig. 3). This is a west-northwest to east-southeast aligned longhouse without interior roof-supporting posts. It has been at least 10 m long and 6.7 m wide. The east gable may have been removed by the installation of a recent field-irrigation system. However, the house seems not to have been longer than 10 m. The interpretation of the structure is uncertain, partly because of the somewhat irregular positions of the posts of the long walls. In the middle of the house was a cluster of deep pits containing heavily burned stones

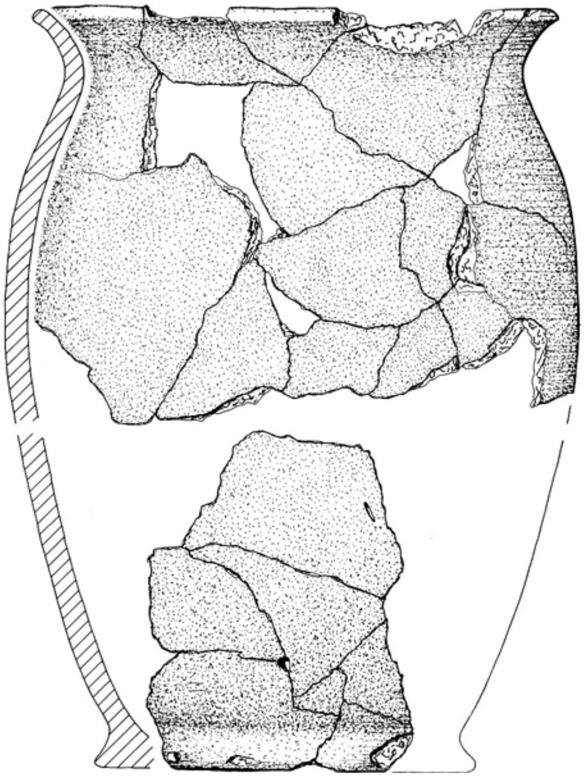

Fig. 5. Højgård. Clay vessel from house VIII. 2:5 (Lars Kempfner-Jørgensen *del.*).

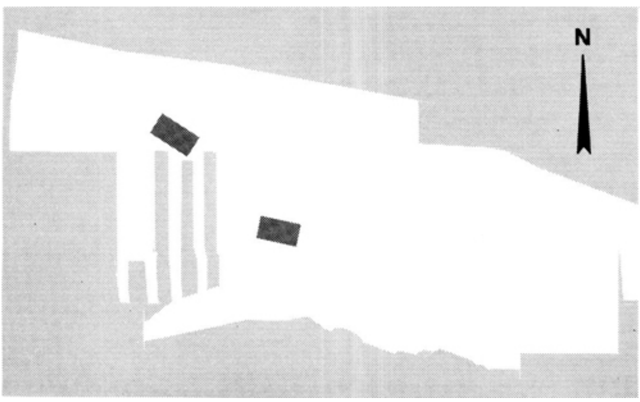

Fig. 4. Højgård. Plan showing the position of the houses with sunken floors (nos. VIII and IX).

that were, however, not tightly packed. So they should perhaps be characterized as fire-pits.

No material suitable for dating was found along with this structure.

House XI (figs. 3). This house is an east-west aligned longhouse without traces of roof-supporting posts. In relation to house X it is turned slighty towards the north. The measurements are 15 × 6.1 m.

The interpretation of the house structure is uncertain partly because of the lacking interior roof-supporting posts, and partly because of the irregular positions of the wall-posts. Off the centre of the house in relation to the central axis of the house was a largish fire-pit but a fireplace proper was not found. Owing to the position of the fire-pit it is uncertain whether this has belonged to the house at all. The long walls are straight and the gables curved. It has not been possible to establish an entrance. No datable objects have been found in connection with the house, but stratigraphically it is earlier than house VI, which can be dated to the beginning of period III of the Early Bronze Age.

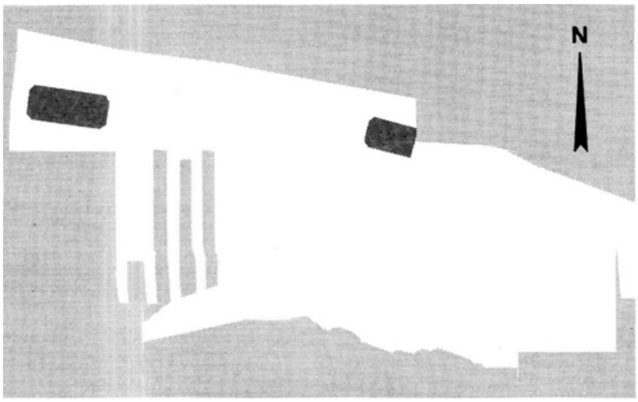

Fig. 6. Højgård. Plan showing the position of the framehouses (nos. VII and XI).

These sites have with reservations been interpreted as houses, partly on the basis of their mutual resemblance, partly on the basis of their positions in relation to the two clusters of houses mentioned below, and partly because they resemble house C from Røjle Mose (Lauersen & Jæger 11983, p. 108). This house has been dated to the Early Bronze Age period I and possibly reaching into period II. On this background, and supported by stratigraphical observations, the Early Bronze Age periods I or II would be a more reasonable dating.

Furthermore, house X, a three-aisled longhouse, which typologically seems to belong with house II, seems to be the earliest of the three-aisled longhouses. They should probably be dated to the later half of period II.

THE THREE-AISLED LONGHOUSES

House I (fig. 7). This is an east-west aligned, three-aisled longhouse measuring 8.2 × 30.5 m. The holes for the wall-posts and the roof-supporting posts are of equal depth. The distance between the wall-posts is from 2 to 3 m, suggesting that the walls have been built of tree-trunks. The gables are rounded and include two posts placed a little closer to the longitudinal line that can be drawn between the two rows of posts, than to the walls. There are 7 pairs of roof-supporting posts placed with regular intervals of 3.4 to 4 m. The distance from the roof-supporting posts to the wall is approx. 1.5 m.

At the west end of the house is a partition, the posts of which have been less deeply imbedded, i.e. 15 to 20 cm. This partition has divided the house into a living quarter of some 80 m^2 at the west end, and a room of some 170 m^2 at the east end, whose function it has not been possible to determine. There is an obvious door in the partition. Partitions for stalls have not been found, and phosphate analyses do not suggest that the room has served as a stable.

Between the two last pairs of roof-supporting posts at the west-end are four fire-pits. It is difficult to determine their use as they are rather flat-bottomed, but their contents of brittle stone and the very sparse presence of charcoal probably exclude their interpretation as regular fireplaces.

In the southern long wall there may be an entrance as two of the wall-posts have a distance of only approx. 1 m between them. The total area of the house has been 250 m^2. Some roof-supporting posts, as well as some of the wall-posts, have been replaced, indicating that the house has been in use for quite a long period of time.

House II (fig. 7). This is another east-west aligned, three-aisled longhouse measuring 22.3 × 6.5 m. Five pairs of roof-supporting posts were found. The distance between them varies from 1.6 to 4.4 m, and the distance between the wall-posts varies from 2 to 4 m.

The dimensions of the wall-posts and the roof-supporting posts are roughly the same. The depths of the post-holes decrease from the west to the east, perhaps due to ploughing. Ploughing may, in fact, have erazed several pairs of roof-supporting posts at the east-end. If so the wall-posts have been more deeply imbedded at the east-end. A few of these posts could only be recorded in the surface and not in depth.

In the north wall two wall-posts are somewhat closer to each other than the others, and they may represent an entrance. The gables are rounded and include two posts on line with the two rows of roof-supporting posts. This house also has a group of fire-pits – five altogether – between the two last pairs of roof-supporting posts. There are also fire-pits along the centre-line of the house.

Houses III and IV (fig. 7). These are also east-west aligned, three-aisled longhouses. The two houses are much alike and will be described together. In these cases only traces were found of roof-supporting posts and possibly of some wall-posts. The houses have had a length of no less than 20 m and an estimated width of approx. 6.5 m, based on the probable position of the

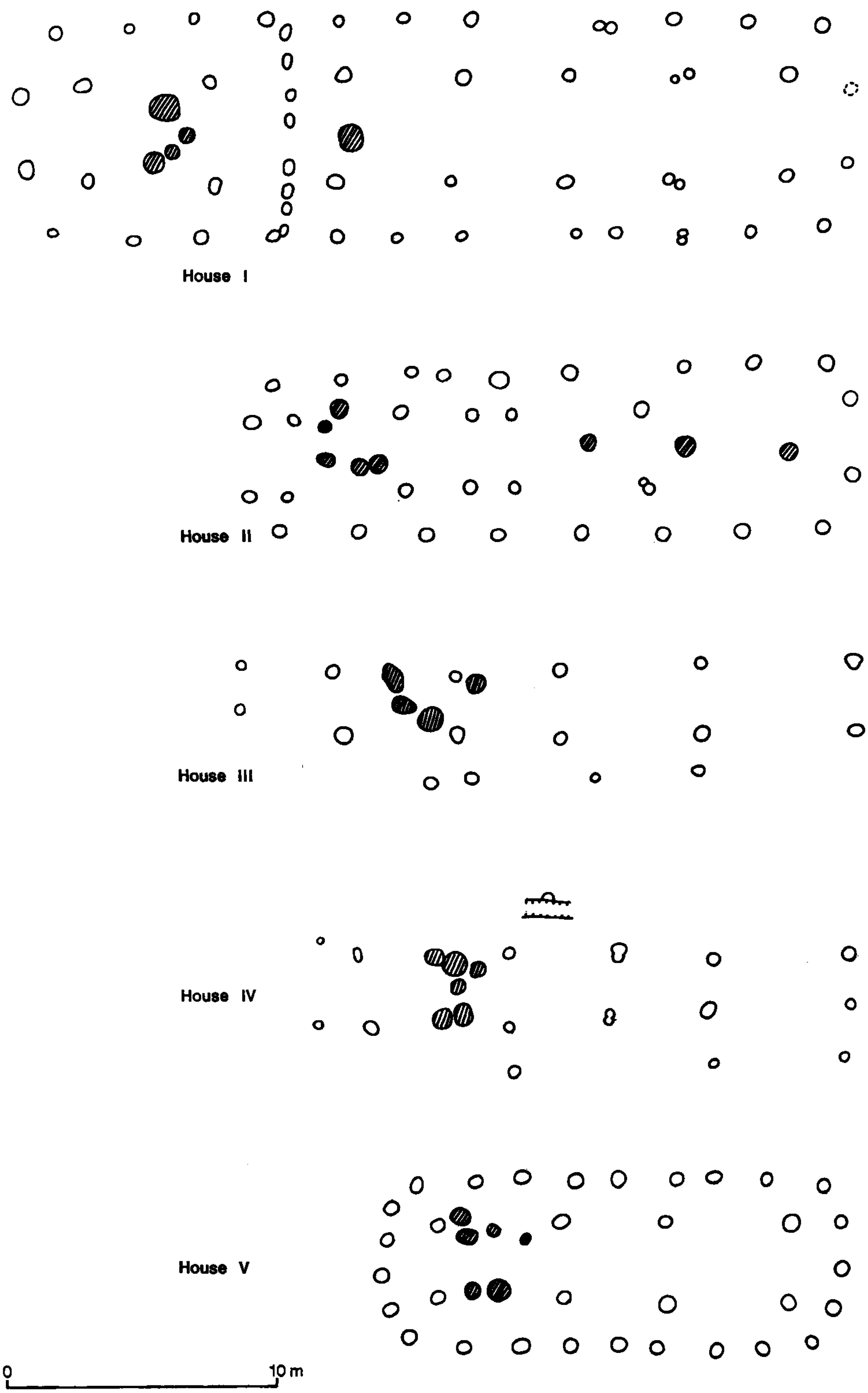

Fig. 7. Højgård. Plan of five three-aisled longhouses (nos. I–V). 1:250.

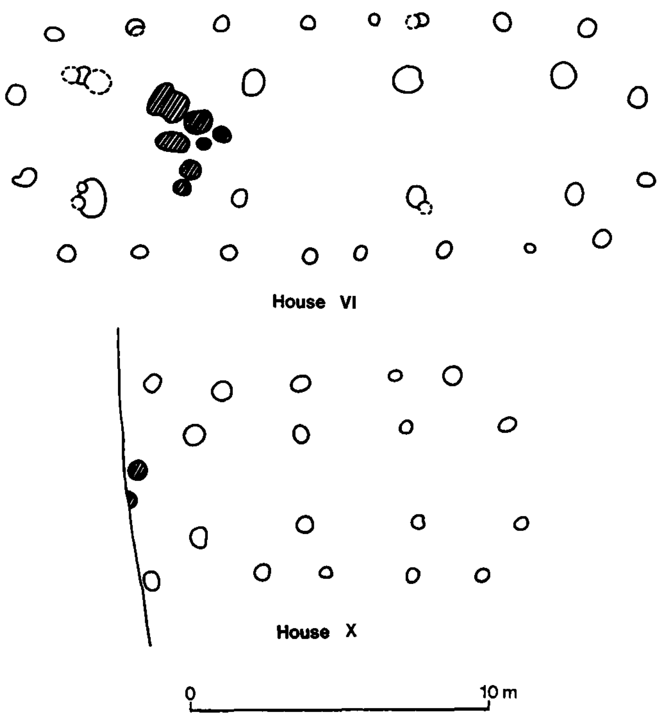

Fig. 8. Højgård. Plan of the three-aisled longhouses nos. VI and X. 1:250.

wall-posts. So the wall-posts have generally not been as deeply imbedded as the roof-supporting posts. Besides, they have had a smaller diameter.

As in the cases of houses I and II there were a number of fire-pits – respectively 4 and 6 – between the last couple of roof-supporting posts at the west-ends of the houses.

There may have been a partition in house IV, though it is not as obvious as in house I. However, they are in the same place. No gables or entrances have been recorded.

House V (fig. 7). Yet another three-aisled longhouse, but this time it is westnorthwest-eastsoutheast aligned and measures 17 × 6.2 m. The house has had four pairs of roof-supporting posts. The long walls are straight and the gables curved. Unlike the other houses with gable-posts where the number has been two, it has here been augmented to five. The wall-line has a distance between its posts varying from 1 to 2 m, but usually it is between 1.2 and 1.5 m. This is a lot closer than in the other houses with preserved wall-posts. On the whole the holes from the roof-supporting posts have had a larger diameter than the holes from the wall-posts. No entrance could be established. At the west-end of the house was a cluster of fire-pits – a total of six. Most of them are quite flat-bottomed with a scattered content of brittle stone fragments, but some are deeper and packed with brittle stone.

House VI (fig. 8). This is an east-west aligned, three-aisled long house measuring 20.8 × 7.9 m. The long sides are straight and the gables rounded. Each gable includes two posts slightly recessed from the two lines of roof-supporting posts.

The wall-posts are spaced at intervals of 2 to 3 m. At the middle of the south wall there is a couple of somewhat tighter spaced posts probably indicating an entrance. In the north wall there is also a couple of more closely spaced posts, which might indicate an entrance.

The diameters of the holes for the roof-supporting posts are generally larger than those of the wall-posts; however, there is no difference in the depths of the holes. Some post-holes in the wall-line indicated that two posts had been imbedded there, but obvious post-impressions could not be observed. Roughly the same situation was found at house I.

Between the two last pairs of roof-supporting posts was a cluster of fire-pits, in fact, a total of 7.

House X (fig. 8). This is yet another east-west aligned, three-aisled longhouse. The west-end has not been excavated. The house must have had four pairs of roof-supporting posts as fire-pits were found on the boundary of the excavated area. The investigated area measures 13 × 6.7 m.

The wall-posts are spaced at distances varying from 2 to 3 m. No entrance was recorded, but at the middle of the south wall was a pair of tightly spaced posts. The diameters and depths of the wall-posts and roof-supporting post-holes were alike. The excavated gable consists of two posts on line with the rows of roof-supporting posts.

THE PHASES OF THE THREE-AISLED LONGHOUSES

The seven above-mentioned three-aisled longhouses fall into two clusters of three houses each and one separate house. The distance between the two clusters is approx. 25 m. The settlement site is demarcated towards the south and the east, but boundaries towards the north and the west have not yet been established.

The houses have so much in common that there is no doubt that they have been in use successively inside a limited span of time. Among common traits can be mentioned the three-aisled construction, the straight walls without recessed doors, the curved gables, and finally the fire-pits between the last two pairs of roof-supporting posts at the west-ends.

This uniform position of the fire-pits in all the houses cannot be coincidental. They must be regarded as an integral part of the house structure. This is important partly because they often contain a good deal of brittle stone, which makes a scientific dating possible, and partly because they seem to enable us to locate the outline of the houses. This should be kept in mind at future investigations of otherwise "uninteresting" clusters of fire-pits.

Among differences should be noted the varying positions of the gable-posts, their varying numbers, the differences of distance between the wall-posts in relation to the holes for roof-supporting posts. These differences and the stratigraphical observations make it possible to establish a chronology of the houses.

Judging by their construction houses III, IV, and V must be contemporaneous (fig. 9), witness the smaller diameter and depth of the holes for the wall-posts compared to those for the roof-supporting posts, their apparently closer spacing, and the increased number of gable-posts. Houses III and IV are compared to house V because the wall-posts have almost disappeared, which means that they cannot have been as deeply imbedded as the roof-supporting posts. These houses constitute *the latest phase, phase 3*, as house V is stratigraphically later than house VI.

Stratigraphically house VI is earlier than house V and later than houses VIII and XI. House VI is contemporaneous with house I (fig. 10). Though they vary markedly in length, their widths are roughly the same. The posts are spaced with the same distance between them. The depths and diameters of the post-holes are the same both as regards wall-posts and roof-supporting posts. The gables are shaped alike, and it seems that the heads above the roof-supporting posts have not extended to the gables. These houses make up *an intermediate phase, phase 2.*

Houses II and X are contemporaneous (fig. 11). They differ from the phase 2 houses in being less wide and in having a different position of the gable-posts, indicating that the heads above the roof-supporting posts have extended all the way out to the gables. These two houses represent *the earliest phase, phase 1.*

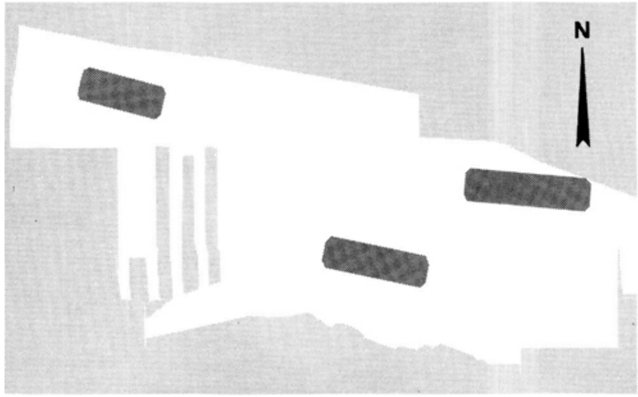

Fig. 9. Højgård. The position of the longhouses belonging to phase 3 (EBA period III).

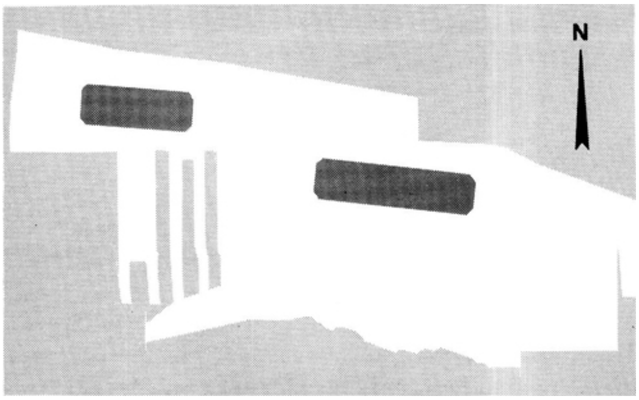

Fig. 10. Højgård. The position of the longhouses belonging to phase 2 (EBA period II/III).

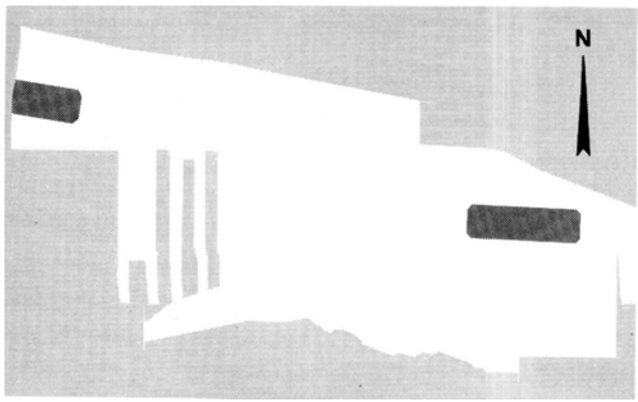

Fig. 11. Højgård. the position of the longhouses belonging to phase 1 (EBA period II).

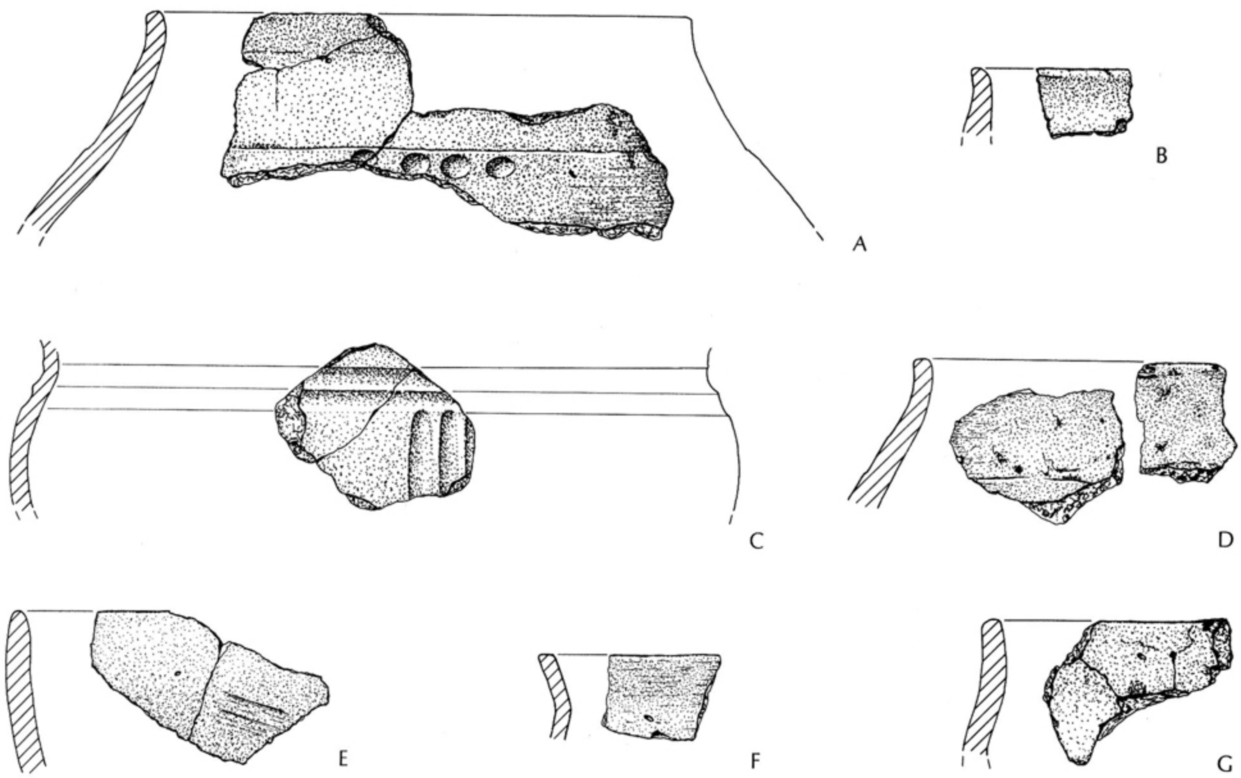

Fig. 12. Højgård. Pottery from the pits. 2:5 (Lars Kempfner-Jørgensen *del.*).

House II seems stratigraphically earlier than house III; but this assumption is uncertain. The division into phases is mainly based on differences in construction between phases 1 and 2.

It seems that the roof-construction is altered from phase 1 to phase 2. The wall-structure seems to grow slighter from phase 2 to phase 3. Finally there is a gradual shifting of the weight of the roof from the wall-posts to the roof-supporting posts from phase 1 to phase 3.

All three phases are later than the Late Neolithic Period and the Early Bronze Age period I, cp. the stratigraphy of houses VI and IX.

The division into phases has not taken the frame-houses into consideration though each is connected to its own cluster of houses.

THE FINDS

The material of artefacts derives partly from the fill of the post-holes (fig. 13), partly from refuse-pits (fig. 12), and partly from stray finds. It consists mainly of pottery and a little worked flint.

The pottery consists partly of thick-walled, very coarse-grained sherds, in fact, a grain-size of 2 to 3 mm or more is not uncommon. The sides of the vessels are hand-slapped or very poorly smoothed, and almost straight or slightly outward-curving. The basis is clearly emphasized. Necks and rims are vertical or slightly outward-curving. Sherds of this description were found both in post-holes and pits.

There were also vessels with somewhat thinner walls, and these were not quite as coarse-grained. Their sides are more curved and likewise their rims. These vessels are smoothed and the burning of the ware is of a higher quality. Some of these sherds derive from one pit and probably also from one single vessel. In this case the transition between the neck and the upper section is marked by a small platform below which there are small circular depressions. Another sherd is equipped with both horizontal and vertical ornaments. Sherds of this type were only found in the pits (fig. 12). In fact, no ornamented sherds were found in the post-holes.

The flint material consists of flake-scrapers, one of which shows traces of pressure flaking, two indeterminate tools with an edge-trimming that connects them with tools – they may be scrapers of some sort –, a good many flakes, and a few blades. The flint was either found in the pits or as stray finds. However, a few small flakes were found in the post-holes.

DATING OF THE FINDS

Especially the first-mentioned type of vessel resembles Late Bronze Age pottery from this part of the country (Ethelberg 1982 pp. 108–32); but it is too coarse-grained for a dating to the Late Bronze Age to be likely. Besides there are no sherds with added bands or finger impressions or oval or round knobs, and these details are characteristic of the most common type of Late Bronze Age vessels. The pottery material is so large that this type of vessel ought to be represented if it were a settlement site from the Late Bronze Age.

The resemblance to the pottery from e.g. Egehøj (Boas 1980 p. 112, and 1983 p. 94), and Røjle Mose (Laursen and Jæger 1983 p. 113) is more obvious, both of which have been dated to the Early Bronze Age period I.

However, these sites are especially rich in worked flint. Pressure flaking is widely used, which also goes for settlement sites from the Late Neolithic period, e.g. Myrhøj (Aarup Jensen 1972 pp. 79–89). These facts, along with the stratigraphical observations, make a dating to these periods unlikely. However, it should be noted that there was not very much worked flint in the two Late Neolithic houses on the settlement site.

As parallels to the circular depressions and the groove-ornamentation can be mentioned:

a) A vessel ornamented with small circular depressions and groove-ornamentation, both vertical and horizontal, is known from Sortehøj grave A (Thrane 1962 p. 117). The grave has been dated as not later than period III (Thrane 1962 p. 120).

b) From Nandrup there is a vessel with horizontal groove-ornamentation running round it. It is dated to period II (Broholm 1952 p. 206).

c) Finally there is a vessel from Jelling with vertical grooves, dated to period III (Broholm 1952 p. 341).

The groove-ornamented sherd may resemble the pottery from the 4th and 5th centuries A.D. But considering the fact that it was found in a pit containing sherds of the coarse-grained type, it must belong to the settlement site's type-inventory. Furthermore, apart from the Late pre-Roman graves, no Iron Age sherds have been found on the site. The large Enderupskov burial ground with graves from the 4th and 5th centuries A.D. is located at a distance of more than 300 m from the settlement site. Judging by the sherds from both the post-holes and the pits the most reasonable dating of the pottery must be the Early Bronze Age periods II and III.

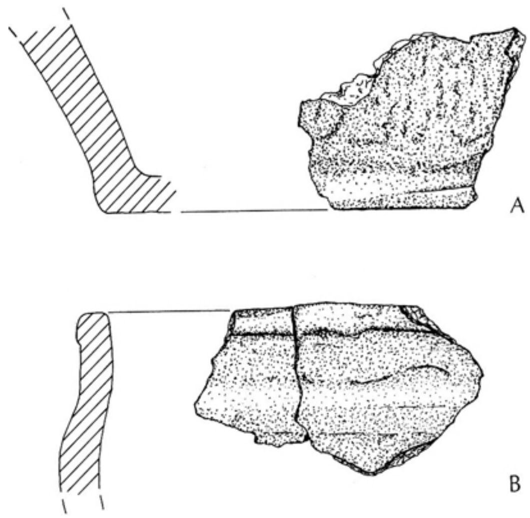

Fig. 13. Højgård. Pottery from house I (a) and IV (b). 2:5 (Lars Kempfner-Jørgenmsen *del.*).

In the subsequent dating of the three-aisled longhouses the material from the pits has not been taken into consideration unless there is a direct connection with the houses, as the pits need not be contemporaneous with the houses, which will appear below.

DATING OF THE THREE-AISLED LONGHOUSES

Five post-holes from house I contained coarse-grained sherds. One sherd from the bottom of a vessel (fig. 13a) was found at the top of the fill in a hole from a roof-supporting post. The remaining 4 sherds are uncharacteristic sherds from the sides of vessels. They are coarse-grained, except one which shows a somewhat finer grain.

There is a coarse-grained sherd from one of the fire-pits in house IV. This is also from the side of a vessel.

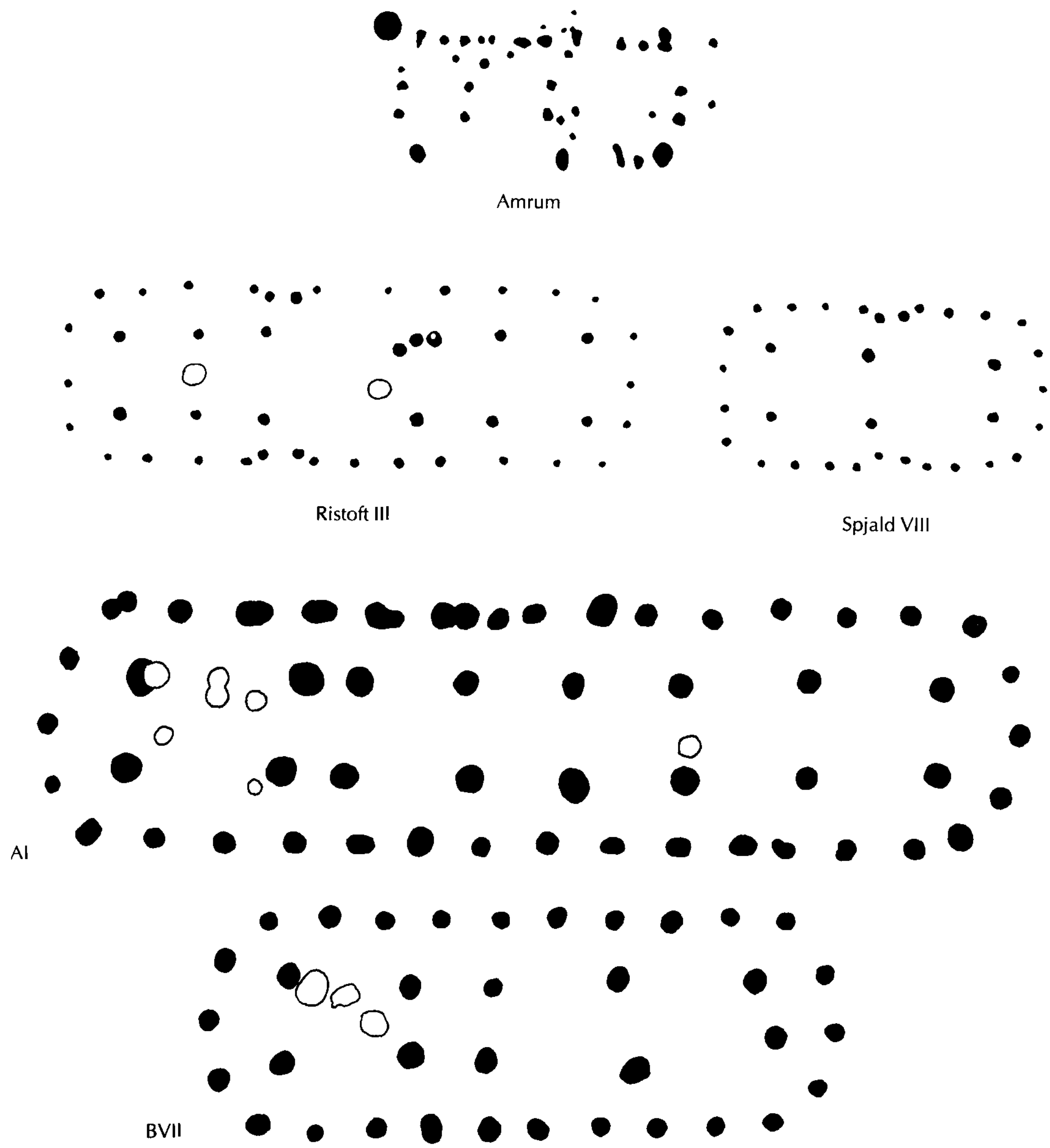

Fig. 14. Plans of Bronze Age longhouses. 1:250.

One of the holes from a roof-supporting post in house IV was covered by the fill from a pit, containing coarse-grained sherds from sides of vessels and a large sherd (fig. 13 b) from the rim of a vessel with a vertical, smoothed neck and a straight, smoothed rim.

The post-holes in houses V, VI, and X also contained a few coarse-grained side-sherds.

The pottery connected with the houses is thus highly homogenous. A dating is best based on the sherds from houses I and IV, and they are typical of the Early Bronze Age. This dating is supported by house I's architectural resemblance to the Trappendal house (Andersen and Boysen 1981 and 1983) and the Handewitt house (Bokelmann 1977). The only differences are the nature of the fireplaces and the wall-structure, the Handewitt house having a wall-ditch, and the Trappen-

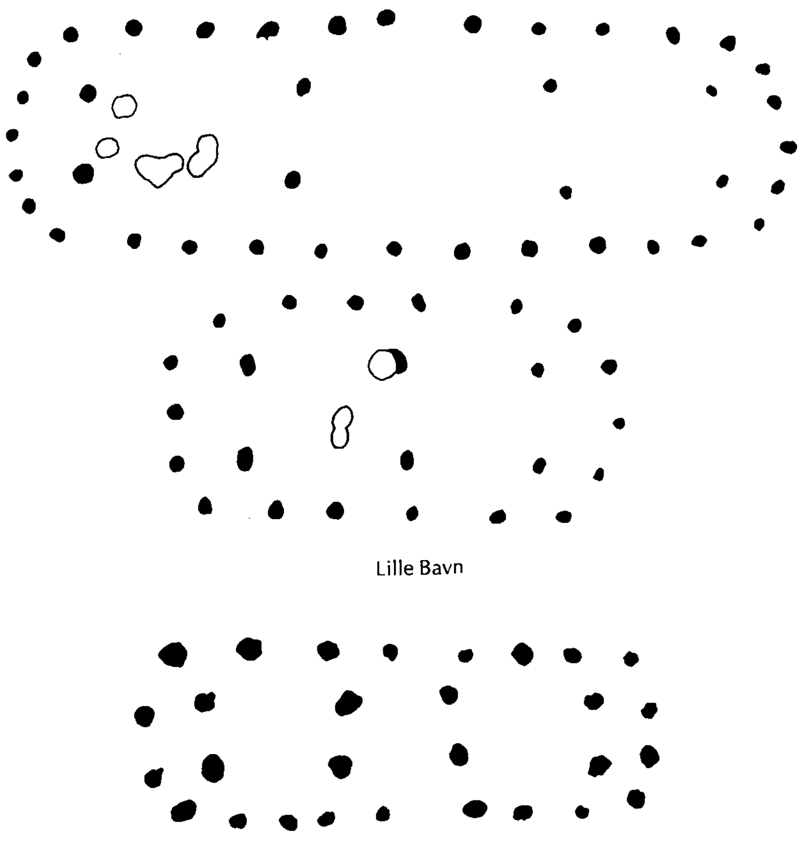

Fig. 15. Plans of Bronze Age longhouses. 1:250.

dal house having closely spaced wall-posts. These houses are no later than the Early Bronze Age period III. The average value of 4 C-14 datings of charcoal from the post-holes of the Trappendal house is 1476± 80 B.C. (recalibrated), corresponding to the first half of the Early Bronze Age period II. On this background the most probable dating of the Højgård houses must be the Early Bronze Age periods I–III.

SCIENTIFIC DATING OF THE THREE-AISLED LONGHOUSES

With a C-14-dating in view the fill of 5 post-holes from each house was suspended in water to extract the charcoal. However, the charcoal content was not big enough for a C-14-dating.

Samples were also taken from the fire-pits, but only one provided enough charcoal for a C-14-dating. However, the result of this dating shows that some of the fire-pits were actually later than the Bronze Age occupation (K-4614: 670 A.D., recalibrated).

Another date derives from a pit which is stratigraphically later than one of the holes for the roof-supporting posts in house IV of phase 3. It gives a recalibrated date of 1010 B.C. (K-4615: 900±75 b.c.) thus dating the pit to the transition between the Early and Late Bronze Age. It confirms the archaeological dating of the settlement and is in support of the view that the last phase is not later than period III.

Against this background it is suggested that phase 1 be dated to the Early Bronze Age period II, phase 2 to periods II and III, and phase 3 to period III.

IMPLICATIONS FOR THE DATING OF BRONZE AGE HOUSES

Besides the Trappendal and Handewitt houses Early Bronze Age three-aisled longhouses are known from three other localities, e.g. Vadgård North (Lomborg 1973, 1976, and 1980). However, these houses are considerably smaller than those described above.

At Hyllerup near Slagelse Jens-Aage Pedersen has investigated a longhouse below a mound whose primary grave is dated to the Early Bronze Age period III (Pedersen 1986, this volume). In this connection a house-site at Ballermosen should also be mentioned (Lomborg 1956), and it is possible that this was also a three-aisled longhouse, or part of one. Like at Hyllerup the site appeared under a mound whose primary grave was dated to the last half of period II. Finally the Amrum house should also be mentioned (Struwe 1954 pp. 35–40). On the basis of potsherds it is dated to period II, or possibly period III (fig. 14). However, these may not be the only Early Bronze Age houses to have been found in Denmark.

Towards the end of the 1960s a large number of Late Bronze Age settlements with house-sites was investigated in the Holstebro-Herning-Ringkøbing area, a.o. Spjald, Bjerg A and B, Ristoft, Kærgård, Hover Gd. (Becker 1980: fig. 1 and note 5), and Jegstrup near Skive (Davidsen 1982). Most of these are three-aisled longhouses with rounded gables and clearly recessed doors (figs. 14–15), a fact which sets them apart from the Højgård houses. Another difference is the absence of fire-pits. Neither has the presence of partitions been recorded. An exception is house I at Nybro (Nielsen and Mikkelsen 1985 p. 58), which may have been divided into separate rooms. This locality is dated to the last half of the Late Bronze Age.

The roof-supporting posts in the Late Bronze Age houses are considerably stouter and more deeply imbedded than the wall-posts. However, this is also observed at Højgård and Trappendal.

At Spjald and Bjerg (fig. 14) (2), however, not all the houses are of this description; a few are very much like the Højgård houses, especially house V. These houses are all dated to an early part of the Late Bronze Age (Becker 1975/76 p. 74 and 1980 p. 132).

However, there is no archaeological support for such a dating, neither on the basis of pottery nor on stratigraphical observations (3). The dating is solely based on the fact that the houses were located on sites with houses and pits reliably dated to the Late Bronze Age.

At Hover Gd. J. Jensen (Jensen 1971 p. 10) (fig. 15) has investigated a similar house. According to stratigraphical observations the house should be later than another house in the locality, dated to the Late Bronze Age (Jensen 1971 p. 10). However, J. Jensen has informed (personal communication) that exactly the opposite is the case, and he would not dismiss the possibility that the house might derive from the Early Bronze Age.

At Lille Bavn (Hvass 1983 p. 127) (fig. 15) near Vorbasse S. Hvass has investigated 5 house-sites, of which at least two resemble house V at Højgård. It is dated to the Late Bronze Age, but solely on the basis of potsherds found in pits nearby. There were no potsherds in the fill of the post-holes (personal communication).

However, too much importance should not be attached to artefacts from nearby pits when dating house-sites with no finds. This is best illustrated by the investigations made at Uldal northwest of Skrydstrup in connection with the construction of a natural gas pipe-line. A great many pits contained pottery and flint from the Early Bronze Age, and there were several house-sites with no artefacts. Based on the potsherds from the surrounding pits the site was dated to the Early Bronze Age (Sørensen 1984 p. 22). However, further investigations showed that this was incorrect. It was in fact a large settlement site from the Early Viking Age.

Furthermore, it is not uncommon to find pits with late Bronze Age pottery without the presence of house-sites near by (Ethelberg 1982).

Judging by the striking similarity between the above houses and the Højgård houses it must be reasonable to regard all these house-sites as contemporaneous. Particular stress should be laid on the fire-pits between the two last pairs of roof-supporting posts at the west-ends of the house that are also found in the above described houses, but which do not appear in the houses from the Late Bronze Age. There is little doubt that these fire-pits are an integral part of the houses. Furthermore, like the Højgård houses the above described houses are also built in clusters. These features, along with the uniform position of the posts, make it reasonable to reconsider the dating of these houses and date them to the Early Bronze Age. However, the assumption cannot be dismissed that these houses may have continued into the Late Bronze Age, but the house-type must be considered as belonging to the Early Bronze Age.

THE DEVELOPMENT OF THE THREE-AISLED LONGHOUSES

As mentioned earlier most of the houses known from the Late Neolithic Period have only had one line of roof-supporting posts and have thus been double-aisled (cp. Simonsen 1983; Nielsen and Nielsen 1985). Common for all the house-sites of this type found in Jutland is the fact that they have partly sunken floors. As indicated by the Egehøj houses this type of house-building continues into the Early Bronze Age. Not until period II of the Early Bronze Age does the three-aisled longhouse make its appearance, e.g. Vadgård North, Trappendal, Hyllerup, and Højgård.

A comparison between the Egehøj houses and the Højgård houses shows both similarities and differences. The main difference is in the basic roof-structure, i.e. single line of roof-supporting posts against double lines. The similarities consist in the position of the fire-pits at the west-ends of the houses, the rounded gables, the fact that the doors are not recessed, and finally the location of the houses in clusters. Furthermore, one of the houses at Egehøj also has a partition.

The gap between the Egehøj houses with their double-aisled structure and the Højgård houses with their three-aisled method of construction may not be as big as appears at first, as the walls have supported the roof in both cases. However, the three-aisled method of construction must be regarded as the more stable one.

It cannot be excluded that a continuous development has taken place. However, if this is not the case, the Amrum house can be regarded as a kind of "missing link", as here the two lines of roof-supporting posts are very close together (fig. 14).

So there is nothing to disprove that the three-aisled longhouse should have been developed in Southern Scandinavia during the Early Bronze Age period II. However, it seems that pretty soon an east-Danish and a west-Danish type have arisen differing partly in their wall-structures, and partly as to the type of fireplace. This may have been a question of access to building materials. The east-Danish houses, which are all located in moraine country, have probably had wattle-and-daubed walls, whereas the west-Danish houses on the other side of the glacial boundary-line have probably had wooden walls built of logs, a building method requiring much more material. And timewise the houses coincide with an extensive deforestation, at least in the south of Jutland (4).

Little is known about the roof itself, but a qualified guess can be made. Tvillinghøj (Ethelberg 1982 and Hvass 1983) near Løsning has been surrounded by a fence of posts spaced roughly like the wall-posts of the Højgård houses and of roughly the same diameter. This mound may have been supposed to represent a longhouse with wooden walls and a turf roof. This would also explain the very massive walls. The east-Danish houses have probably had another kind of roof not requiring so powerful walls.

FURTHER ASPECTS

Some 300 m west of the settlement site, which is located on the most elevated terrain in the area, there is a small cluster of 6 mounds. As the area has been wooded for very many years, it may be assumed that this is the original number of mounds. The mounds may very well be a burial ground associated with the settlement site. As the houses were located in clusters, it is possible that each cluster has had its own burial mound.

If so, there should be another four clusters of houses, if they haven't disappeared into the gravel pit. A line drawn exactly midway between the two clusters of houses aims precisely at the centre of the cluster of mounds. None of the mounds have been investigated yet, and there is no knowledge of stray finds associated with them. If the number of house clusters and the number of graves were the same, it would be exciting to see if the mounds have the same number of phases and the same dating as the houses.

The other houses of this type were also found in clusters, so if the burial mounds are an exponent of the number of families on the settlement site, they would give a reliable idea of the settlement pattern and the size of its population. We hope to be able to clarify these matters in the future.

SUMMING UP

Three-aisled longhouses are a well-established type of structure already from period II of the Early Bronze Age. There are two distinct types, a west-Danish and an east-Danish one. The west-Danish type differs from Late Bronze Age houses in having wooden walls, non-recessed doors, fewer gable-posts, and fire-pits at the west-end. General differences between the east-Danish type and Late Bronze Age houses are more difficult to establish. However, it seems that they may have been larger and have had a different kind of door; but the number of houses so far known is modest.

Several types of wall-structures from the Early Bronze Age have been recorded: log-built walls, shingled walls (Handewitt), wattle-and-daubed walls (Trappendal and Hyllerup), and turf walls (Vadgård North). It seems that some of the largest pre-historic houses belong in the Early Bronze Age. The three-aisled long-house was developed by the same people who erected the large burial mounds. The architectural principles of the house were to prevail till the beginning of the Middle Ages.

On the basis of the results of the Højgård investigations and their significance for the dating of a series of comparable house-sites the theory that the Bronze Age people was an itinerant, nomadic people must be regarded as invalidated – also in the case of the Early Bronze Age.

It seems that already during the Early Bronze Age people have been relatively settled inside limited areas. The house clusters, which are also known from the Iron Age, bear witness to this. However, the social infrastructure has probably been different. The large Bronze Age houses may have housed several nuclear families related to each other. The modest size of the earliest Iron Age houses may suggest that at this point of time, society has split up into nuclear families.

The separate houses are not located in such a way that they can be said to have formed a village. Thus no enclosures have been recorded. The settlement has probably consisted of separate houses or farms succeeding each other.

The number of house sites datable to the Early Bronze Age thus seems somewhat larger than so far assumed, though it is still relatively modest. So the conclusions made here should be regarded with some reservation. On the basis of the experience from Højgård there is a hope that the coming years will bring to light further house-sites from the Early Bronze Age.

Translated by Ul S. Jørgensen

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NOTES

1. The investigations took place during the periods 31/8 – 6/9 1984, and 19/11 – 13/12 1984, and April 1985. Højgård, Gram parish, central register no. 170, Haderslev museum file no. 1706.
2. Becker 1972 p. 13 ff. and fig. 10. From Spjald can be mentioned a house measuring 27 × 8 m and from Bjerg A a house measuring 33 × 8 m, i.e. houses roughly of the same size as Højgård house I. Becker 1980. From fig. 2. p. 131 it appears that three of these house-sites have been found on Bjerg A and at least 3 on Bjerg B, fig. 5. p. 135. Another house from Bjerg is shown in Becker 1982 p. 57.
3. On the basis of the published plans it appears that the houses overlap, but neither from the text nor from the drawing does it appear whether stratigraphical observations have been made, apart from the fact that the biggest houses, which are supposed to be the earliest, are generally at the highest elevation. The lacking archaeological foundation for a dating to the Late Bronze Age has been ascertained by C.J. Becker through personal communication.
4. Personal communication from B. Aaby. The information was based on pollen-analytical investigations made by Aaby in Abkær Bog in Southern Jutland. Still unpublished.

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A New Early Bronze Age House-Site under a Barrow at Hyllerup, Western Zealand

by JENS-AAGE PEDERSEN

The curving ridge separating the elevated plain around Slagelse from the wide coastal plain along Musholm Bay carries a large number of burial monuments, among which the best-known are the Slotsbjergby-mounds. However, several sites have not been registered until recently, among which 7 mounds and a dolmen recorded during field survey before constructions of gas-pipelines in the area. Among these is Byhøj just northwest of Hyllerup.

This site, which appeared as a shift of colour in the topsoil and a large, ploughed-up stone, but which did not display recognizable contours, blocked the passage of gas pipeline and was thus speedily excavated in the spring of 1985 due to the ongoing construction work.

Fig. 1. The location of the Hyllerup site.

THE MOUND

Due to its position near the edge of an east-west aligned ridge with a pronounced slope towards the west and south, the mound was heavily damaged by ploughing, and the intact fill between the fossil and the recent topsoil was nowhere thicker than 15 cm. On the steep south slope the fill was, in fact, only preserved up to 5.5 m from the centre of the central grave, whereas the escarpment to the north ensured reasonable conditions of preservation up to 10 m from this point. Thus only the northern part of the measured section was able to yield information about the various phases of the monument.

The stratigraphy observed in the section established that the mound consisted of at least two, possibly three, building phases extending respectively 7 and 11 m from the centre of the primary grave and thus with diameters of respectively 14 and 22 m, if both centred on the primary grave. The original mound had not been fenced in any way, but after the extension it was surrounded by unsupported, fairly large stones, some of which were found, although all in a secondary position, due to disturbances caused by later cultivation.

THE GRAVE(S)

A small number of fist-sized stones imbedded in the bottom of the modern topsoil and in the top of the fill of the earliest phase was found inside a few square metres approximately 5 m north of the primary grave. These stones were possibly the remains of a totally destroyed secondary grave; however, no artifacts or other conclusive evidence were found.

The primary grave (fig. 3) was an ENE-WSW aligned excavation with vertical walls, measuring 2.4 × 1.1 m and having a flat bottom some 45 cm below the fossil surface. The topsoil dug up at the construction of the grave was redeposited in a 1.1 m wide heap along the south wall of the grave, whereas the dug-up subsoil was deposited both north and south of the grave in sloping heaps reaching up to 2.5 m out from the edges of the

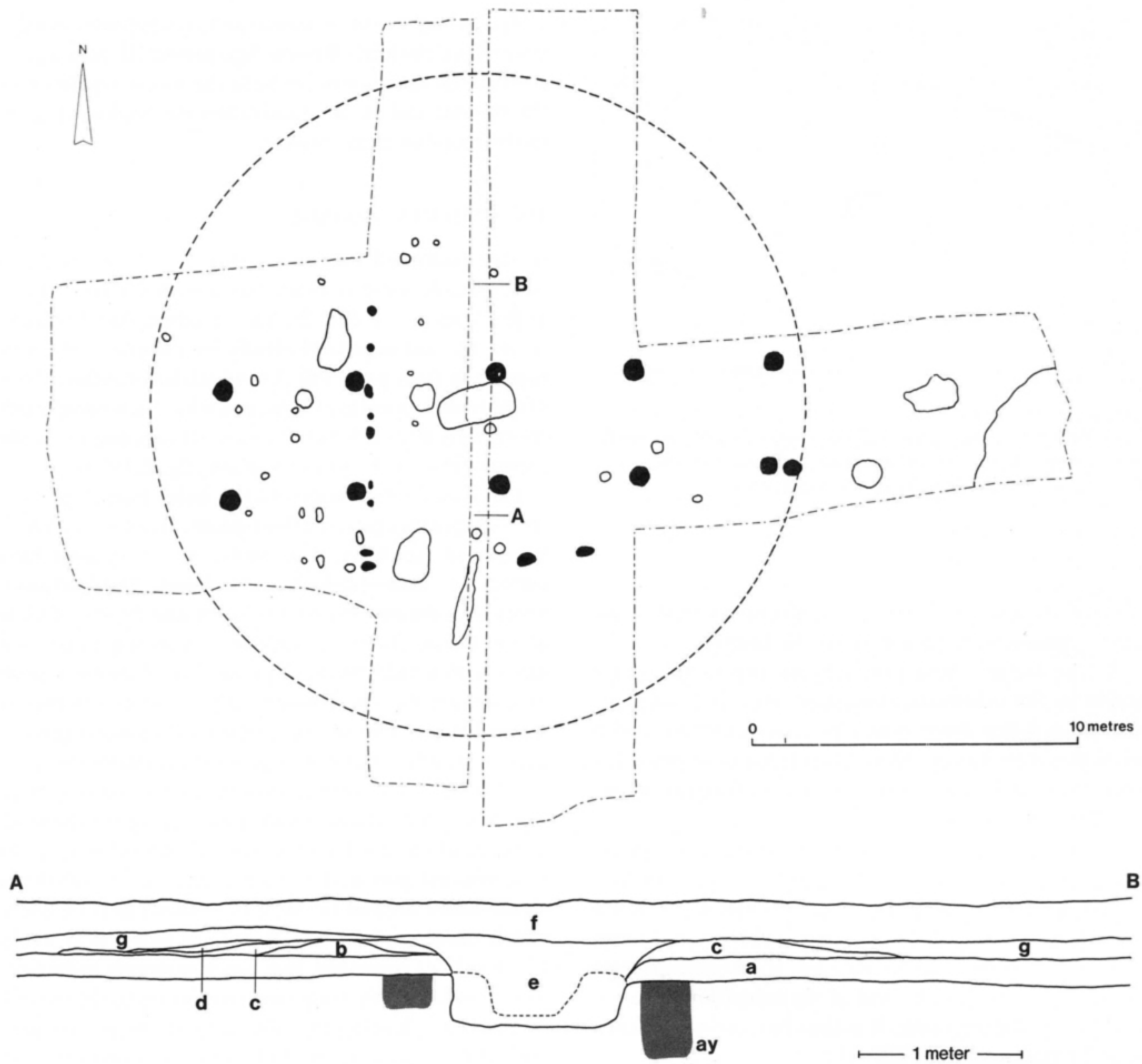

Fig. 2. Hyllerup. Above: Plan of the excavation showing the house-site and the estimated maximum perimeter of the barrow. – Below: Middle section of the barrow. a: Fossil surface. b–d: Raw clay and material from the ancient topsoil in secondary position on top of the ancient surface. e: The primary grave. f: Recent topsoil. g: Fill of the mound. Shaded: post-holes.

grave. The bottom of the grave was paved with mostly irregular stones among which were many sharp-edged flint nodules. The larger stones were placed along the edges of the grave and the smaller ones along the centre line, thus making the surface slightly trough-shaped. Stone-packings mixed with earth and inclined towards the centre line of the grave rested on the pavement along the sides, surrounding an area without stones, measuring 1.7 × 0.35 m at the surface of the pavement. The original presence of a log-coffin is thus ensured, although no traces of wood had survived.

In the area with no stones was a heap of cremated bones, measuring 0.6 × 0.3 m, on top of which four bronze objects were deposited as grave goods (fig. 4),

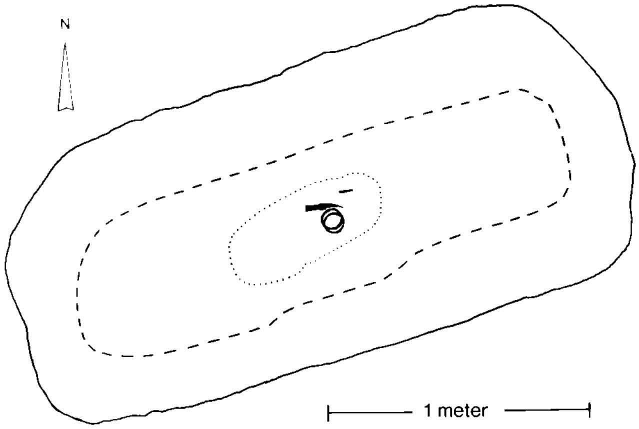

Fig. 3. Plan of the primary grave. Full line: Edge of the grave at subsoil level. Dotted line: Inner limit of stone packing at the base of the grave. Fine, dotted line: Limit of the heap of cremated bones.

covered by a fist-sized stone on whose underside organic remains were preserved by the bronze.

As the stone rested precisely on top of the grave goods in the otherwise stone-free area, it is unlikely that it has fallen down from a position above the coffin when this rotted away. More likely it has been placed as a weight on a shroud or on a container of organic material, housing the bronze objects.

The sex of the deceased and the dating of the grave appear clearly from the grave goods: a knife, an awl, and two unequal arm-rings (fig. 4). The knife has a curved, single-edged blade with a bipartite frame-handle, and is decorated with cast, transverse grooves at the end of the handle and at the transition between the handle and the blade. It is thus in close accordance with the type specimen DO III 259.

The awl is short and thick with a rounded point and a flat-hammered basis with remains of a wooden handle.

One arm-ring is made from a round, twisted bronze pole with smooth ends, corresponding to the type specimen DO III 290. The other is made of a cast bronze band with a frontal profilation consisting of a broad central rib and two narrower ribs along the edges, all decorated by oblique transverse dents or notches. At the ends the ornamental band is terminated by cast transverse grooves. The ring is thus a variant of type DO III 297.

The primary grave is consequently a typical woman's grave from the Early Bronze Age period III, which gives a terminus ante quem for both the house site beneath the mound and for the cultivation succeeding it, prior to the erection of the mound.

THE SETTLEMENT REMAINS

In the excavated area some fifty post-holes and pits were found, most notably the post-holes of a three-aisled long-house (fig. 2). The stratigraphical relation to the mound appeared clearly in a number of cases, especially from post-hole AY, which had contained one of the roof-supporting posts, and which was completely covered by the undisturbed heap of clay dug up at the construction of the primary grave (fig. 2, below).

The house-site comprised the holes from 5 pairs of roof-supporting posts, 2 door-posts, and 9 posts from a transverse partition. The roof-supporting post have rested in stone-packed, cylindrical, flat-bottomed holes with diameters around 50 cm and depths of 60 to 65 cm below the fossil surface. According to the few holes with actual traces of posts their diameters seem to have varied some, though with a tendency to cluster around 30 cm. The out-lay of the roof-supporting posts was unusually regular with a constant transverse span of 3.4 m between the centres of the posts and a constant distance of 4.3 m between the pairs, except in the western end, where the distance was only 4.0 m between the westernmost pair and the next one. The regularity is furthermore broken by the easternmost pair of posts, which does not have one deeply founded post in the south side as expected, but two less deeply imbedded posts, both slightly staggered in relation to the expected position, showing that they are not an original post and a later replacement, but two posts that have been dug down at the same time.

The door is indicated by two oval post-holes reaching 40 to 50 cm below the fossil surface and containing posts with a diameter of approximately 20 cm and with a distance of 1.8 m between their centres.

The door-posts, standing 2.2 to 2.3 m south of the centre-line through the southern row of roof-supporters, are staggered slightly towards the east, undoubtedly to give free passage by the southern post of the central pair of roof-supporters.

A total of 9 small post-holes with diameters of 20 to 30 cm and depths below the fossil surface of 35 to 45 cm

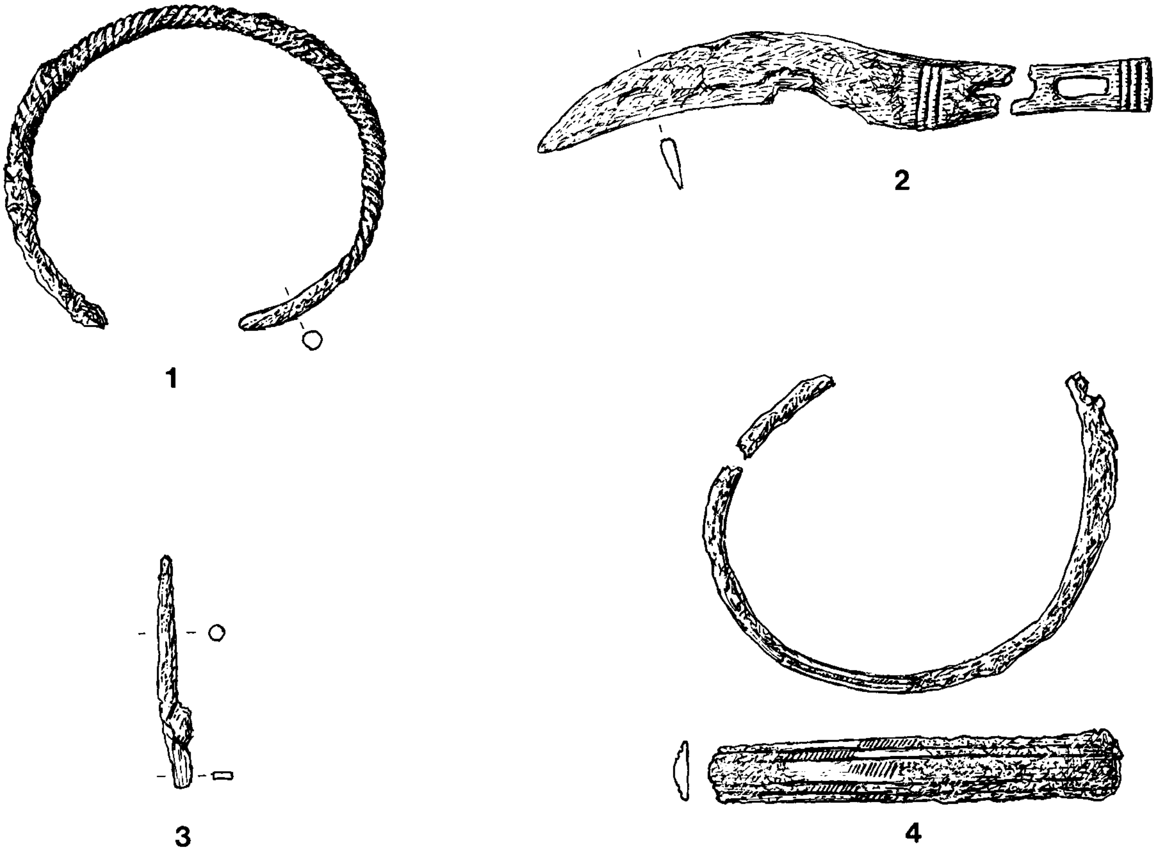

Fig. 4. Bronze objects from the primary grave. 1 and 4: Arm-rings. 2: Knife. 3: Awl. 2:3. Drawn by H. Ørsnes.

have contained more slender, often stone-packed posts of a transverse partition, 7.7 m long.

The partition wall, whose ends protrude respectively 2.2 and 2.3 beyond the nearest row of roof-supporting posts, divides the house into a smaller western room and an eastern room three times as large.

The fact that the ends of the partition wall are at almost equal distances to the nearest row of roof-supporting posts suggests that they indicate the position of the outer walls, which entails that the door has been on line with the wall and not recessed behind it.

The absence of indisputable wall-posts is not a consequence of modern agriculture. Whereas this explanation could be accepted as regards the south wall as the border-line of the intact fill roughly coincides with the course of the south wall, it cannot be accepted as regards the north wall as this was overlayered by the undisturbed fill of the mound. The absence of wall-posts is thus the result of the architectural construction of the house which has not entailed firmly imbedded wall-posts, so that every trace of the walls could be removed by ploughing prior to the construction of the mound. The use of wattle-and-daub with a smooth surface is documented by fragments mainly found at the surface of two post-holes near the south wall, probably deposited during the conflagration of the house.

As no traces of the gable walls were present it is unknown whether these have been straight or rounded, and for the same reason the length of the house is uncertain. A length of some 21–23 m seems to be qualified guess, while the breadth judged by the partition wall and the position of the door-posts was 7.7 m.

The fact that the house was burned down appears from the relatively abundant contents of charcoal in the post-holes, the relatively large amount of burnt daub fragments, and from the presence of tar-and-pitch precipitations on stones, secondarily imbedded in the pavement of the primary grave and in the packing of the coffin. Likewise, the calcination of some flint artifacts may also be due to the conflagration.

TRACES OF CULTIVATION

An area of approximately 10 × 10 m was covered with very regular traces of ard-ploughing in two directions, N-W and E-W respectively, and with a quite regular distance of roughly 30 cm between the separate furrows. The furrows only penetrated a few cm into the subsoil, which indicates a ploughing-depth of approximately 18 cm measured from the fossil surface as found. As for the ploughing depths of the Early Bronze Age a couple of cm must probably be added, due to the compression of the topsoil, caused by the mound.

Only a couple of ard-furrows deviated from the regular criss-cross pattern.

The dating of the criss-cross ploughing appeared clearly, as the furrows in some cases could be observed across the surface of the infill in the post-holes of the house.

Judging solely from the actual traces of ard-ploughing it could seem that only a single ploughing had taken place prior to the construction of the mound. However, the presence of the house-site clearly proves this assumption wrong. In connection with four post-holes sections as well as surfaces were carefully studied in order to establish whether the sides of the post-holes could be traced up into the fossil cultivation layer or not, and whether a difference in the composition of the topsoil directly above and around the individual post-holes could be established.

The actual state of affairs, a clear cut between the fill of the post-holes and the covering ancient topsoil, and an identical composition of the topsoil above and around the post-holes, can only have come about be repeated ploughing, especially in view of the fact that the tool in question was an ard, which only scratches the soil without turning it.

Intensive ploughing on the site is furthermore documented by the absence of such features of the house as floor layers, fireplaces, walls and debris from the roof, which must have caved in when the house was burned down. The total removal of these remains can only be due to the cultivation prior to the erection of the mound.

So the Hyllerup site unambiguously shows that the agricultural ploughing proper in the Early Bronze Age is not identical with the well-known criss-cross ploughing, found beneath practically every mound excavated in recent years. No way the single criss-cross ploughing could have caused the thorough destruction of the Hyllerup house. This must be due to a heavy ploughing of another kind, only affecting the topsoil without going deep enough to eraze the bottom of the furrows of the criss-cross ploughing.

The fact that typical criss-cross ploughing not only occurs beneath mounds but also outside such features, consealed otherwise, suggests that the traditional interpretations as either ritual ploughing in connection with burials or as traces of turf-cutting for the building of the mounds is incorrect.

In view of the observations at Hyllerup the most obvious explanation now seems to be that criss-cross ploughing was used to break up virgin soil prior to the more shallow cultivation ploughing proper.

THE ARTIFACTS

As the house site had been ploughed down before the mound was erected, the yield of artifacts was very limited, and the artifacts that were recorded were mostly found in secondary position in the fossil topsoil or imbedded in the fill of the primary grave.

The otherwise pure Bronze Age setting was slightly contaminated as a Maglemosean microlith was found in one of the post-holes, a micro-blade found in the fossil topsoil and, furthermore, a flat-bottomed pit just south-east of the house contained sherds from the neck of a funnel-beaker from the late Early Neolithic or early Middle Neolithic.

The rest of the artifacts includes 48 flakes, 5 cores, 11 tools and 4 pot-sherds, of which respectively 31, 4, 9 and 2 were found in secondary position. Unfortunately, most of the chronologically important objects were found in secondary position.

The flake-and-core material plus the simple tools, including 4 disc-scrapers, a disc-perforator, a burin, and a combined scraper and perforator made from a used-up core, display a rather rough and simple flint technique comprising rather casual flaking and no particular avoidance of cortex covered surfaces.

The remainder 4 tools are pressure-flaked and were all found in secondary position.

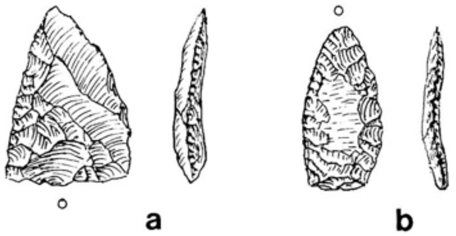

Fig. 5. Flint arrowheads found in the fossil, ploughed layer (a) and in the fill of the primary grave (b).. 2:3. Drawn by H. Ørsnes.

In the fossil topsoil under the mound a burnt edge-fragment of a pressure-flaked sickle of indeterminate shape, and likewise a partly cortex covered rough-out for a D-shaped sickle were found.

A pressure-flaked arrowhead of broad, almost isosceles, triangular shape with a straight basis, made from a flake, the percussion-bulb at the basis, was also found in the fossil, ploughed layer, and a slender arrowhead with curving sides and an almost straight basis made from a long, curving flake, the percussion-bulb at the point, was found in the fill of the central grave (fig. 5).

The ceramic material consists of a few body-sherds and a rim-sherd of a thin-walled vessel with a rounded, probably upright rim.

The limited faunal material has been analysed by Knud Rosenlund of the Zoological Museum, University of Copenhagen, who has identified both domestic pig and domestic ox.

DATING

Flat-retouched arrowheads (fig. 5) are known from some fifty EBA-graves, but only rarely in combinations with types that allow a closer dating. According to Lomborg it does not seem possible to separate types of chronologically limited occurrence (Lomborg 1959, p. 169). However, pronounced barbs seem to be an early feature, mainly found in the Late Neolithic, though also seen as late as EBA III (DB I, grave 1602). Bronze Age arrowheads on the other hand mostly have an only slightly inward-curving basis – from which the transition to a straight basis is gradual – often in combination with curved edges.

Typical examples of this type are known from the well-equipped Herslev-grave, by Lomborg dated to the late EBA I, the Valsømagle-horizon (Lomborg 1968), but already in the LN A the type appears at Myrhøj (Aarup Jensen 1972, fig. 23,3, 8 and 13). Only a few arrowheads with a straight basis have been published, i. a. some from the settlements of Røjle Mose and Vejlby (Jæger & Laursen 1983, fig. 13 a; Jeppesen 1984, figs. 2 c–d).

A dating of the Hyllerup sickle cannot be made on the basis of the grave material as sickles are extremely rare as grave goods. A typical D-shaped sickle has, however, been found in a stone cist at Videbæk accompanied by a palstave of the EBA II, but a simultaneous deposition of the two items cannot be ensured (Lomborg 1959, p. 165).

In settlement finds the type is known from *i. a.* Vejlby, Røjle Mose, and Egehøj (Jeppesen 1984, fig. 2 a; Jæger & Laursen 1983, fig. 13 b; Boas 1983, fig. 4, 11–12), in all cases in combination with arrowheads resembling the Hyllerup specimens, a combination further occurring in the Fornæs Klint-material (Glob 1951, figs. 11 and 13), which reaches up into the EBA according to the presence of type VI daggers.

The same group of settlements also contains close parallels to the solitary rim-sherd from Hyllerup.

The material equivalent to the Hyllerup find is clearly dominated by the copious material from the settlement site of Egehøj, which Boas dates to an early part of the EBA I due to the presence of daggers of types V and VI (Boas 1983, p. 100). As so far there are no equally rich finds from neither the LN C nor the EBA II, and as the Hyllerup material is very limited it is hardly allowed to attempt a closer dating of the find material than the Early Bronze Age in general.

However, the presence of the covering mound ensures that the settlement was abandoned prior to or early in the EBA III.

A sample of burned daub from the southern wall of the house, deposited in two post-holes just west of the door, has been submitted to TL-analysis, the result of which, 1270 ± 200 BC (R-852801), suggests a dating of the house to the EBA II.

A sample of unburned bones, collected from the upper part of the infill of a hole for one of the roof-supporting posts, must be regarded as contaminated by a recent intrusion, as the dating by the C 14-method turned out to be 810 ± 70 AD (K-4633).

OTHER EARLY BRONZE AGE HOUSES

Whereas so far three EBA settlements have displayed oval, short houses (Vadgård: Lomborg 1973, 1976 and 1980; Røjle Mose: Jæger & Laursen 1983; Brændekilde: Unpublished excavation by J. Jacobsen, Fyns Stiftsmuseum), longhouses have now been recorded from several localities. Due to the sparse material from most of them precise datings are hard to come by.

As the background for the dating of Vadgård house BL has not yet been published, Lomborg's rough dating of the site to the EBA II (Lomborg 1973, p. 10; 1976, p. 429; 1980, p. 124) must so far be accepted. The dating of the newly found settlement of Højgård to the EBA II–III (Ethelberg 1986 a; Ethelberg 1986 b) seems to a large extent based on typological considerations and on TL-measurements as finds were extremely sparse. The Norddorf house contained *i. a.* a flint sickle with a curved edge, a type occurring in Ballermosen in a grave of the EBA II (Lomborg 1959, p. 165), combined with finger-smoothed body-sherds from storage vessels very similar to those frequently appearing in graves of the EBA II–III in the North Frisian Islands (Struve 1954, p. 40). As mentioned above Boas dates the Egehøj settlement to the EBA I, but as the site is well-equipped with cordoned vessels the beginning of the occupation may reach back into the LN.

The above-mentioned sites are all open sites, whereas the following have been covered by later mounds. The material from the Handewitt house contains pottery of a rather late character, although the EBA II cannot be excluded. The primary grave of the covering mound was unfurnished, but the presence of an uncremated burial in a man-sized log-coffin ascertains that the mound was built before the end of the Early Bronze Age (Bokelmann 1977, p. 82).

Trappendal causes a problem as the chronological relationship between the house and the mound has probably been misinterpreted (Andersen & Boysen 1983). For the present writer there is no evidence to support a connection between house and mound; on the contrary certain details seem to indicate a period of cultivation sandwiched in between the house and the mound, exactly as at Hyllerup and at Lusehøj (see below). The sparse material from the house itself has not been published, and the primary grave, the so-called "central structure", was unfurnished, whereas the secondary graves 24/36 must be dated to the EBA III (Andersen & Boysen 1983, p. 124).

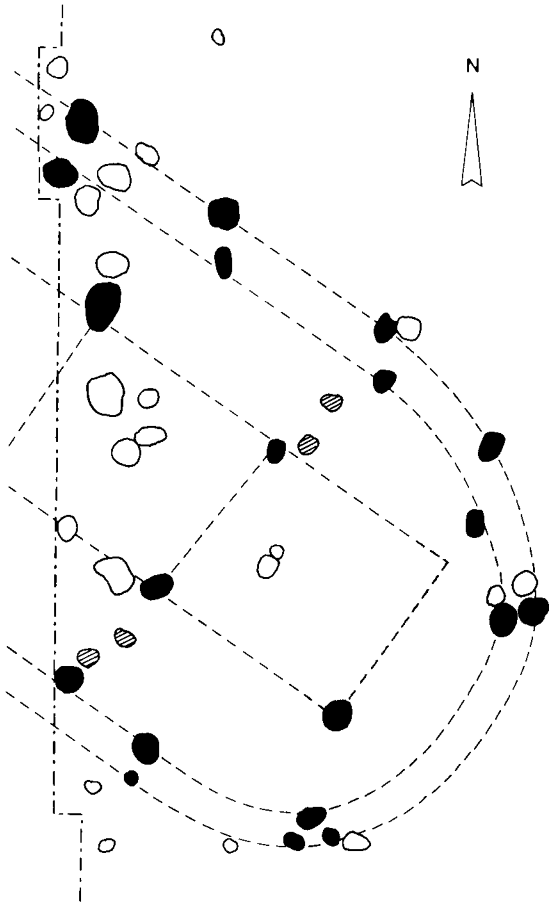

Fig. 6. The author's interpretation of a house-site below Lusehøj, Funen. Redrawn after Thrane 1984 fig. 16 and 105. Post-holes representing wall-posts and roof-supporters are shown in black, while post-holes possibly belonging to a transverse partition wall are marked with oblique haching. Shaded: pit. 1:100.

Beneath the mound of Lusehøj some settlement structures were found, among them the eastern part of a three-aisled long-house, overlooked by Thrane (Thrane 1984, p. 112) (fig. 6).

The transverse span is 2.5 m, the distance between the pairs of roof-carriers is 3.0 m, and the curved gables and the rectilinear side walls are marked by double rows of deeply founded posts, normally spaced 2.0 to 2.5 m apart in the individual rows. As only the eastern part of the house was uncovered, the length is unknown; the breadth is 6.5 to 7.0 m.

Thranes description of the individual holes (Thrane 1984, p. 30 ff) gives at hand, that the posts of the inner wall-row with only one exception are deeper dug than the corresponding ones of the outer with a maximum difference of 45 cm and an average of 20 cm.

Although the dating of the settlement remains to the EBA III (Thrane 1984, p. 110) is not quite certain, the house cannot be much later, partly covered as it is by the small barrows GÆ and GZ, clearly of the LBA IV (Thrane 1984, p. 75).

As at Hyllerup and Trappendal a period of heavy cultivation is sandwiched in between the conflagration of the house and the erection of the small barrows (Thrane 1984, p. 113).

To sum up the chronological discussion: The artifact material from Egehøj ensures the existence of the two-aisled long-house in the EBA I, whereas the barrows at Handewitt, Trappendal and Hyllerup make sure that the three-aisled long-house was introduced prior to or early in the EBA III. The TL-dating of the Hyllerup site suggests that the conflagration took place in the EBA II.

TYPOLOGICAL CONSIDERATIONS

The very regular construction of the three-aisled Hyllerup house diverges clearly from the houses of Vadgård, Trappendal, Handewitt and from some of the Højgård houses, but resembles the Norddorf house. Here the distance between the rows of roof-supporting posts were, however, only 1 m.

The wall-construction without deeply imbedded posts distinguishes the Hyllerup house from most of or all the other houses, as the lack of wall-posts can only be mentioned from a few of the Højgård houses, where, however, this feature need not be seen as an original characteristic, but may simply be due to recent cultivation, an open site as it is.

The door of the Hyllerup house seems to have been placed in the wall line in accordance with the houses from Norddorf, Vadgård and Højgård, but in contrast to the recessed doors at Trappendal and Handewitt and numerous houses of the Late Bronze Age.

The partition wall in the western end of the Hyllerup house is parallelled in Trappendal, Handewitt, and Højgård house I. Unlike Hyllerup and Højgård I the two other houses have an additional partition wall in the eastern ends, but in both cases these eastern partitions are of considerably slighter construction than the western ones in the same houses.

In view of the considerable damage to the Hyllerup house caused by cultivation prior to the erection of the barrow the original presence of a similar eastern partition wall cannot be excluded, although no traces were preserved.

The still very few EBA houses display an important development in the construction of long-houses. The two-aisled houses at Egehøj are closely related to the Late Neolithic ones from Limensgård (Nielsen & Nielsen 1985) and Fosie IV (Björnhem & Säfvestad 1983) and share with these the stoutly founded walls carrying most of the weight of the roofs.

The two rows of roof-supporting posts in the Norddorf house are too close together to relieve the walls to any great extent, which is affirmed by the fact, that the holes for the wall-posts are deeper dug than those for the roof-supports.

Although with a good distance between the two rows the houses of Trappendal and Handewitt possess such an irregular, almost casual framework that the walls still have an important function as carriers for the roof, corresponding to the fact that the foundations for the walls are still deep, although the roof-supports go even deeper down.

Whereas the holes for the wall-posts and for the roof-supports are equally deep in the houses I, II, VI and X at Højgård, which all possess a rather regular framework, the roof-supporting posts are the deeper ones in the cases of Højgård III and IV.

Alone in the series the Hyllerup house has a roof-supporting framework of such a regularity that it alone must have been able to carry the entire weight of the roof, thus allowing such a light wall-construction that every trace of it could be, and has been, destroyed by the Early Bronze Age cultivation.

However, this typological development does not reflect a chronological one, as several of the Højgård houses with relatively stable framework retain deeply imbedded wall-posts, a feature commonly met with during the Late Bronze Age in Jutland.

The possibility that Bronze Age houses in Zealand continue to have a slighter wall-construction than the contemporary ones in Jutland must not be overlooked, but a present only a few indisputable houses of the LBA have been investigated in Zealand, mostly so badly worn by cultivation that every trace of the wall-constructions are absent (note 1).

Thus the Hyllerup house raises questions, which can only be answered on the basis of future material. This is easy to come by, as the settlement site of Hyllerup according to the scatter of worked flint in the topsoil seems rather large.

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NOTE

1. Traces of wall-constructions in connection with more or less certain houses of the LBA are claimed from Skamlebæk (Lomborg 1977), Søgård, Gerlev par. (unpublished investigation by P.O. Nielsen and F. Kaul) and Pugbjerg, Tårnborg par. (unpublished investigation by the present writer).

The neatly preserved houses from Jersie, published as of the LBA, must according to the TL-analysis be redated to the Early Migration Period (Tornbjerg 1982 b, p. 92).

LBA houses with posted walls, similar to the Jutish ones, are recorded in increasing numbers in southern Sweden (Strömberg 1982, p. 154 with further ref.).

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Dyes and Fleece Types in Prehistoric Textiles from Scandinavia and Germany

by LISE BENDER JØRGENSEN and PENELOPE WALTON

During the past few years a large quantity of prehistoric textiles has been recorded from all over North Europe. The many textiles (from approximately 2,500 finds) have been sorted into about a score of cloth types, defined by a combination of weave, spin and quality. Distribution maps of each type have shown that most can be linked with geographical and cultural entities, and a distinction between locally produced cloth and imported fabrics has been ventured (Bender Jørgensen 1984).

It was, however, felt that additional documentation for the origin of the various cloth types would be desirable, especially as the conditions for the preservation of textiles vary greatly, and it would be impossible to gather a homogeneous material from all of the Old World. One such source of information is the examination of the fleece types found in wool fabrics, another is the dyestuffs used for colouring.

Methods for the analysing of both fleece types and dyestuffs have been developed greatly in recent years in England, based mainly on British material, but on other European material (even some Danish) as well. A grant from the Danish Research Council for the Humanities made it possible to take advantage of the English specialist knowledge by letting Penelope Walton, a textile consultant based in York, analyse a group of selected samples of Scandinavian and North German Iron Age textiles.

THE SAMPLE

The main purpose of the investigation was to see if the types defined on a technological background also had been made from homogeneous fleece types; and if any difference could be told between the wool of cloth supposed to be of local origin, and the wool of allegedly imported cloth. To this was to be added the evidence of the dyestuffs.

It was decided to take samples of 4 different cloth types of the Pre-Roman and Roman Iron Age, and two of the Late Germanic/Viking Age. A wide geographical background was obtained through the friendly cooperation of Klaus Tidow of the Textilmuseum Neumünster, and Bente Magnus of Historisk Museum in Bergen, who provided samples from the settlements of the North German marshlands and from Norway.

The four Early Iron Age cloth types selected for analysis were the Huldremose- and Haraldskjær types of the Pre-Roman and Early Roman Iron Age, and the Virring type and dog's tooth spin-patterned twills of the Roman Iron Age. The Late Iron Age types were the Birka type and the Hessens/Elisenhof type. All these types are described in Bender Jørgensen 1984 and 1986.

The Huldremose- and Haraldskjær types are both considered to be local products, the Virring type is supposed to be of central- and West European origin and thus imported to Scandinavia. The dog's tooth twills are a feature of Scandinavian Late Roman Iron Age without any known parallels. The origin of the Birka type has been greatly discussed, and Bender Jørgensen has suggested that it is of West Norwegian origin (1984, p. 131f); the Hessens/Elisenhof type was probably made along the North Sea Coast.

The following textiles were included in the investigation:

Huldremose type: Krogens Mølle Mose, Stokholm Mose, Borre Mose, and Fræer Mose, all from Denmark, and all dated to the Pre-Roman Iron Age.

Haraldskjær type: Haraldskjær Mose (Pre-Roman Iron Age), and Lønne Hede (1st century AD), both from Denmark. From Germany some samples from Feddersen Wierde were selected, however only tabbies, as no twills were available from the stores of the Textilmuseum Neumünster; to these were added two samples of raw wool.

Virring type: Vester Lem, Hjørring Præstegårds Mark, Vrangstrup grave 1, and Verdens Ende from Denmark, Tofte and Blindheim from Norway. All samples are dated to the Late Roman Iron Age.

Dog's tooth twills: Hjørring Præstegårds Mark and Donbæk from Denmark, Blindheim from Norway, all from the Late Roman Period.

Birka type: Lousgard (Denmark), from the Late Germanic Iron Age, and Dale, Veka, Vinjum and Sandanger (all Norway) from the Viking Age.

Hessens/Elisenhof type: Hessens and Niens (North Germany), both 8th century AD. To the Hessens/Elisenhof diamond twills were added samples of raw wool, a chevron twill and a tabby from the same sites. L.B.J.

Unfortunately, it was not possible to fleece-type and dye-test every specimen. Samples of 20mg are necessary for a thorough dye analysis and this is not always available where the surviving textile fragment is small. Fleece-typing requires less sample but unless the wool fibres are in an excellent state of preservation, it is not possible to measure their diameters accurately. Thus, dye tests were sometimes carried out on poorly preserved textiles which could not be fleece-typed, while particularly small fragments were fleece-typed but not dye-tested. However, in many cases it was possible to carry out both analyses.

THE METHODS OF ANALYSIS

Dye tests

A procedure for analysing dyes on textiles was introduced into archaeology by Professor M.C. Whiting of Bristol University. These techniques, which have been further developed by Dr G.W. Taylor of the York Archaeological Trust, are now regularly in use in dye identification (Taylor 1983).

Briefly, the procedure consists of putting the sample through a sequence of solvents, each of which will extract a different group of dyes. Any dye present is isolated and its detectability enhanced with further solvents, etc. The light absorption of the extracts is then measured with a U.V./Visible spectrophotometer and the spectra compared with those of known dyestuffs (for more precise details see Taylor 1983). Any uncertain results are checked with chromatography, in this instance thin layer chromatography.

Work carried out on British textiles has shown that although any number of local dye-plants must have been available, in fact only a very small number of well-known dyes, such as madder and woad, were used throughout the Roman, Saxon, Viking and medieval periods. However, it has to be said that our techniques are less effective at detecting and identifying the yellow dyes, which are often masked by yellow/brown staining from the soil.

Fleece typing

As with dye-testing, this is a technique used in the modern textile industry, but which has been transferred to good effect into archaeology – in this case by Dr M.L. Ryder of the Hill Farm Research Organisation (see for example Ryder 1964, 1969, 1982, 1983a).

Samples of fibre were viewed at 400x magnification and features of the structure such as scale pattern and medulla were examined to establish that it was indeed sheep's wool and not any other animal coat fibre. The diameters of 100 fibres were then measured and recorded in histogram form. According to the range, mean and distribution of this histogram, the sample was placed in one of the seven fleece type categories, which range from fine to hairy (see table 4). Since a sample is taken for each type of yarn visible in the textile, there are usually two fleece types per fragment, one for the warp and one for the weft.

Dr Ryder's work was originally aimed at developing a theory concerning the evolution of the fleece of sheep. However, to the archaeologist interested in textiles, his work has been significant in showing that the raw material of wool textiles has varied considerably in the past and that different fleece types have predominated at different periods of time and in different areas.

Of course, in the past, flocks were much less uniform than they are nowadays and no fleece type is therefore exclusive to any particular period or country. For this reason no conclusions can be drawn concerning individual textiles. However, when comparing the character of one *group* of fabric types with another it is a useful piece of information.

While examining the wool, a record was also made of the percentage of fibres which showed the dark granules of natural pigment and how densely the granules were distributed. Thus a white fleece could be differentiated from a grey/fawn or a brown/black.

RESULTS

The results of both types of analysis are recorded in Tables 1–3. A summary of fleece types is given in table 4. The main points of interest are discussed below.

Pre-Roman Iron Age, Denmark

The wools from the Pre-Roman Iron Age, 18 in number, are all of the same type. They consist of fine fibres, mostly less than 35 microns in diameter, with coarse 'kemps' of 90–176 microns and very few intermediate fibres. Most have no pigment (white) although four specimens have pigment on a high proportion of fibres (brown or dark grey) and three have pigment in a few fibres (still probably white to the naked eye). This is a primitive type of fleece (classified as hairy medium), only a few stages removed from the double-coated fleece of the wild ancestor of domesticated sheep.

The present day wild mouflon has a fleece with numerous short bristly kemp fibres and an extremely fine woolly undercoat, is brown with a white belly, and is subject to an annual moult (Ryder 1982 pp 224–5, 237). The 17 Danish wools from the Bronze Age which have been studied by Ryder (1969, 1983b) resemble the fleece of the mouflon in their remarkably fine undercoat and predominance of natural pigment. However, a few examples were white and the proportion of kemps was small, indicating that the fleece had begun to evolve from the wild type. Seven of these wools were clearly of the same type as the others, but lacked the kemp altogether, which Ryder suggests may indicate that they were plucked during the moult, before the kemps had been released from the skin (1983b p 330).

The Iron Age fleece types at present under discussion continue this line of development, with more white fleeces and a slight coarsening of the undercoat. Their most common measurements (modes) are 16–26 microns (average 20.4) as compared with 14–22 microns (average 17.0) in the Bronze Age and 14 microns in the mouflon. This coarser undercoat brings them closer to the Soay of St Kilda (off the north-west coast of Britain) which is believed to be a survivor from the British Bronze Age (although this sheep has a mainly brown fleece, while most of the Danish pre-Roman examples were white).

These Danish wools are a useful group, since few other fleece types have been identified from the Pre-Roman Iron Age, either from Denmark or elsewhere. Other hairy medium types are known from Iron Age Britain (Bender Jørgensen and Walton forthcoming) and France (Ryder 1982 p 226), but true hairy types are also recorded, at Hallstatt in Austria and Potrems in East Germany (Ryder 1969 p 502, 1977 pp 177–8). The Danish Rønbjerg textiles showed quite a range of types, hairy medium (1) generalised medium (5) and shortwool (1) (Ryder 1982 p 226) but unfortunately this bogfind is not firmly dated, although tentatively placed in the Celtic Iron Age (Munksgaard 1982 p 42).

All in all, since there is nothing to suggest that the present sample is not from local products and since they come from several different sites, ranging from the 6th to 1st centuries BC, it seems reasonable to suppose that their wool reflects the predominant fleece of the native Danish sheep in the Pre-Roman Iron Age. However, the Rønbjerg examples may suggest that the fleece was beginning to evolve away from the hairy median type at this time.

Although the majority of the samples were from white fleeces, some pigmented yarns had been used to introduce colour patterning. Ryder suggests this pigment was dark brown rather than grey/black, from analogy with the Soay (Ryder 1983b p 327). Only two of the pre-Roman textiles, both from Krogens Mølle, were tested for dye and both gave negative results. The group selected for dye-testing was kept small because natural pigment had clearly been used and dyeing therefore seemed unlikely.

Roman Iron Age, Denmark, Norway, Germany

Fleece types

The textiles from the Roman Iron Age show a much wider range of fleeces than the pre-Roman group. There are 5 fine (3 Denmark, 2 Norway), 2 fine/generalised medium (1 Den, 1 Nor), 3 generalised medium (2 Den, 1 Nor), 1 medium (Den), 4 shortwool (1 Den, 3 Nor), 15 hairy medium (10 Den, 1 Nor, 4 Germany), 2 hairy (Germany). The Lønne Hede textiles had already been studied by Ryder and Hedges (1973) and had proved to be 5 fine, 3 fine/gen. medium, 2 hairy medium.

The hairy medium type predominates in the Danish and German samples, but although these wools belong to the same category as the pre-Roman Danish fleeces,

FLEECE TYPES: DENMARK

	Range	Mode	Mean±S.D.	P.coeff. Distribution	Medullas	Pigment	Fleece type
Krogens Mølle							
D1310 (a–b)	13–28, 37	23	23.7±15.7	Symmetrical	3%	50–70% fibres	Hairy
dark	55, 59, 167		(22.2±6.4)	undercoat with kemp	(1 kemp)		medium
light	10–33, 41,	22	21.9±10.6	ditto	1%	approx. 6%	Hairy
	47, 114		(21.0±5.2)		(1 kemp)		medium
D1310 (c)	12–31, 46,	19, 23	23.9±17.0	ditto	41%	none	Hairy
a	126, 151		(21.5±4.2)		(2 kemps)		medium
b	12–31, 45,	21, 24	23.3±16.4	ditto	6%	none	Hairy
	87, 167		(21.2±4.5)		(2 kemps)		medium
Stokholm Mose							
C7649 (a–b)	9–35, 49,	21	23.6±16.9	+1.16, pos.skew	10%	10% pigmented	Hairy
a	92, 122, 128		(20.8±5.2)		(3 kemps)		medium
b	13–40, 138	17, 19,	22.8±12.6	Symmetrical	9%	none	Hairy
		21, 22	(21.6±5.0)	undercoat with kemp	(1 kemp)		medium
C7649 (c)	10–31, 46,	16	22.6±16.1	+0.61, pos.skew	6%	none	Hairy
a	79, 113, 131		(20.0±4.9)		(3 kemps)		medium
b	10–29, 144,	17, 18	23.5(±26.4)	+0.64, pos.skew	6%	none	Hairy
	149, 154, 159		(18.2±3.7)		(3 kemps)		medium
Borre Mose							
8/43 a	15–32, 56,	21	24.6±11.1	symmetrical	1%	approx 75% of	Hairy
	126		(23.6±4.5)	undercoat with kemp	(kemp)	fibres	medium
b	12–37, 128,	26	26.2±15.4	ditto	2%	none	Hairy
	131		(24.1±4.5)		(kemps)		medium
Fræer Mose							
7141–42 a	12–28, 72×2,	21	23.4±17.7	ditto	5%	none	Hairy
	81, 123, 128		(19.6±3.5)		(kemps)		medium
b	13–28, 108,	21	29.3(±29.5)	ditto	7%	none	Hairy
	117, 123, 126		29.3±3.8		(kemps)		medium
	146, 154, 167						
Haraldskær Mose							
3706(c) a	14–38, 65,	19	23.7±14.8	+0.66, pos.skew	18%	approx. 6% of	Hairy
	155		(21.9±5.4)		(1 kemp)	fibres	medium
b	12–37, 155	23	28.1±20.2	+0.51, pos.skew	8%	none	Hairy
	176		(25.3±5.1)		(2 kemps)		medium
3707c2 a	12–32, 138,	21	23.3±18.4	symmetrical	7%	none	Hairy
	159		(20.7±4.7)	undercoat with kemp	(2 kemps)		medium
b	12–27, 63,	19	20.8±13.8	ditto	5%	pigment on most	Hairy
	68, 99, 105		(18.2±3.5)		(4 kemps)	fibres	medium
3707c? a	10–29, 42,	18	23.0±17.5	ditto	6%	none	Hairy
	90, 106, 108, 118		(19.6±4.6)		(4 kemps)		medium
b	12–27, 35	18	20.5±13.9	ditto	5%	pigment on most	Hairy
	42, 108, 119		(18.6±4.1)		(2 kemps)	fibres	medium
Vester Lem							
C13920 Z	12–31	18	19.9±4.1	+0.18, symmetrical	0	none	Fine
(Virring)							
C13920 S	9–41, 50,	14	19.4±10.6	+0.59, pos.skew	4%	2% of fibres	Hairy
	72, 83						medium

(Mean and S.D. for undercoat only, given in brackets)

Table 1. Denmark: Fleece types and dye tests. Measurements in microns (1 micron = 0.001 mm).

	Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Hjørring Præstegårdsmark							
C2181 (g–h) (Virring) Z	10–36	21	21.3±5.1	+0.28, symmetrical	0	none	Fine
S	13–33	21	20.5±4.3	+0.26, symmetrical	0	none	Fine
C2181 (a–c) (dogtooth) Za	14–40	21	23.4±5.7	+0.87, pos.skew	0	none	Fine/gen. medium
Sa	17–45, 53	24	25.9±6.3	+0.86, pos.skew	0	none	Gen. medium
Zb	12–32, 65, 76, 79	22	23.7±9.6	+0.47, pos.skew	3%	none	Hairy medium
Sb	13–37, 63, 73	27	24.5±7.9	+0.20, symmetrical	2%	none	Hairy medium
Donbæk							
C5998(c) (dogtooth) Za	14–38, 51, 85	23	24.9±8.2	+0.64, pos.skew	2%	none	Hairy medium
Sa	15–42, 59, 60, 62, 90	26	27.1±10.3	+0.65, pos.skew	4%	none	Hairy medium
Zb	15–41, 49, 72	27	26.1±7.9	+0.13, symmetrical	3%	none	Hairy medium
Sb	12–50, 85	22	26.5±9.0	+0.40, symmetrical	1%	none	Hairy medium
Vrangstrup, grave 1							
C23585(d) (striped Virring) Z	14–47	24	25.0±5.4	+0.38, symmetrical	0	stripes produced by varying proportion of pigmented fibres	Short-wool
S	17–62	27	28.7±7.3	+0.56, pos.skew	3%	14%	Hairy medium
C23585(d) (Virring w. border) Z	13–37, 57, 62, 90	19, 28	24.6±9.6	+0.49, pos.skew	2%	none	Hairy medium
S	10–38, 72, 91	23	24.1±9.1	+0.52, pos.skew	2%	none	Hairy medium
Verdens Ende							
C29460(a) (Virring) Z	18–51	33	31.5±7.4	+0.05, symmetrical	0	?	Medium
S	12–50	23	25.2±7.1	+0.50, pos.skew	0	?	Gen. medium
Lousgård							
C5602 (Birka-type) warp	15–38	24	27.1±4.0	−0.10, symmetrical	0	none	Short-wool
weft	14–36	24	23.1±4.2	+0.12, symmetrical	0	none	Short-wool

DYE TESTS: DENMARK

Lønne Hede	type land 2	indigotin
	type 4 blue	indigotin
	type 4 red	unidentified orange dye
	type 5	same unidentified orange dye
	type 7 blue	indigotin
	type 7 red	same unidentified orange dye
Krogens Mølle D1310	coarse a–b	no dye detected
	fine c	no dye detected
Hjørring Præstegårdsmark	C2181 g–h (Virring type)	indigotin
	C2181 a–c (dog-tooth)	indigotin
Donbæk	C5998 c (dog-tooth)	indigotin
Vrangstrup	C23585 d (striped)	no dye detected
Verdens Ende	C29460 a (Virring)	?no dye detected

Table 1 (continued). Denmark: Fleece types and dye tests. Measurements in microns.

FLEECE TYPES: NORWAY

	Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Tofte, Halsnøy, Hordaland							
B5406: Z (Virring)	15–45, 67	26	29.1±7.7	+0.67, pos. skew	1%	none	Hairy-medium
B5406: S	19–41, 51	22	29.0±5.6	+0.44, pos. skew	1%	none	Gen. medium
Blindheim, Giske, Møre og Romsdal							
B8628: Z (Virring)	15–42	22, 26	26.4±5.9	+0.26, symmetrical	0	none	Short-wool
B8628: S	12–34	19	21.6±4.2	+0.26, symmetrical	0	dense on 6%	Fine
B8628: ZSa (dog-tooth)	10–40	19	22.0±5.4	+0.62, pos. skew	0	none	Fine/gen. medium
B8628: Sa	12–50	19, 23	22.5±6.7	+0.49, pos. skew	1%	none	Gen. medium
B8628: Zb	13–44	27	27.0±5.3	+0.09, symmetrical	0	none	Short-wool
B8628: Sb	15–41	27	26.5±5.2	−0.04, symmetrical	0	none	Short-wool
Dale, Fjaler, Sogn og Fjordane							
B5910: warp (Birka)	21–67, 83	35	43.0±11.1	+0.45, pos. skew	4%	none	?*
B5910: weft	22–64	36	38.2±8.6	+0.65, pos. skew	0	dense on 1%	?*

* Not easily categorised – possibly a primitive longwool.

	Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Veka, Voss, Hordaland							
B6228: warp (Birke type)	17–44	33	29.9±6.0	−0.20, symmetrical	1%	slight on most fibres	Short-wool
B6228: weft	15–45	24	27.8±6.9	+0.45, symmetrical	1%	slight on most fibres	Short-wool
Vinjum, Aurland, Sogn og Fjordane							
B7731: warp (Birka type)	18–42	31	30.3±5.2	−0.02, symmetrical	0	slight on most fibres	Short-wool
B7731: weft	17–44	31	30.0±5.5	+0.09, symmetrical	0	slight on most fibres	Short-wool
Sandager, Sande, Møre og Romsdal							
B10772: warp (Birka type)	17–53, 63	22	27.0±7.6	+0.57, pos. skew	2%	slight on most fibres	Hairy medium
B10772: weft	13–40, 47	22	24.7±4.9	+0.27, symmetrical	2%	slight on approximately 50% of fibres	Short-wool

DYE TESTS: NORWAY

Tofte B5406 (Virring type)	madder (*Rubia tinctorum*)
Blindheim B8628 (Virring type)	indigotin plus an unidentified yellow/orange dye
Dale B5910 (Birka type)	indigotin
Veka B8228 (Birka type)	indigotin
Sandanger B10772 (Birka type)	indigotin

Indigotin is the dyestuff extracted from both the woad and indigo plants. At this date, woad is more likely.

Table 2. Norway: Fleece types and dye tests. Measurements in microns.

FLEECE TYPES: GERMANY

	Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Feddersen Wierde							
FW 593 raw wool	10–83	17	24.8±15.3	+1.11, pos. skew	>6%	dense on all fibres over 29 microns (20%)	Hairy medium
FW 708 raw wool	10–53, 74, 77	15	23.2±14.2	+1.51, pos. skew	>2%	dense on all fibres over 28 microns (24%)	Hairy medium
FW 204 tabby: warp	13–33 51–118	26	27.9±17.7	+0.70, pos. skew	9%	none	Hairy medium
FW 204 tabby: weft	9–35, 65, 83, 118	18	21.4±13.1	+0.60, pos. skew	3%	none	Hairy medium
FW 451 tabby: warp	14–83	37	42.4±13.0	+0.31, continuous	30%	slight on most fibres	Hairy
FW 451 tabby: weft	17–81, 91	26, 31,	44.4±16.0	−0.20, continuous	44%	slight on most fibres	Hairy

FW 593 consists of wool staples approximately 3.0 cms long, square-ended or slightly pointed in shape. A number of dark hairs are clearly visible projecting beyond the paler undercoat. The shortness of the staple and the presence of fibre tips in the underwool indicates that this is lambswool.
FW 708 consists of several staples approximately 4.5 cms long, similar in appearance to FW 593. Some fibre roots are present, indicating that this is 'fell wool' plucked from the skin of a dead animal.

	Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Hessens							
HE 70 raw wool	17–104	21, 23 26	34.2±18.7	+1.03, pos. skew	9%	dense on all fibres over 31 microns (22%)	Hairy
HE 43 raw wool	18–96	32	33.4±14.3	+0.63, pos. skew	8%	dense and light; only in fibres over 45 microns (10%)	Hairy
HE 36c diamond twill: warp	14–65	21, 22, 23	32.7±13.2	+0.88, pos. skew	>10%	dense on most fibres	Hairy medium
HE 36c weft	12–62, 69	27, 28	31.9±12.4	+0.91, pos. skew	>15%	dense on most fibres	Hairy medium

HE 70 is a staple approximately 16.0 cms long, pointed or "tippy" in shape. The pale undercoat is only 6.5 cms long, the remainder of the staple length being dark hairs.
HE 43 is a matted pad of fibres with no intact staples.

	Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Niens							
Nie 5: warp (Chevron)	10–67, 82, 82	29	30.1±12.4	+0.58, pos. skew	7%	none	Hairy medium
Nie 5: weft	15–56, 64, 74, 78	24	28.9±11.7	+0.85, pos. skew	6%	none	Hairy medium
Nie 6: warp (tabby)	23–79	27	37.5±13.0	+1.05, pos. skew	>3%	dense on some coarse fibres (7%)	Hairy
Nie 6: weft	14–56, 69	19, 24	28.0±10.3	+0.95, pos. skew	>2%	dense on some coarse fibres (8%)	Hairy medium
Nie 10: warp (diamond)	22–72	37	42.0±14.1	+0.96, pos. skew	>10%	very dense on most fibres	Hairy
Nie 10: weft	15–85	24	37.6±17.4	+1.28, pos. skew	>10%	very dense on most fibres	Hairy

DYE TESTS: GERMANY

Tests for dye were carried out on the three samples from Niens, Nie 5 (Chevron/herringbone), Nie 6 (tabby), Nie 10 (diamond) but no dye was detected on any of them. This does not indicate that they were never dyed, only that any dye which may have been present is no longer detectable. Nie 10 however probably would have appeared dark brown or black to the naked eye, due to the natural pigment in the fibre. Nie 6 may also have had a greyish appearance due to the presence of a few dark fibres.

Table 3. Germany: Fleece types and dye tests. Measurements in microns.

	Fine	Fine/gen. medium	Gen. medium	Medium	Short wool	Hairy medium	Hairy	Total
Pre-Roman Iron Age, Denmark	–	–	–	–	–	18	–	18
Virring-type, Norway, Denmark	4	–	2	1	2	5	–	14
Dogtooth, Norway, Denmark	–	2	2	–	2	6	–	12
Lønne Hede (Ryder and Hedges 1973)	5	3	–	–	–	2	–	10
Germany, Roman, raw wool and textiles	–	–	–	–	–	4	2	6
Germany, 8th century	–	–	–	–	–	5	3	8
Diamond twills, Norway, Denmark	–	–	–	–	7	?3	–	10

Table 4. Summary of fleece types.

they are much further evolved. The kemps have disappeared and are replaced by true hairs, that is continuously growing fibres with narrow medullas. This fleece would probably no longer moult in spring and would have to be shorn. Only the two hairy mediums from Lønne Hede still show a fine undercoat (modes 13 and 14 microns) with one coarse hair (not kemp) each.

One of the primary reasons for the present investigation was to discover whether fibre or dye gave any indication for the place of origin of the different fabric types. The sample size was too small to draw definite conclusions, but a few tentative remarks may be made. The Virring-type and the dogtooth fabrics both showed a range of fleece types (see table 4: Virring-type fine, generalised medium, medium, shortwool, hairy medium; dogtooth fine/generalised medium, gen. medium, shortwool, hairy medium), while the Lønne Hede group were fine, fine/generalised medium, hairy medium.

The generalised medium and the hairy type are both believed to have developed from the hairy medium type and then fine, medium and shortwool to have derived from the generalised medium (Ryder 1969; see figure 1). The predominant hairy medium and generalised medium of the Roman Iron Age textiles could, then, be a straightforward development from the sheep of the pre-Roman period; the more 'advanced' fine, medium and shortwool types could perhaps be variants from within the same flocks.

However, it should be remembered that the Lønne Hede hairy mediums were more primitive in type than those of the other textiles and that this group lacked the more highly evolved shortwool and medium types. Further, several of the fine and fine/gen. medium types from this site included medullas in fibres of less than 30 microns diameter: again this is a primitive feature, not to be seen in the same fleece types of the Virring-type and dogtooth textiles. At this stage it would appear that there may be a difference between the Lønne Hede group and the other two fabric-types. Whether it is significant or not and whether it has to do with date or place of origin can only be a matter for conjecture at the moment.

Turning to Germany, the picture is much clearer, since two samples of raw wool were available there. One of them showed fibre roots, indicating that the wool had been plucked from the skin of a dead animal. Such 'fell wool' is of low value and is unlikely to have been traded far, so that this specimen is almost certainly from a local sheep. Both samples of raw fibre were hairy medium in type and both already showed the pigment distribution which is to be seen in the later samples and in the modern native sheep of Germany (see below).

It is interesting to compare the Scandinavian and German fleece types with those from other contemporary sites. From Vindolanda in northern England (a 1st century AD site within the Roman Empire) there is a

	Fine	Fine/gen. medium	Gen. medium	Medium	Short wool	Hairy medium	Hairy	Total
Vindolanda	9%	18%	34%	2%	4%	34%	2%	
	(5)	(10)	(19)	(1)	(2)	(19)	(1)	57
Mainz	17%	43%	19%	2%	13%	6%	–	
	(8)	(20)	(9)	(1)	(6)	(3)	–	47
All other sites	29%	31%	11%	6%	3%	20%	–	
(including some more from Mainz)	(10)	(11)	(4)	(2)	(1)	(7)	–	35

Table 5. Fleece types from Roman period sites. From Ryder 1981.

large group of wool textiles considered to be native British products (Wild 1977 p 30). All seven fleece types were represented there, but hairy medium and generalised medium predominate (Ryder 1981). This is different from the totals for other sites including Europe, studied by Ryder (*ibid*; see table 5), where fine and fine/gen. medium predominate with gen. medium and hairy medium a little behind. At this stage it is not known which are likely to be native products or traded goods. However, it is worth noting that Ryder noticed an overall trend towards finer wools in the earlier sites on the periphery of the Empire, such as Denmark and Palestine (Ryder 1983a p 178).

Finally, two other points of interest emerged during the study of these finds. Firstly that natural pigment was still being used for patterning, in the example from Vrangstrup. Secondly that although alternating Z- and S-spun yarns were used in both warp and weft of the dogtooth textiles, in general the same, or similar, wool was used throughout the warp and another type throughout the weft (although only three textiles were analysed). In other textiles of this date, warp and weft are frequently of different types, perhaps because the different yarns, serving different functions, require different fibre-types.

Dyes

Dye tests were carried out on all five textiles from Lønne Hede, five Virring-type fabrics and two dogtooths. Four of the Lønne Hede, two of the Virring-types and the two dogtooths showed that they had been dyed with indigotin (in one Norwegian Virring-type, this was combined with an unidentified yellow dye). Indigotin is a blue substance which can be derived from both the woad and the indigo plant. However, indigo, a native of India, seems to have been only of slight importance to the Romans (Forbes 1964 pp 111–112) and it therefore seems safe to assume that the indigotin in these textiles comes from woad, *Isatis tinctoria* L. Woad seeds of the Early Roman Iron Age have been found at Ginderup in North Jutland (Hald 1980 p 137) while Pliny mentions the use of the plant in Gaul (*Nat.Hist.* XXII 2–3); seeds have also been recorded at the Viking Age ship-burial at Oseberg in Norway (Hald *ibid*). It seems likely that this dye-plant was readily available throughout north-west Europe, including Scandinavia.

The red dye in one of the Virring-type textiles from Norway, however, tells a different story. This was madder, obtained from the roots of *Rubia tinctorum* L. The tests proved that the dye was not from wild madder, *Rubia peregrina* L. or from bedstraw, *Galium verum* L., which yields a madder-like dye. *R. tinctorum* is indigenous to Asia Minor, the Caucasus, Greece and other parts of southern Europe, but has been widely cultivated in the past, especially in Holland, Provence, Alsace, Silesia and Hungary (Schaefer 1941, p 1398). In the Roman period it was cultivated in Italy and the dye was found in textiles, mainly of fine quality, from Roman Vindolanda (Taylor 1983b p 118). By the 9th century it was being grown in France and by the 10th–11th centuries in England (Walton forthcoming). In the 'madder boom' of the 18th century, the plant was grown on the island of Zeeland and even in Sweden, near Lund (Schaefer 1941 p 1403), but this appears to have been a new introduction at this time and one which must have been beset by problems of climate and soil. It seems highly unlikely that madder was grown within Scandinavia in the Roman Iron Age and unless the dye itself was traded, the textile is in all probability an import.

Another dye was discovered, on three of the Lønne Hede textiles. This was a red dye, probably a little more orange than madder. Unfortunately this dye could not be identified with any of our large collection of dyestuffs and has not been encountered before on any other textiles. This in itself may be significant, since it is clearly not one of the well-known dyes which were important to the Roman world. Perhaps a study of native Danish dye-plants would provide an answer.

The only other dye not to be identified was the yellow combined with indigotin in a Virring-type textile from Norway. Yellow dyes are unfortunately particularly difficult to identify, especially when combined with another dyestuff. However, its presence indicates that the textile was not originally pure blue. Judging from its spectrum, the unknown dye is an orange shade of yellow, but if combined with an iron mordant it would probably have given brown. Thus with the blue indigotin it would have made either olive-green or black.

8th century Germany

From Hessens in Germany there was one sample of unprocessed wool, hairy in type. The staple was long and pointed, the wool coarse with several hairs and kemps, and pigment was present only on the longer, coarser fibres which protruded beyond the finer white undercoat. This same arrangement of pigment can be seen in a piece of felt from Hessens (hairy fleece type) and also in a coarse textile from Niens (warp hairy, weft hairy medium). Coarse textiles are less likely to have been traded, so this too is probably from a local sheep.

The heath sheep of present day Germany, the Heidschnucke, have wool which is remarkably similar to the Hessens example. A sample of Heidschnucke fleece supplied by Dr J.P. Wild, proved to have staples of the same length and shape and to have a similar diameter and pigment distribution. The development of this fleece can therefore be seen, beginning with the Roman lambswool from Feddersen Wierde, hairy medium in type, through the predominantly hairy (sometimes hairy medium) wool of the 8th century, to the present day hairy Heidschnucke.

Ryder mentions that among the Heidschnucke there are also some brown animals and some finer-fleeced white types probably hairy medium (Ryder 1981 p 405; 1983a p 393), so it is not impossible that the wools from the other German textiles came from the same stock. Both of the diamond twills had densely pigmented wools, either dark brown or black, a fact discussed further below. The three samples of textile from Niens were tested for dye, but none was detected.

Viking Age diamond twills

The analysis of fleece and dye in this group of textiles confirmed that it is a discrete group. Five examples, one from Denmark and four from various sites in Norway were tested for dye and all proved to be indigotin, again almost certainly woad. Ten fleece types were identified and seven of these proved to be shortwools.

The shortwool is a highly evolved type of fleece. It first begins to appear in the Roman period (for example there were four shortwools among the Roman Iron Age textiles from Scandinavia). However, it has previously appeared that shortwools are not found in any numbers until the later medieval period (Walton 1981 p 191). These then are an unusual group. It is also odd that several of the shortwools include a certain amount of pigment, which is a primitive feature.

The combination of natural pigment with what appears to be a very heavy dyeing with the blue woad, would give a dark fabric, probably close to black. It is therefore interesting to note that the coarser diamond twills of 8th century Germany were also dark, probably a brownish black. Perhaps the weavers of the two types of fabric were aiming at a similar appearance, although the Scandinavian textiles were achieved with a greater degree of sophistication.

SUMMARY

The textiles of the Pre-Roman Iron Age would originally have been white with colour-patterning in naturally pigmented wools, probably brown. The handle of the fabric would have been soft, due to the fineness of the majority of the fibres.

In the Roman Iron Age textiles, natural pigment was still being used for patterning. However, by the 1st century AD, dyes were in use, one of them woad and the other unidentified, perhaps a local dye which has not since reached commercial significance. In the late Roman Iron Age, strong colours, red, blue and green or black were used for fine quality textiles and in one of these the dye was madder, almost certainly foreign to Scandinavia at this time.

The German samples show that wools of similar type

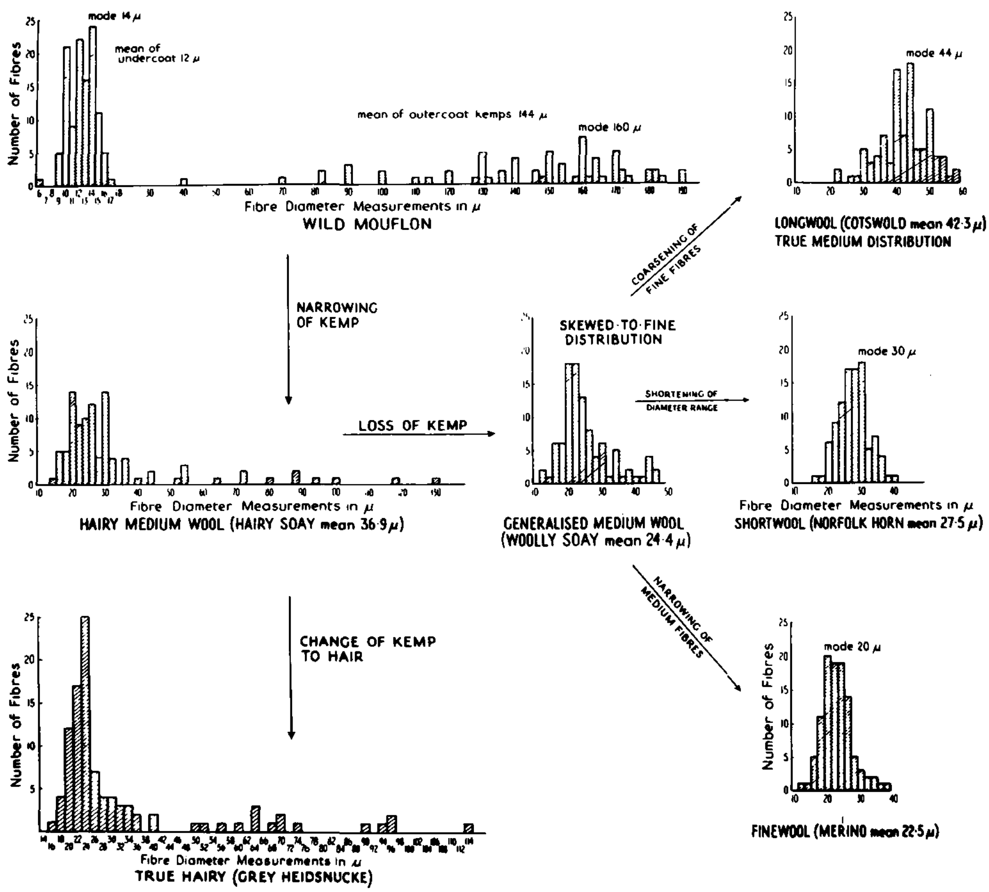

Fig. 1. (From Ryder 1983a).

to the fleece of modern Heidschnucke were already present in the Roman Iron Age and the 8th century. The textiles include two almost black diamond twills, which form an interesting comparison with the finer dark blue or black diamond twills of Viking Age Scandinavia.

COMMENTS

The sample size was necessarily small as the work is time-consuming: adequate dye-testing of one fragment, together with a fleece type identification for warp and weft, requires at the very least five hours of concentrated work.

However, the tests have produced some significant results even on such a small sample. They have also raised many more questions. For example, it would be useful to study more Scandinavian textiles of the Roman Iron Age which may be considered to be definite local products, in order to establish the nature of the native fleeces at that time. The same is true of the Viking Age when the anachronistic shortwool types appear in the fine quality textiles whose origin is open to question. More samples of raw wool would also be extremely useful.

We hope that this report has shown that a widening of the database for both dyes and fleece types would considerably improve our understanding of textile manufacture, and, more significantly for the archaeologist, of trade in textile products. P.W.

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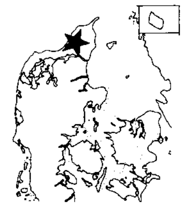
Ploughing in the Iron Age. Plough Marks in Store Vildmose, North Jutland



by VIGGO NIELSEN

In the late 1930s A.E. van Giffen and Gudmund Hatt demonstrated the existence of prehistoric ploughmarks under barrows and settlements to the archaeological world and the world in general. It soon became apparent that ploughmarks would become an extensive source of information.

Plough marks were revealed under barrow after barrow and in other contexts from all periods of agricultural prehistory, from the Neolithic, Bronze Age and Iron Age. Quantification of a number of examples was undertaken in 1960 by Johs. Pätzold, and a summary of the north European finds including those of Denmark was given by Michael Müller-Wille in 1965 and by Peter Fowler in 1971.

An ever more extensive material has subsequently appeared in Denmark. Plough marks have been revealed under most burial mounds or remains of mounds to be excavated. Plough marks have been found under prehistoric field boundaries, and covering large areas under settlements during modern excavations by machine. One such example occurs under the settlement and field boundaries at Rønne Plantage (Nielsen 1984, 139), but foremost among these are the marks found during the excavations at Grøntoft in West Jutland (Becker 1971).

In all these excavations the plough marks appear as an interesting by product of the main aim of the excavation (such as the investigation of a mound). Because the layers that seal the marks are of such limited extent, there is of course a corresponding limit to the information that can be obtained. An excavation will almost always have another main aim in view, even though a good excavation will never leave any material unrecorded.

The chance for an investigation directed primarily at the elucidation of prehistoric plough marks occurred in 1967 in the bog of Store Vildmose, in Vendsyssel in northern Jutland.

THE LANDSCAPE

Store Vildmose used to be Denmark's largest raised bog. It grew on low lying land, the raised sea bed of a shallow marine embayment extending from the south during the Litorina period, when Vendsyssel lay lower than it now does and was broken up into a series of islands. The area covers some 60 km^2, and still has the appearance of dried sea bed. Standing on it one continually has the sensation of looking towards land when facing the old marine cliffs and their foreland.

The bog and the slightly higher lying adjacent water meadows are delimited to the east, north and southwest by the just slightly falling Ryå River, which runs near the raised beach of the Litorina Sea.

The base of the bog, the sandy Litorina sea bed, is very flat. With a few variations, it drops very gently from the north or northeast. At Grishøjgårds Krat the base is at 6.40 m above sea level; 5 km to the southwest at Centralgården it is at 5.30 m; and 2 km further to the southwest off Åby Bjerg it is at 4.70 m.

The Litorina sea bed is formed by a variety of littoral and marine deposits, including pure sand, clay sand, thin clay, and marl containing chalk. Many deposits contain marine shells. Large and small stones are found everywhere, most probably carried out from the coasts by the movement of ice. The depth of these deposits varies greatly, but can be as much as 9 m. At Centralgården they measure 5.5 m, and cover much deeper deposits laid down by glacial seas.

As the land had begun to rise by 2000 bc, peat began to form in the basin, leading to the appearance of the Store Vildmose bog.

Major geological or geobotanical investigations have twice taken place in the bog.

The most recent of these has been carried out within the last decade by Bent Aaby of the Geological Survey of Denmark, using all modern methods: pollen analy-

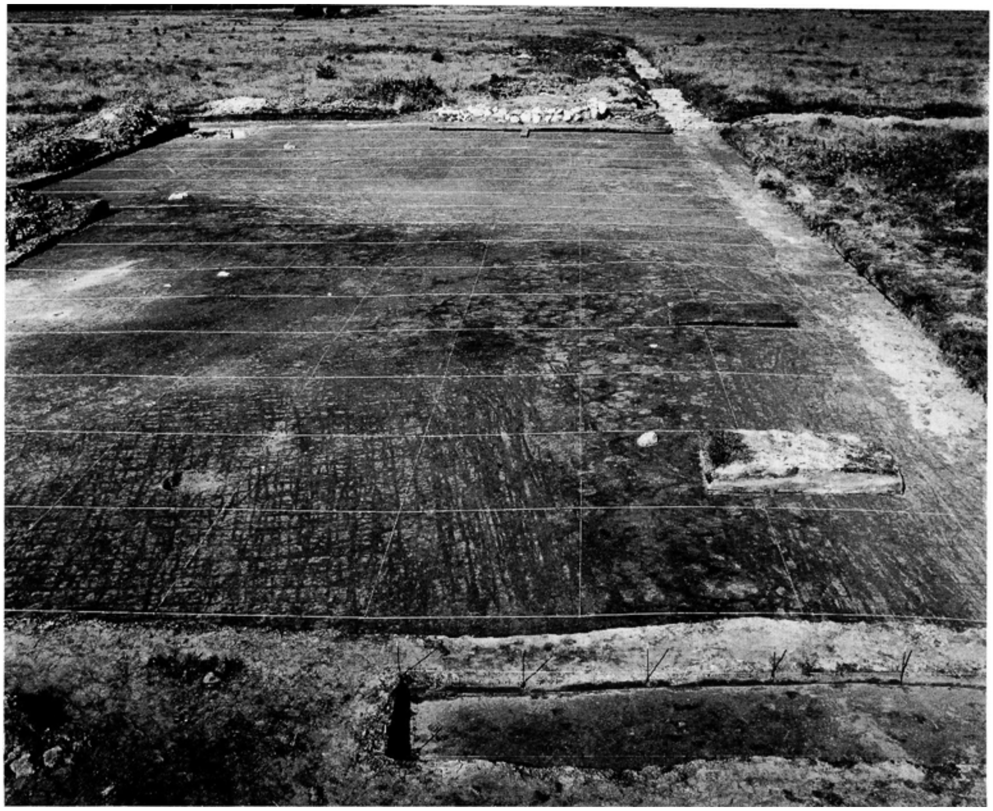


Fig. 1. Store Vildmose. View of field x185–y380, seen from the East. In the background barrow W.

sis, the identification of fossil wood, carbon 14 determinations, examination of charcoal and humification, and also the incorporation of an ever larger archaeological material from investigations in the bog.

The earlier investigation was carried out by the botanist Knud Jessen, during preparations for the drainage of the bog which was begun in 1920 after the Danish government had acquired most of the area with a view to cultivation.

Knud Jessen's investigations were only to some extent carried on and published (Jessen 1945). A general view of the development of the bog and the region thus rests on the extensive investigations of Bent Aaby. Some major aspects are however certain.

After the raising of the land and the formation of the coastal meadows, a forest peat was formed in the central southern part of the bog with stumps of alder, birch and (near the edges) oak. In and under the forest peat were limited layers of carr or fen peat, with among other things numerous remains of reeds. Fen peat was also found in the northeastern part of the bog, forming a basal layer over the sand.

Above the forest peat and the fen peat was a raised bog several metres thick. This was divided into a lower layer of dark brown, sterile, sandy material, and a very thick upper layer of pale brown peat which stretched much further to the north and northeast than the underlying layers and so defined the extent of Store Vildmose. The younger raised bog peat supported the vegetation which gave the bog the appearance described in older accounts; small areas which remain uncultivated can still give an impression of this.

Knud Jessen assumed that the formation of the first peat, the forest peat, took place during the sub-boreal, in the Bronze Age; and that when the raised bog began to be formed, it spread (except with one break) continuously and irresistibly over an ever larger part of the flat area. This assumption, supported by finds of earlier and later Iron Age date under the raised bog peat, has now been proven by Bent Aaby's work. This shows a continuous advance of the raised bog of around three metres per year during the earlier and later Iron Age and into the Middle Ages.

THE ARCHAEOLOGICAL INVESTIGATIONS AND DATINGS

Much archaeological material has been found during recent activities in the bog, particularly in the northern and northwestern parts. Most striking among a series of single finds is a Pre-Roman Iron Age bull's head made of bronze, found in the western part of the bog. Settlements have also been found, as well as a series of stepping stones, but first and foremost it has turned out that the bog covers a large number of burial mounds. These appear to grow out of the bog as the peat shrinks or is removed; they are most common in the northern part of the bog, but are also present in the central and western parts. A few of the mounds are from the Roman Iron Age, but in the northern part the great majority are of earlier Germanic Iron Age date. They are generally small, 0.5–1 m in height, with kerbstones indicating a diameter of 8–10 m. A number of these have been excavated, while others have been preserved.

Several of these buried barrows appeared in the early 1960s in a so far uncultivated area in the northeastern part of the bog, at Grishøjgårds Krat (Tolstrup parish, North Jutland county) where clearing of scrub had begun in order to undertake cultivation (Danish "krat" = scrub or coppice). The area comprised c. 200 ha. During an investigation of some of these mounds by the Vendsyssel Historiske Museum (Bech 1971) in the summer of 1966, plough marks were observed in the sand under the barrow, stretching out under the kerbstone ring. It thus seemed that the area could be suitable for a systematic investigation of plough marks.

The author therefore organised the excavation of test pits that revealed several hectares of plough marks after talks with the National Museum and with support from the Danish State Research foundation. Excavations proper in the years 1967–69 and 1970–72 were supported by the Carlsberg Foundation. These investigations provided stimulus for the investigations of Bent Aaby, and for the systematic recording of finds and further investigations in Store Vildmose as a whole. Furthermore, the whole of the 200 ha uncultivated area in this part of Store Vildmose was acquired by the nature protection administration, now the Ministry of the Environment, as an archaeological reserve open for future research on prehistoric fields and problems to do with ploughing.

The site was subjected to study in the following way: A measuring grid in squares based on the national grid (System 1934) was set up, and concrete marker blocks placed every 100 m. Trial pits were dug to the subsoil every 50 m in this grid to search for plough marks, and to obtain soil samples for phosphate analysis.

Plough marks appeared all over the 200 ha area. Further surveying in the neighbourhood revealed plough marks in almost all places where the surface of the subsoil sand had not been damaged by modern activity. It is thus plausible that prehistoric cultivation took place over most of that part of Store Vildmose which was not covered with peat in the sub-boreal period, i.e. perhaps 20–30 km^2.

Phosphate analyses of the soil samples, which came from an area of over 35 ha, generally gave very low values (2 or less), indicating a very poor soil. Slightly higher values (around 4) in a strip in the northern part of the area could suggest that there was a settlement in the area, and very high values (8 and 19.5) in the southeastern peat-covered area must mean that there was a settlement here.

Normal archaeological surveying and recording also revealed settlements from the earlier Iron Age, both in the southwesterly end of the uncultivated area and also to the north in cultivated fields – in this case from the Pre-Roman Iron age. The investigated area itself thus seems to have been some distance away from the settlements from which the cultivation was carried out.

The palynological geology of the site was a further basis for the investigation and its interpretation. The Natural Scientific Section of the National Museum took samples from a trial trench, which gave a typical picture of the stratigraphy:

Layer 1, below 5.97 m:	stratified sand.
Layer 2, 5.97–6.12 m:	outwashed sand, containing plough marks.
Layer 3, 6.12–6.295 m:	sandy humus (cultivation layer).
Layer 4, 6.295–6.38 m:	podsolised sand.
Layer 5, 6.38–6.46 m:	sandy humified fen peat.
Layer 6, 6.46–6.555 m:	peat and fen peat mixed with sand.
Layer 7, 6.555–6.72 m:	disturbed raised bog peat.

Experimental pollen analysis of samples from several layers showed the following:

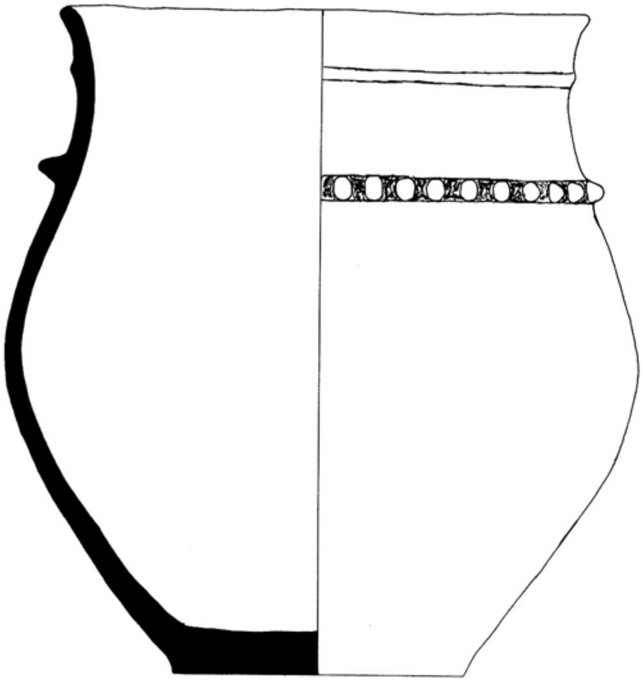


Fig. 2. Pot, c. 40.5 cm high, from the pit in the SW corner of the field X185–Y380, referred to period I of the Pre-Roman Iron Age. Drawing: Per Lysdahl.

Layer 2: 72% arboreal pollen, late Litorina period.
Layer 3: Arboreal pollen reduced to 7–8%, grass pollen 60%, and also 4% heather. Several annual weeds, including *Polygonum* and *Spergula arvensis*. Also cereal pollen, probably of several types.
Layer 4: Increase in sedges, and doubling of heather to 8–9%.
Layer 5: Heather increases to 27%, grass 30%, sedges 10%, a few *Polygonum* and *Spergula arvensis*. Willow appears at 6%.
Layer 6: Increase of sedges such as *Carex* and *Eriophorum*, but *Sphagnum* does not yet appear.

The transition from layer 4 to 5 is radiocarbon dated to AD 400, the upper part of layer 5 to AD 1040, and the middle of layer 6 to AD 1290, all calibrated (Clark), and ±100 years. The cultivation horizon (layer 3) thus dates from the earlier Iron Age, and at this site the formation of the raised bog with *Sphagnum* did not begin until the High Middle Ages.

Although it is not particularly relevant for a more general understanding of plough marks and ploughing methods in the earlier Iron Age, the period of cultivation can be fixed rather more precisely. During the excavation a pit was found, containing pottery referred to period I of the Pre-Roman Iron Age (fig. 2). The plough marks went over the top of the pit after it was infilled. The ploughing is thus roughly contemporary with or later than the earlier part of the Pre-Roman Iron Age. A radiocarbon date on charcoal from the pit of 80 b.c. is presumably unreliable. In the southeastern part of the same field was a hole resulting from the removal of a large stone, surrounded by a heap of pot sherds several metres across. The sherds lay in and on top of the cultivation layer, overlying the plough marks. The sherds from this site of votive offerings thus either post-dated or were contemporary with the cultivation. Apart from a few younger sherds, the pottery in this heap most likely dates from period II of the Pre-Roman Iron Age

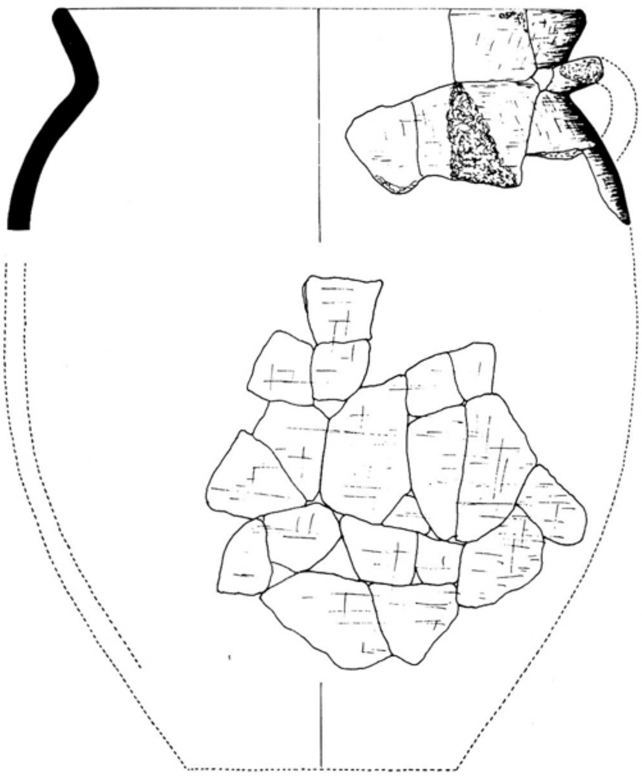


Fig. 3. Pot, estimated height 31 cm, from the heap of pot sherds in the field X155–Y365. The sherds overlay the plough marks and are interpreted as votive offerings at a large stone. They most likely date from the period II of the Pre-Roman Iron Age. Reconstruction and drawing: Anne Preisler.

(Preisler 1982; Nielsen 1980, p. 218). Unless there was any ploughing which has left no trace in the existing pattern, the heap of sherds must be regarded as dating from the end of the period of cultivation (fig. 3).

The cultivation thus took place between the 5th and 3rd centuries b.c., and after its cessation the area was covered with grass and heather. Several burial mounds were established on this around AD 400, contemporary with a major increase in heather.

The soil, the surface of the raised sea bed, was poor. Cultivation must therefore have been relatively extensive. Although some manuring may have been carried out, the area must have layn fallow at times. The high water table and the flat nature of the terrain would have made the area vulnerable to variations in rainfall. Store Vildmose is also one of the coldest areas of Denmark, with a shorter growing season than areas further south and east.

METHODS AND DOCUMENTATION

The main aim of the investigation was the documentation of the plough marks.

The size of the documentation project was however so great, and the areas uncovered so large, that some decisions had to be made. This was the case for the method of uncovering the area, which was carried out as far as possible by machine without disturbing the subsoil sand. The same was true regarding the depth to which the site was uncovered. The chosen depth was that at which most plough marks appeared most clearly. This could result in the removal of some plough marks. For every millimetre scraped away, a mark will become narrower or will disappear, or perhaps a new one will appear.

As the sole method of documentation, photography was chosen. Drawings of the marks would involve an on-the-spot analysis of ploughing direction and relative chronology, and hence constitute a much more subjective and imprecise form of documentation. It is, furthermore, expensive and time consuming. Drawings were only used at the beginning of the work, on an experimental basis (fig. 4).

In order to obtain a form of documentation that could be built on by future work, vertical photography in 6 × 6 cm format was chosen. Square areas were photographed, measuring 2 × 2 m in the first two seasons, 5 × 5 m in the 1970s (fig. 5). These squares were linked into the established co-ordinate system, so that they could easily be put together. The black and white photographs were enlarged to a scale of 1.40 and mounted on boards of 50 × 50 cm, which, when complete, would each represent an area of 400 m^2 of the excavation (fig. 10). These boards can be archived (and reproduced) according to their place in the co-ordinate system.

Preparation of the areas for photography demands fine cleaning so that the results will not be blurred. Any impurities, drops of water, or sunshine will also spoil a picture. The photographs therefore had to be taken in overcast weather, after sunset, or with the whole area shaded from the sun.

The uncovering of the subsoil started with the digging of two trenches, 100 m long and 1.75 m wide, in the shape of a cross oriented NS-EW, in order to get an impression of the state of preservation of the plough marks and to locate some field boundaries. In 1968 a 700 m^2 rectangle was excavated in the SE quadrant; in 1970, 160 m^2; in 1971 and 1972, 3430 m^2; and in 1978–79, a further 300 m^2 were uncovered.

The state of preservation of the plough marks varied in the different parts of the area. In some places where the sandy mould was thin or lacking certainly because of wind erosion after the breaking up of the surface, the subsoil surface seemed to have been waterlogged. In these cases the contours of the marks were effaced or the edges amorphous. In other areas as well the nature of the soil as the earlier vegetation appears to have had an important effect on the coloration of the mould.

EXAMINATION OF THE INDIVIDUAL PLOUGHED UNITS

The uncovering of this roughly 5000 m^2 area of ploughmarks should form the best basis so far available for recognizing patterns in the plough marks in cultivation units or fields (fig. 6). As the basis for an evaluation, the main structure of each cultivation area in the uncovered section will be described. Description moves from the N towards the S and W, starting in the northernmost corner of the uncovered area. The individual fields are designated by a co-ordinate lying within their boundaries (fig. 7).

As for a frequently occuring phenomenon, here termed "bunch of parallel marks", see further below under "The Boundaries". The term is chosen to indicate a clear distinction to other sets of parallel marks.

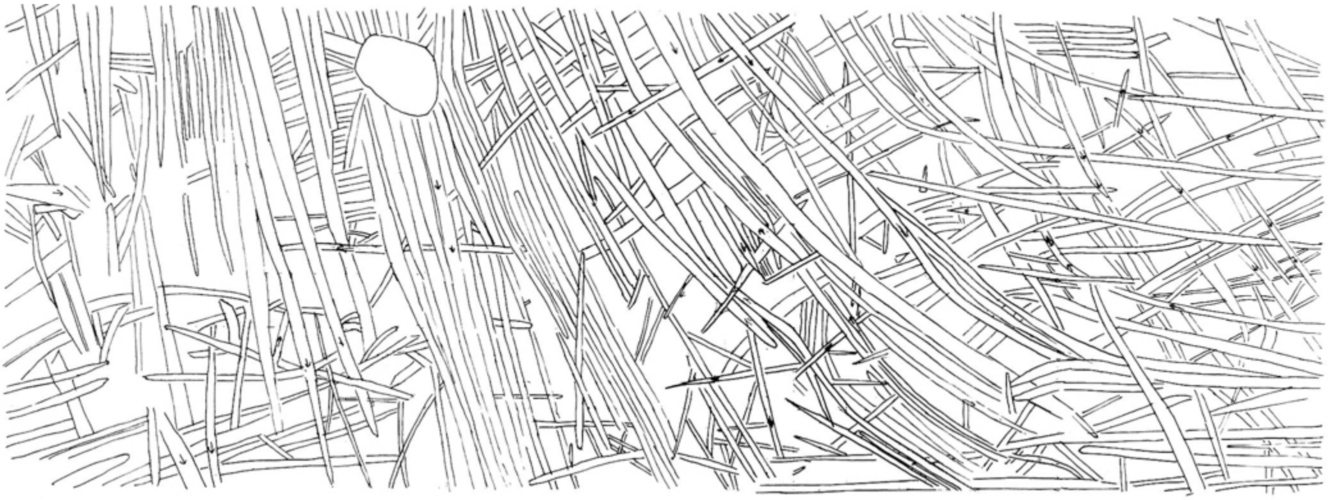


Fig. 4. Sample drawing of plough marks in the cross trenches excavated in 1967. Drawing: Gudrun Nielsen.

X200–Y325

The corner, c. 30 m^2, of a field with well preserved marks.

This is marked off from the field to the S, X180–Y325, by a bunch of parallel marks. The southern part of this group may be part of the ploughing of this neighbouring field. It is bounded to the W by a lesser worked zone 0.5–1 m wide with a bunch of parallel marks on each side.

Ploughing directions are predominantly N-S and E-W, with slight curves E-W and N-S respectively. The furrows are very close together, as if they exclusively represent bunches of parallel marks.

X200–Y340

The southern part, c. 80 m^2, with the SE and SW corners of a field with well preserved plough marks.

To the E this is bounded by a bunch of parallel marks along the lesser worked zone mentioned under X200–Y325. It is bounded to the S by a bunch of parallel marks 2–3 m wide, along an uncultivated area in a field boundary or weak lynchet running WWSW-EENE. To the W, about 30 m from the E edge, there is a boundary bank about 3 m wide (Nielsen 1970 fig. 1) with a bunch of parallel marks along and under it.

Ploughing took place in several directions. The plough marks clearly run parallel to the field boundaries, although with slight curving towards them. Besides these, there are also plough marks running NW-SE and NE-SW (Nielsen 1970, fig. 1) and in several other directions.

X185–Y380

The southern and part of the western section of an irregular field, estimated 40–50 m N-S and 30 m E-W. The marks are generally well preserved, although less so in the central part of the field. The area uncovered, which includes a stretch of the northern trial trench running N-S through the western part of the field, encompasses 5–600 m^2.

The boundary to the E is the bank between this field and X200–Y340. The N boundary is assumed to have been the bunch of parallel marks which crosses the trial trench in a NE-SW direction about 30 m N of where this trench crosses the E-W trench. To the W the boundary is a bank running NNNW-SSSE, upon which the mound described on p. 191 is placed. Ploughing under the boundary bank is less intense along its central part. There are bunches of parallel marks 2–3 m wide each side of this central part. The boundary bank and the bunches of parallel marks run S as far as the pit described on p. 192, 10 m south of the mound.

This pit is approximately the western corner of the field's unclear southern boundary. Here ploughing runs up to a bunch of parallel marks, which form the boundary with the neighbouring field to the S for 12–15 m, but after this there is a 400 m^2 triangular area of uncultivated land. It was evidently this that determined the direction of the ploughing, forming an open area between the adjacent fields.

This unploughed triangle terminated to the NE in the narrow unploughed strip S of X200–Y340, and to the S in a similar narrow strip between two fields. There was no evidence as to why it had not been ploughed. The soil had the same consistency as in the adjacent fields. Only a slight difference could be seen in the colour of the sand, and animal burrows or runs were particularly numerous in the unploughed area. There were no traces either of banks or of a fence. As a probable result of erosion the level of the ploughed land was a shade lower than that of the uncultivated stretch. The line along which the ploughing stopped was not fixed, for the boundary of the ploughing could be seen to have changed at least twice.

The bunches of parallel marks marking the boundary run in different directions. One set, probably the oldest, runs in a definite s-shaped curve from the SW corner of X200–Y340 to the pit. The other, starting slightly to the N, has an opposing curvature.

The closely spaced furrows running in all directions in the irregularly worked area make an understanding of the ploughing difficult. An E-W ploughing can be discerned, however, with its main direction corresponding to the s-curved bunch of parallel marks. Another ploughing, running N-S, corresponds more to the phase marked by the bunch of parallel marks running N-S.

Two hearths were seen in the subsoil near the s-curve just described. One was c. 1.5 m, the other 0.6 m, in diameter. Both had been ploughed over, and their edges were ragged. They were thus older than or contemporary with the ploughing. A dark oblong patch immediately E of the barrow was probably made by a tractor. Some stakeholes were found in the axis of the bank running S from the barrow, perhaps indicating the presence of a fence with upright stakes (Nielsen 1970, fig. 7).

X180–Y325

The western part, c. 350 m^2, of a possibly regular rectangular field, measuring about 35 m N-S. The state of preservation of the marks is generally very bad.

To the N the field is bounded by a bunch of parallel marks which run together with the southern boundary of X200–Y325 and X200–Y340. At the NW corner is the uncultivated strip between X200–Y340 and X170–Y345. On the W side is the bunch of parallel marks extending over c. 30 m, and to the S, at right angles to these, a similar E-W bunch. The poor conditions of preservation mean that it is uncertain whether this group runs further than 7 m to the E.

One ploughing direction is particulary clearly marked. This is E-W, with a curve towards the S near the edge of the field. The parallel marks are 25–30 cm apart, and stand out so clearly with regard to the others that it can probably be assumed that this represents only a single ploughing episode. A few traces are visible with different orientations, such as SE-NW and NE-SW, curved towards the northern boundary.

In general it would seem that the field was not intensively cultivated. The reason for this may have been the soil structure, but it may also be that it was the fact that the field was only lightly cultivated that caused a slight difference in soil structure from that in other, more thoroughly worked fields.

X170–Y345

A completely uncovered, more or less rectangular field oriented N-S and E-W. The N side is 26 m, the S side 25 m, the E side 32 m and the W side 30 m in length. The orientation of the sides varies somewhat. The W side is thus oriented a little more to the NW than the E side, and the N side a little more to the N than the S side.

The state of preservation of the marks is poor, particularly in the northern central part. Together with the fact that there were many closely spaced ploughings, this means that the directions of ploughings and the relationships between them are difficult to determine.

The boundary to the N is formed by the 1.5 m wide uncultivated area described under X200–Y340, along which runs a c. 2 m wide bunch of parallel marks.

The bunch of parallel marks on the W side form a right angle with the N side, and run along the uncultivated triangle described under X285–Y380 for about 20 m, and a 1.5 m wide uncultivated strip for some metres further to the S. Where this strip ends there is a datch patch 20 cm in diameter, which might be a stakehole. A similar patch is visible 4 m further N, at the southerly corner of the uncultivated triangle. Furrows from the neighbouring field, X155–Y365, run across the southernmost 10 m in an oblique direction towards the bunch of parallel marks, which meets those of the S side at a near right angle. It is interesting that, where the uncultivated strip ends, the bunch of parallel marks seems to stop and respect the plough furrows that intrude from the adjacent field to the W. In a zone along these southernmost 10 metres and down to the SW corner, the furrows on the adjacent field are weaker, and more animal burrows are visible. This could mean that this zone was left as an uncultivated field boundary for a period during the cultivation of field X170–Y345.

The southerly cultivation limit is marked by a bunch of parallel marks c. 2 m wide, dividing this field from the neighbouring X145–Y335. It becomes narrower and more diffuse to the E. It runs at least some metres beyond the right angled junction with the E edge of the field, evidently in connection with the cultivation of the adjacent field.

The E side is marked by a gently curved bunch of parallel marks c. 2 m wide, which also marks the limit of cultivation of the neighbouring field to the E, X180–Y325.

The bunches of parallel marks in general follow the fairly straight N-S and E-W alignments of the field's boundaries.

The other ploughings, which took place before the bunches of parallel marks were made, were multiple and have therefore left many closely-spaced marks. Generally these are oriented with the field boundaries, i.e. N-S and E-W. Running in these directions can be seen uniform furrows with a consistent spacing (25–30 cm), paralleling and crossing each other and suggesting cross-ploughing. The ploughing was not carried out quite so systematically, however. To some degree they do run up to the field boundaries more or less at right angles, but they often curve away in an arc near the edge of the field. This means, in a relatively small field such as this, that some furrows follow a gentle curve from one side of the field to the other. Along the W and S sides these curves get shorter near the mid parts of the sides, as if the intention was to plough a small remnant area. This presumably means that ploughing started in the N and E, where the furrows more or less follow the directions of the sides, and ended in the S and W where the curves become stronger. The initial profile at the edge of the field is followed by the subsequent parallel furrows, and may therefore have determined the shape of the field.

In the plough soil (the sandy subsoil) is a number of stones, often about the size of a fist or head and often surrounded by a patch of dark soil. The large stone in the NW corner has been mentioned. It would seem that no efforts were made to remove these stones. Any stones collected from the fields would have been dumped on the field boundaries; but there are no more stones here than in the fields themselves.

Besides the plough furrows, there are other dark markings in this layer. It is assumed that some broad, parallel marks

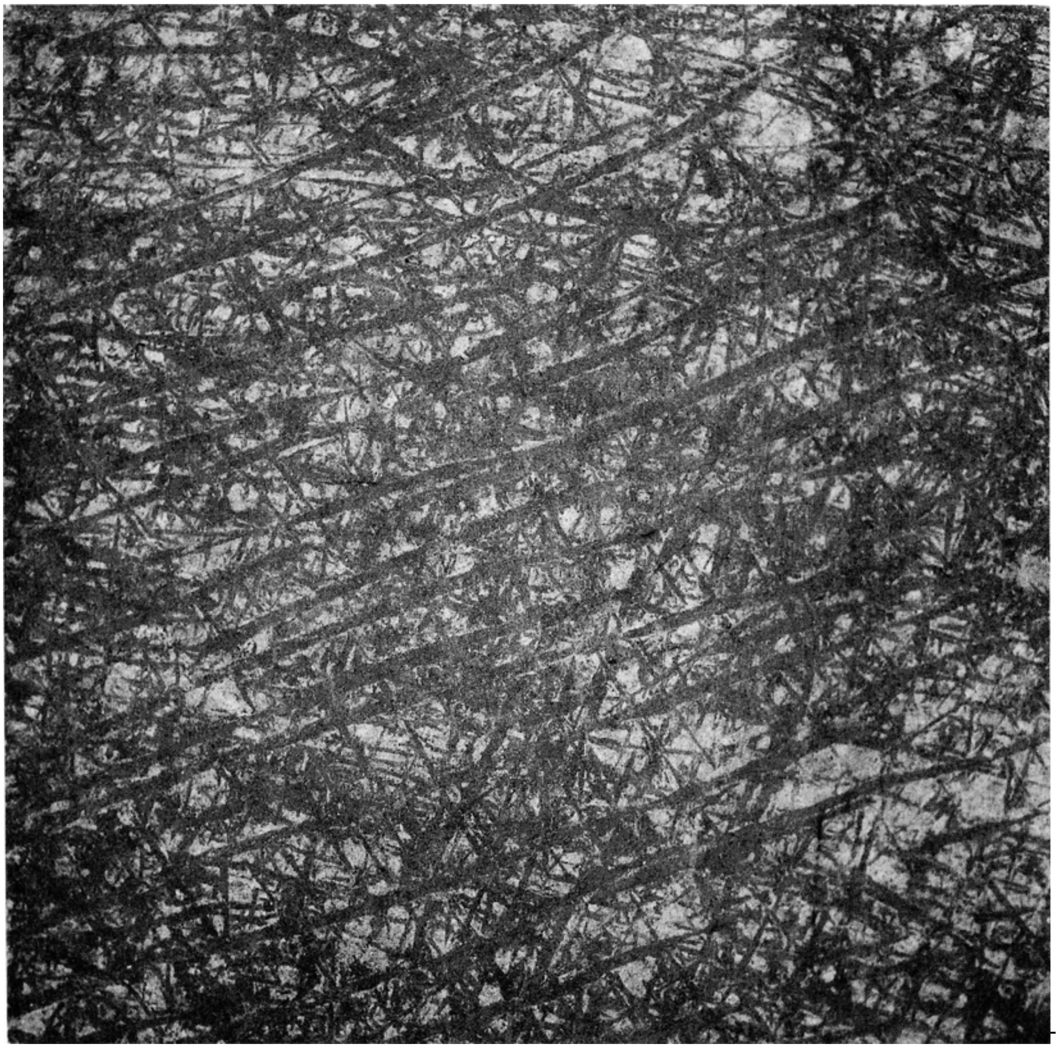


Fig. 5. Square of 5 × 5 m in the field X105–Y365. Only one square at a time can be prepared for photography. In this one is seen ploughings running N-S and E-W as well as very clear ploughing aligned ENE-WSW and less distinct ones running NW-SE and WNW-ESE. Photo: Gudrun Nielsen.

running N-S were made by tractor wheels when the bog was prepared for cultivation. Others are patches stained with charcoal, resulting from downward penetration from the hearths on the field surface.

X155–Y365

A 5–10 m wide N-S strip of the eastern part, and also parts of the northern rim of the c. 55 m long field adjacent to X170–Y345. C. 350 m^2 were uncovered. The plough marks are generally badly preserved. There were deposits of silt in several places on the uncovered surface, and many pebbles.

The northern boundary is formed by the bunch of parallel marks that runs in a curve to the SE, from a point a little to the W of the pit described in X185–Y380 to run obliquely into the W boundary of X170–Y345. There is no independent marking of the boundary further S, along the common boundary with X170–Y345. The possibility that X170–Y345 has simply cut away the NE corner of the field cannot be excluded. The boundary reappears with a slight change of direction beyond the SW corner of X170–Y345: a bunch of parallel marks run along a gently curving 1–2 m wide strip (which has many animal burrows and few plough marks), forming a corner at right angles to a 2–3 m wide bunch running E-W and forming the boundary of field X105–Y355.

The shape of the field cannot be determined more precisely on this basis. The strongly curved N side is clear; so is the rather irregular E side, and the rudiments of the S side; but the breadth of the field, and the W boundary, cannot be determined.

As mentioned, the parallel group along the N side curves strongly towards the SE. Some of the curved furrows postdate others aligned nearly E-W. These E-W furrows, and others at right angles running N-S, dominate the pattern. The N-S ploughing is not completely regular, but shows a faint s-curve partly corresponding to the field boundary and with slight curves towards the end of the field. Slight curves both to N and S can also be seen from various of the E-W furrows. Here and there faint traces can be seen of furrows in other directions.

On the surface of the field a few metres W of the boundary was the hole described above that had contained a cultic stone, blasted and removed before the excavation. The furrows ran towards the site of the stone without any deviations.

X145–Y335

A virtually trapeze shaped field, completely uncovered, with N side measuring 30 m, S side 35 m, W side 45 m and E side 55 m. The sides are all aligned differently: the N side has a slight angle towards the NE, the S side correspondingly towards the SE, the W side towards the SW, while the E side runs N-S except for about 10 m in the middle where it bends slightly to the SE.

The plough furrows are reasonably well preserved, particularly in the southern part.

Evaluation of the ploughing pattern and particularly of the W side of this field is complicated by the fact that a smaller field, X125–Y350, was later established and worked within its boundaries.

The N side is formed by the 2 m wide bunch of parallel marks (described above), which forms the S side of X170–Y345 as well, except for 5–7 m at its eastern end, where it projects beyond X170–Y345 and thus only belongs to the field described here. There is a sharp right-angled corner to the bunch of parallel marks forming the E side, which as mentioned runs due N-S except for the kink in the middle. During its course to the SE corner, it is joined at this kink by a bunch of parallel marks coming in from the E, and by another 10–12 m further S. The S side is not as clear. The outer part of the corner was not exposed. From here towards the E is a strip which is less worked – although it does have closely spaced parallel furrows – which has bunches of parallel marks running along both sides, both in this field and in the 2–3 to the S of it. The bunch on the W edge forms a right angle to this. The W boundary (also the E boundary of X155–Y365) appears also to be the boundary for the later field X125–Y350.

Several major orientations appear in the densely ploughed area of the field. A N-S ploughing is most prominent, together with a corresponding E-W one. The N-S furrows run parallel to the E boundary, except that they continue due S where this kinks. The ploughing to the E of this boundary takes the kink as its starting point, however, and runs N-S from here. In some places the N-S furrows show the usual curves, both to the E and the W. Where they run up to the N boundary of the later field X125–Y350, however, they are abruptly cut off. The same is true of the approach of the E-W furrows to the E boundary of the main field; but they run straight into the boundary of X125–Y350.

Besides these furrows aligned with the boundaries, two other directions are clear. One runs NNE-SSW, the other (the clearest) NW-SE; both are variable, particularly in the corners. The latter is prominent in the narrow area between the N boundary and field X125–350. These NW-SE and NE-SW furrows are also cut across by field X125–Y350.

It is doubtful whether the area in the NW part of the field, only 7 m broad, could have been cultivated at the same time as X125–Y350 was in use. It is therefore probable that X125–Y350 was laid out later, at a time when X145–Y335 was lying fallow.

X125–Y350

A completely uncovered field, lying within X145–Y335, with straight N, W and S sides, respectively 12 m, 35 m and 22 m long, and with a curved E side c. 37 m long. The plough marks are well preserved.

All the boundaries are marked by bunches of parallel marks 1–2 m wide. The W side also forms the W side of field X145–Y335.

The corners are more or less rectilinear, except for the NE one, where the curved side approaches the N boundary at an angle of 120°. It may have been aligned on a stone a little further N, which protruded above the ground surface.

Ploughing is generally parallel to the sides, the N-S ploughing in the curve dictated by the outer edge. This probably means that ploughing began here, and went from S to N. The distortion means that the furrows get shorter the more the ploughing was constricted to the W and S. The E-W ploughing is at right angles, and has slight curves towards the edges. Besides this, a NNE-SSW oriented ploughing is also visible, forming parallel furrows covering the whole of the field but clearest in the northern part, with some variability in orientation especially in the corners. Less clear furrows are visible aligned ENE-WSW, clearest in the southern part, and finally some aligned WNW-ESE and particularly clear in the northern and western part.

X150–Y320

West side of a field, the extent of which cannot be determined from the area so far uncovered, which has revealed c. 150 m^2 of it. The state of preservation of the marks is very poor; they can only be discerned here and there.

The boundaries are problematic to the N, S and W. For the N boundary, it might be assumed that this was formed by a continuation of the N boundary of X145–Y335, but the traces are too faint to permit conclusions to be drawn – there is a theoretical possibility that this field was the same as X180–Y325. The W boundary is marked by a bunch of parallel marks that separate this field from X145–Y350. The S boundary, finally, takes the form of a bunch of parallel marks running NNW-SSE, separating this field from X125–Y315.

In the northern part of the field traces of furrows are visible aligned NNW-SSE. Further S, however, there are parallel furrows running NE-SW, and close to the S boundary there is cross-ploughing running E-W and N-S.

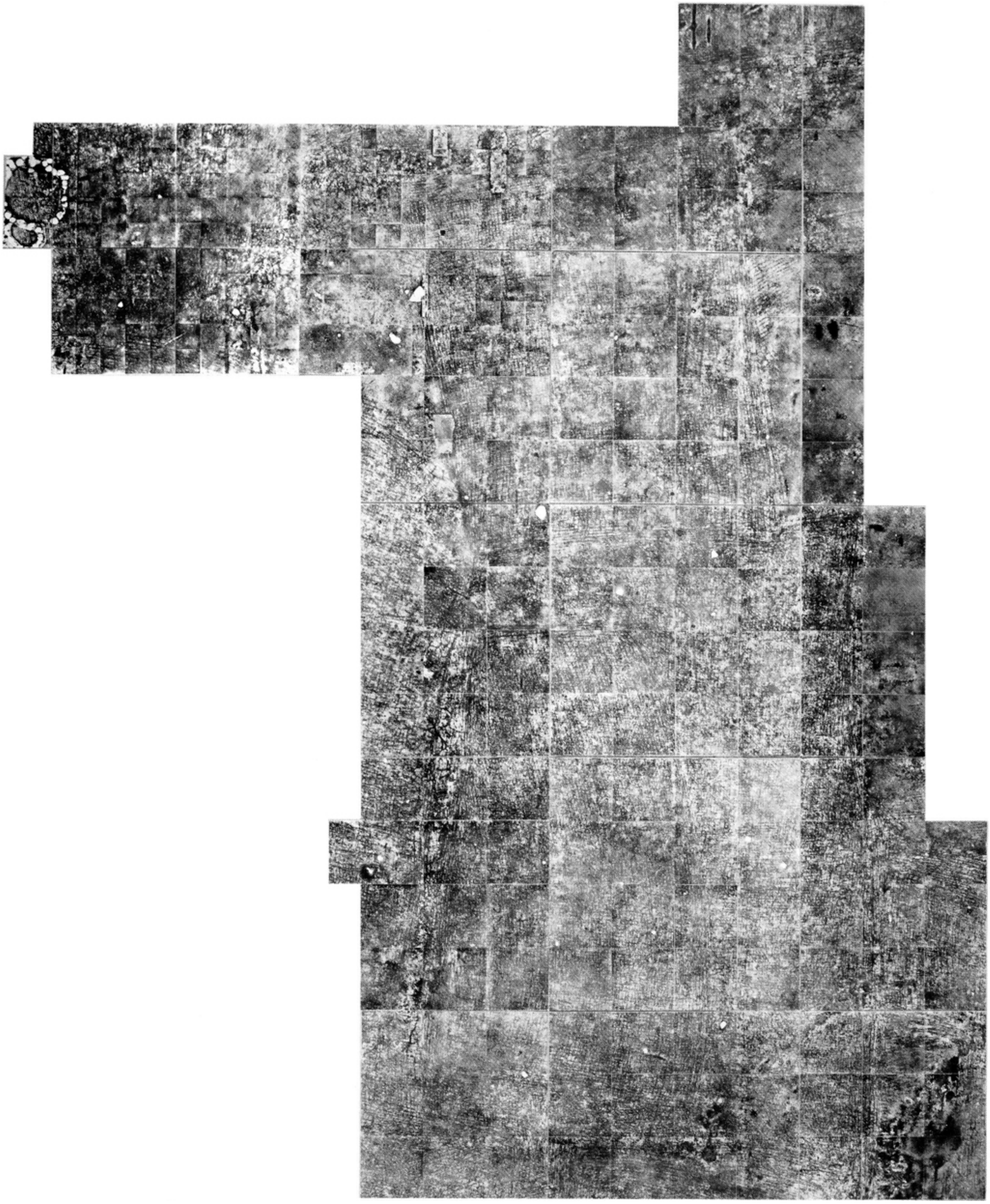


Fig. 6. The area excavated 1968–72 composed of photographs of 5 × 5 m squares and in NW 2 × 2 m squares. Reproduction and montage: Svend Thomsen.

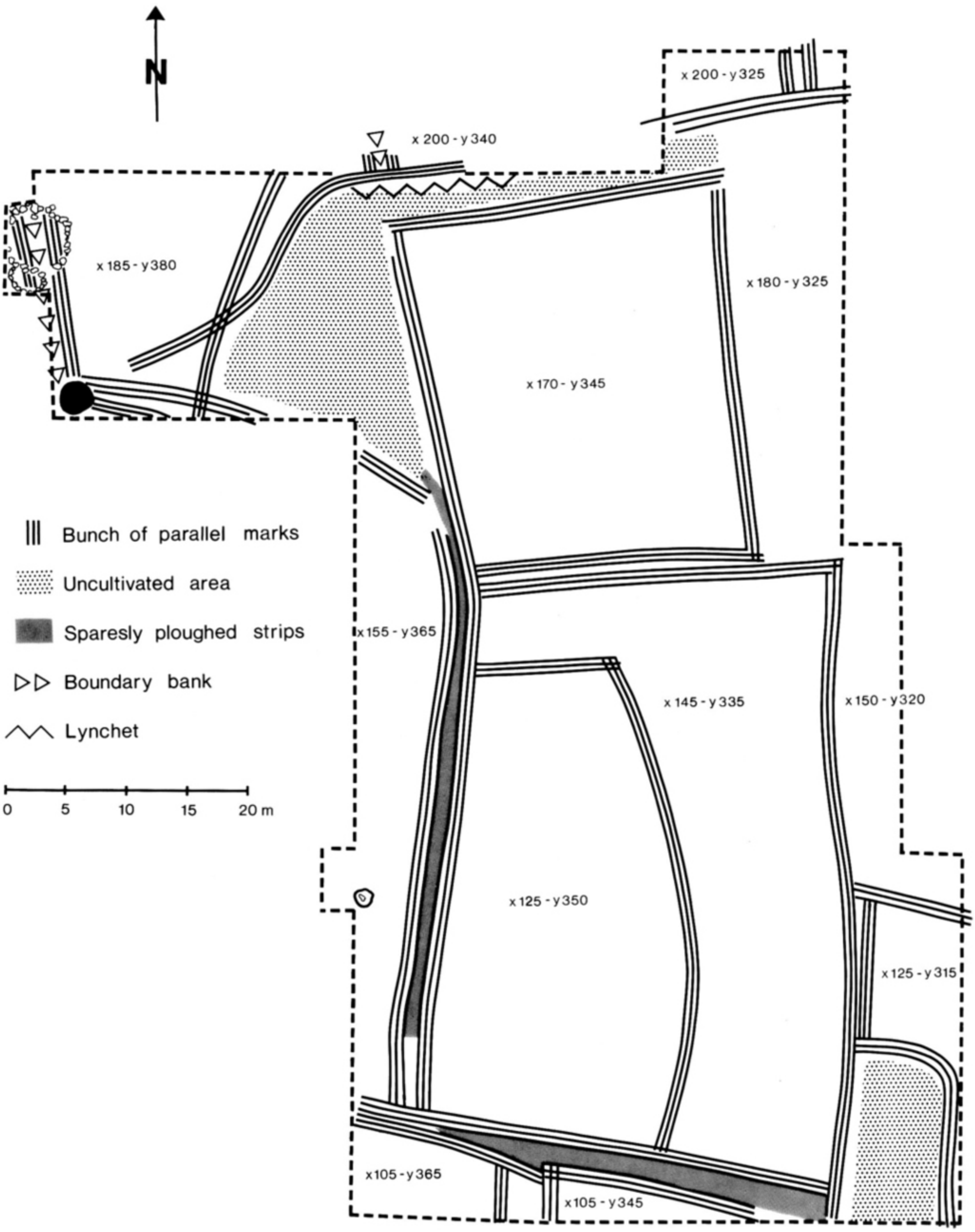


Fig. 7. Sketch showing the boundaries of the fields and the co-ordinates used for designating the fields in the following description. Also shown are the kerbstones of the barrow W of X185–Y380, the pit in the SW corner of the same field, and the site of the heap of pot sherds in the field X155–Y365. Drawing: John Falck.

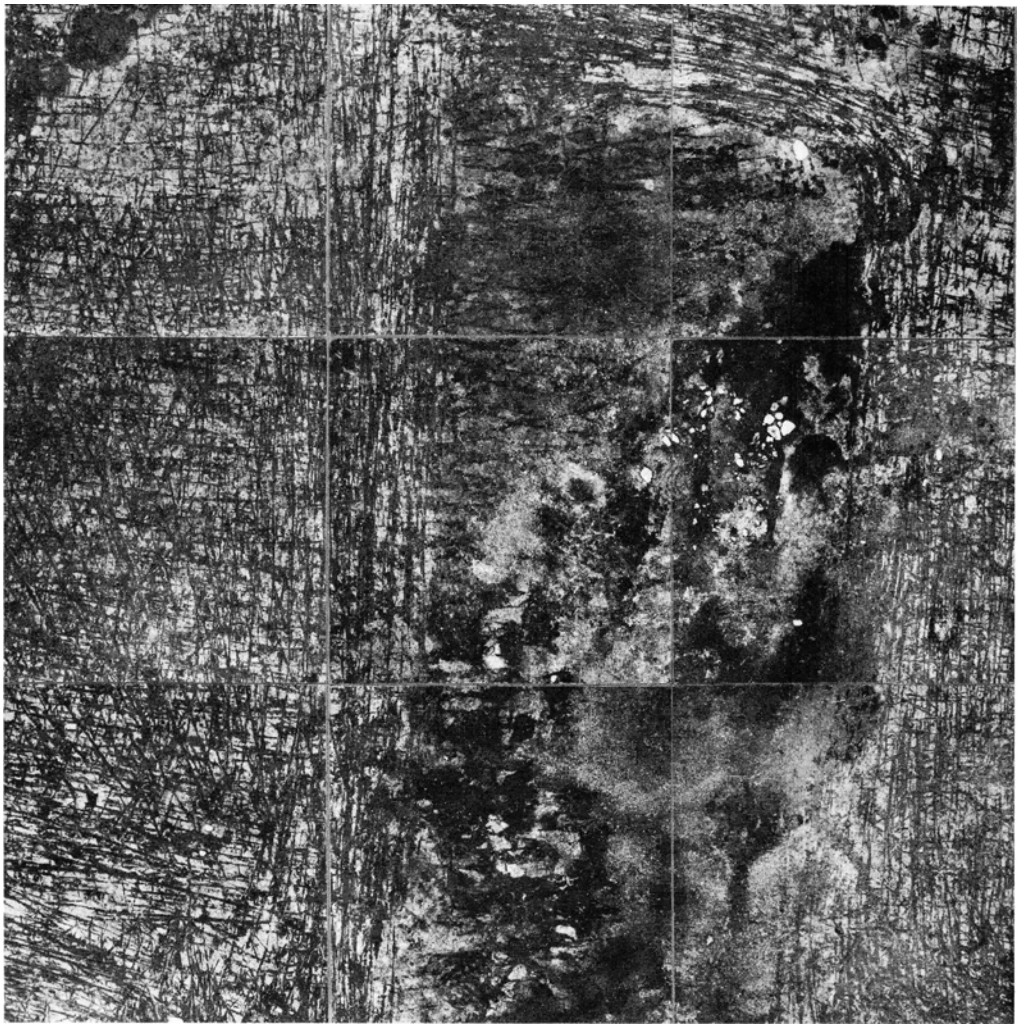


Fig. 8. 225 m^2 of the excavated area showing the SE part of X145–Y335 and the strip separated off from X125–Y315. Photo: Gudrun Nielsen.

X125–Y315

A c. 10 m wide western section of a field, which extends c. 30 m N-S. In its southwestern part, for over 15 m along the E edge of X145–Y335 there is a 7–8 m wide strip not included in the cultivation that characterises the rest of X125–Y315. The exposed area totals c. 150 m^2, including 100 m^2 of the strip.

The preservation of the marks is reasonably good, except in the area separated off, where the soil is porous and has much downwashed charcoal dust; traces of earlier ploughing are effaced.

The field is clearly delimited to the N by a 2 m wide bunch of parallel marks, aligned E-W with a slight tilt towards NW-SE. It runs straight or slightly curved into the bunch of parallel marks that also forms the E boundary of X145-Y335, just S of where this changes direction slightly. 10–12 m further S on the W boundary the field is bounded by a bunch of parallel marks, which to the N and S surrounds the separated area of the field. This bunch runs E–W for c. 7 m as the N boundary, and turns to the S for 12 m, curving slightly. Test pits to the S reveal that this curve marks the S edge of the field.

The very closely spaced plough marks are completely dominated by two main directions, corresponding to the edges of the field. One is N-S, with a slight curve, the other at right angles, similarly curving as it approaches the W boundary.

The state of preservation and the structure of the bunches of parallel marks are similar to those in the field to the N and in X180–Y325.

The exposed surface contained much charcoal dust, and there were many small pebbles in the central part. There were no traces of any constructions. It was clear that the ploughing was at least in part later than the charcoal, and also that this ploughing preceded that on neighbouring fields.

The 7–8 m wide strip, specially segregated from the rest of the field, seems from the test pits to have been c. 20 m long N-S, and may have had a further extension towards the SW. This strip also had plough furrows: running E-W, curving a little N and S respectively, and at right angles to these running N-S. No continuation of the E-W furrows could be seen outside the strip. On the other hand, it seems unlikely that such a narrow strip would have been cultivated specially.

Charcoal coloured patches were also visible in X125–Y315, as if forming an extension of those visible in the adjacent X145–Y335.

X105–Y345

Part of a field edge covering 75–100 m^2, the NW part with well-preserved marks, bordering on X145–Y335. A test pit at point X100–Y325 revealed furrows running N-S, to the W of the uncultivated area described under X125–Y315; this suggests that the E-W dimension of the field was around 25 m.

The N boundary is the 1–2 m wide strip with a paler colour and rather less ploughing, described under X145–Y335. There is also a fireplace 1.2 m in diameter. It is cut through by several plough marks.

Along this strip is a 2–3 m wide bunch of parallel marks running E–W, with a curve towards the SE. To the W is a bunch of parallel marks running N-S, forming a right angle with the N boundary.

In this narrow field section there is a limit to what can be seen in the way of plough furrows, except some parallel to the N-S and E-W bunch of parallel marks with curves near the field edges. Some ploughing can, however, be seen running WSW-ENE, forming a rhombic pattern where they cut the others.

X105–Y365

Edge section, c. 100 m^2, with the northeasterly corner of a field, which borders X145–Y335 and X155–Y365. The state of preservation of the many closely spaced furrows is unusually good.

The N boundary is also the S boundary of the two fields just mentioned, and is formed by a 2 m wide bunch of parallel marks. The E boundary is more complex. There is the bunch of parallel marks bounding X105–Y345, but 2–3 m W of this is another N-S bunch which forms a right angle with the N boundary. Although this bunch of parallel marks seems to be later, some furrows can clearly be seen running across it up to the more easterly parallel group. At some stage, therefore, the field has been cultivated over a smaller area than that given by the boundary to X105–Y345.

The main directions of ploughing are parallel to the boundaries, running N-S and E-W, slightly offset towards the NE and NW respectively, and slightly curved near the edges. There is also a very clear ploughing aligned WSW-ENE, and less clear ones running NW-SE and WNW-ESE.

THE CROSS SECTION

The two trial trenches with which work started in 1967, each 100 m long and 1.75 m wide and laid in the form of a cross, were recorded by vertical photography, and were also partially drawn (fig. 4). However, they contribute little to an understanding of the field system and the direction of ploughing. In one case a field boundary was revealed which probably showed the length of one of the fields in the area of excavation; but the information from the trenches is mostly more general, concerning soil conditions, state of preservation, and the relatively irregular orientations of ploughing.

These excavations thus reveal traces of ploughing in 11–12 fields or ploughed units, some of which were completely excavated (1).

THE BOUNDARIES

As is clear from the foregoing, several criteria have been employed to characterise field boundaries (fig. 7). The classic idea is that fields of this period were surrounded by boundary banks or lynchets. The method of excavation might make it difficult to see boundary banks. The cultivation layer itself may be thin or lacking at least outside the field boundaries (Nielsen 1970, fig. 1). This is to some extent certainly due to wind erosion after vegetational cover was broken up by the plough, but also later on the absorbtion of material from the former field surface into the fen peat mentioned on p. 191, layers 4–6. Boundary banks were, however, visible in some instances. This was the case with the N-S boundary between X200–Y340 and X185–Y380, where the sandy mould over the layer with the plough furrows formed a boundary bank. The E-W boundary between X200–Y340 and X170–Y345 is also a classic, in that an uncultivated strip 1–1.5 m wide separates the two fields, and also marks a drop of 0.08 m in the landscape from the N to the S field. Finally the W boundary of X185–Y380 seems to have been a bank, upon which the barrow was built over half a millennium after the end of cultivation.

On the ground traceable banks and lynchets thus only represent part of a system, which would also include divisions not formally marked on the ground. This certainly explains why the visible banks and lynchets in other field systems very often appear to provide incomplete boundaries (Nielsen 1984, 161).

While bearing in mind the possibility that some may not have been recognized during excavation, it can be said that banks and lynchets were not a necessary form of boundary for the cultivated units. The material described here thus differs from other known sites, where lynchets or banks appear as uncultivated strips upon which is dumped waste from the fields – primarily stones (Nielsen 1984, 142 ff). In some cases there were strips or sections that were cultivated little or not at all; animal burrows were particular common in these. This is the case for the N-S boundary between X125–Y350 and X155–Y365, and the E boundary between X145–Y345. The pit described above, and some fireplaces, lay in these areas. If these are more or less contemporary with the field system, one must imagine that burning took place just on the field boundaries.

Post holes were seen in a few cases. In the axis of the W boundary of X185–Y380 a row of stakeholes was found, perhaps indicating the presence of a fence with upright stakes (Nielsen 1970, fig. 7).

Thus it appears that the boundaries between the different ploughed units are traceable by traditional archaeological means only in a few cases. In some cases there were no obvious traces at all, except that there was simply no ploughing. This was observed regarding the almost triangular uncultivated area between X185–Y380 and X155–Y365.

In the foregoing description it was nevertheless possible to discuss boundaries between the ploughed units. This was because the plough marks themselves mark them.

As described, the ploughed units are almost without exception surrounded by up to 2 m wide belts with sets of closely spaced parallel furrows, the bunches of parallel marks. Adjoining fields may together have a belt up to 4 m wide. Bunches of parallel marks may be seen on both sides of uncultivated strips and boundary banks, and along other unploughed areas. The marks are very close together, often so tightly packed (and numbering up to 50 or even 100) that it may be difficult to distinguish individual ones.

These bunches of parallel marks indicate intense ploughing of the field edges, to tidy the furrow ends after the rest of the field had been ploughed, and to reduce weeds spreading from the uncultivated areas, among them the boundary banks.

There can therefore be assumed to have been boundaries where the bunches of parallel marks occur.

The direction of ploughing is to a degree also important with regard to the definition of boundaries. Most furrows run rather straight, but curve slightly when they approach the end of the field, presumably in the direction the draught animal was to turn when the end was reached and the plough lifted.

Finally, when ploughing simply stops along a line or at an uncultivated strip, this is also an indication of how far the ploughing reached. This can be particularly characteristic in special areas, such as those ploughed obliquely, but is also seen in more normal ploughing at right angles to a boundary.

SHAPE AND LAYOUT

The boundaries of the ploughed units are thus fairly clear, so that the shape of individual units may be examined.

The starting point is that the terrain is almost completely level, with relatively minor variations in soils. There were therefore no significant constraints regarding field layout, and it can be assumed that their shapes were determined mostly by the technical aspects of ploughing.

Determination of field shape must start from the corners. These are primarily marked by the junction of two bunches of parallel marks. In several cases the corners are clear and sharp, forming near right angles between two bunches of parallel marks. This is the case for the SW corner of X200–Y325, the SE and SW corners of X200–Y340, the four corners of X170–Y345, the NE, NW and SW corners of X125–Y350, the SW corner of X155–Y365, the NW corners of X125–Y315 and X105–Y345, and the two successive NE corners of X105–Y365. Variations involve degrees of curvature. In some cases, as with X170–Y345, straight lines converge, but in other cases there is slight curvature, and in a few, such as the SW corner of X200–Y340, the curves are stronger, so that it may seem as if the ploughing turned a corner.

At the NW corner of X125–Y350 the bunches of parallel marks intersect at an angle of 120°.

Two of the fields, X180–Y350 and X150–Y320, had relatively few and weak furrows, so the nature of their corners could not be examined. It seems that the NW

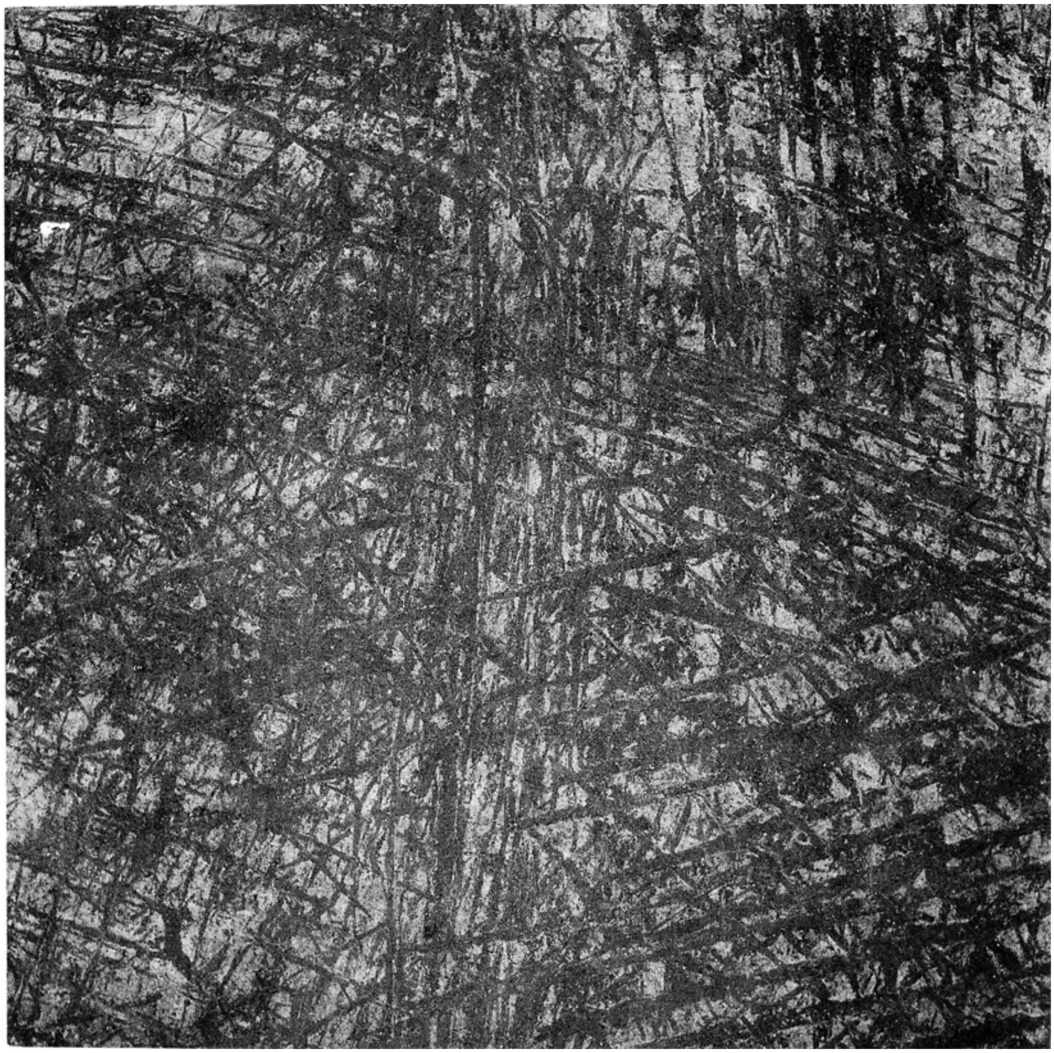


Fig. 9. Detail, 5 × 5 m square, from the boundaries between the fields X105–Y365 and X105–Y345. Photo: Gudrun Nielsen.

corner of X180–Y325 was rather diffuse. The uncultivated strip N of X170–Y345 runs into this corner.

The other intersections of bunches of parallel marks are more complex. X185–Y380 has very varied ploughing directions, and the SW corner has a bunch of parallel marks running N-S but none running E-W. The bunch that runs in from the E actually belongs to the field to the S, X155–Y365. There is more of a corner to the SE, where a bunch of parallel marks curves round strongly from the SW to meet at right angles the N-S boundary between X185–Y380 and X200–Y340. The NE corner of X155–Y365 forms an angle of c. 135°, perhaps because it was later cut through by X170–Y345.

The SE corner of X145–Y335 seems to form a kind of funnel running to the SSE and the open uncultivated area there.

It is unclear how the SW corner of X125–Y315 was layed out against the area separated off there.

Field corners only form the fixed points for shape determination in certain cases, therefore. There is a corresponding looseness on the courses of the sides. Straight lines are virtually non-existent. The short N and S sides of X125–Y380 can be said to be straight, as can a number of similar cases (e.g. the S part of the E side of X145–Y335, or the sides of X170–Y345), but in almost all instances the sides are somewhat irregular, with curves, deviations or smaller kinks in their course. The curves may be quite clear, as with the E side of X125–Y350 or the N side of X105–Y345, which like the S side of X145–Y335 curves down towards a funnel-shaped exit. Very distinctive courses are followed by the curved edges of the areas separated off to the NW and SE.

Neither are the field sides uniform in length. It is characteristic that not even in the most regularly shaped field, X170–Y345, are the N and S sides, or the E and W sides respectively, of the same lengths. It might be because it is easy to keep going a little further than intended once ploughing has begun, so that some sides become longer, causing some irregularities in field shape as ploughing progresses.

Variations in side length mean that their orientation also varies. It is true that the ploughed units are broadly oriented N-S and E-W (when abnormalities along the uncultivated areas are ignored), but the fields in the N part of the excavated area clearly have a slight WSW-ENE inclination, while those in the S part incline more WNW-ESE.

All these irregularities of course make it more difficult to make a precise estimate of the sizes of the cultivated areas. There is a further uncertainty in that some ploughed units are later than others and are placed inside earlier, larger units.

Certain size classes do, however, seem to be repeated despite the quantitatively limited material. The two completely clear units X170–Y345 and X125–Y350 both contain c. 750 m^2, although their proportions are very different. X145–Y335 is about twice this, at c. 1525 m^2. If the estimated size of X185–Y380 is correct, the ploughed area of this would also be about 1500 m^2. These sizes must probably be seen in relation to ploughing capacity. 750 m^2 may be about what can be ploughed over twice in a day, and thus correspondingly 1500 m^2 may be ploughed once.

Apart from these uniform areas, and the fact that sides are often around 25–30 m in length, there are no consistent figures, and no precise alignments.

The two areas that were separated off contribute to the variability of this system. One of these was not worked at all, the other only to a limited extent at an early stage. They would have caused the plough to manouever completely irregularly, for example at the funnel-shaped SE end of X145–Y335, and the strip between X200–Y340 and X170–Y345.

The reason for these areas being separated off is not clear. They can definitely not be explained by reference to the soil. They might have been due to vegetational growth, or they could have been for storing crops or dumping cleared weeds. The area to the SE had a strong coloration of charcoal. It could possibly be that they were used for the burning of turf or peat, for use as fertiliser. It is worth noting that ploughing took place after burning, because the furrows contain charcoal, and that the areas were not separated off until after this. Finally, it seems that the separated areas connect up with the uncultivated strips in between some of the fields. These strips might to some extent have been used for transport.

THE PLOUGHING

There is thus no regular system of fields and ploughing visible in the material. The degree of preservation is also highly variable even within the limited area uncovered.

Not all ploughings reached down to the subsoil sand, of course. Some were restricted to the mould layer. In some places in the sandy mould, the lighter streaks of plough marks not reaching down to the subsoil sand were seen. Similarly, although ploughing was generally carried out very evenly (as can be seen from sections along the longitudinal line of the furrows), it was common for the share now and then to be raised from the subsoil, so that the plough mark was interrupted. Only very few marks can in fact be followed for more than a few metres. It cannot be proved that the separate parts of a line form a continuous sequence, which naturally weakens their value as archaeological source material. Furthermore, it can often be seen how two or more marks run together in one track, or that what looks like a single mark is in reality composed of two or more marks running in the same line.

In most cases it is therefore necessary to deal with main orientations of the ploughing, in the form of sets of parallel furrows that seem to belong to the same ploughing episode. Furthermore there exists the possibility for determining direction provided by either the longitudinal sections or crossing furrows, as described elsewhere in detail (Nielsen 1970, 152, 159).

An elementary aspect is the ploughing of parallel furrows. This was necessary to ensure that the whole field

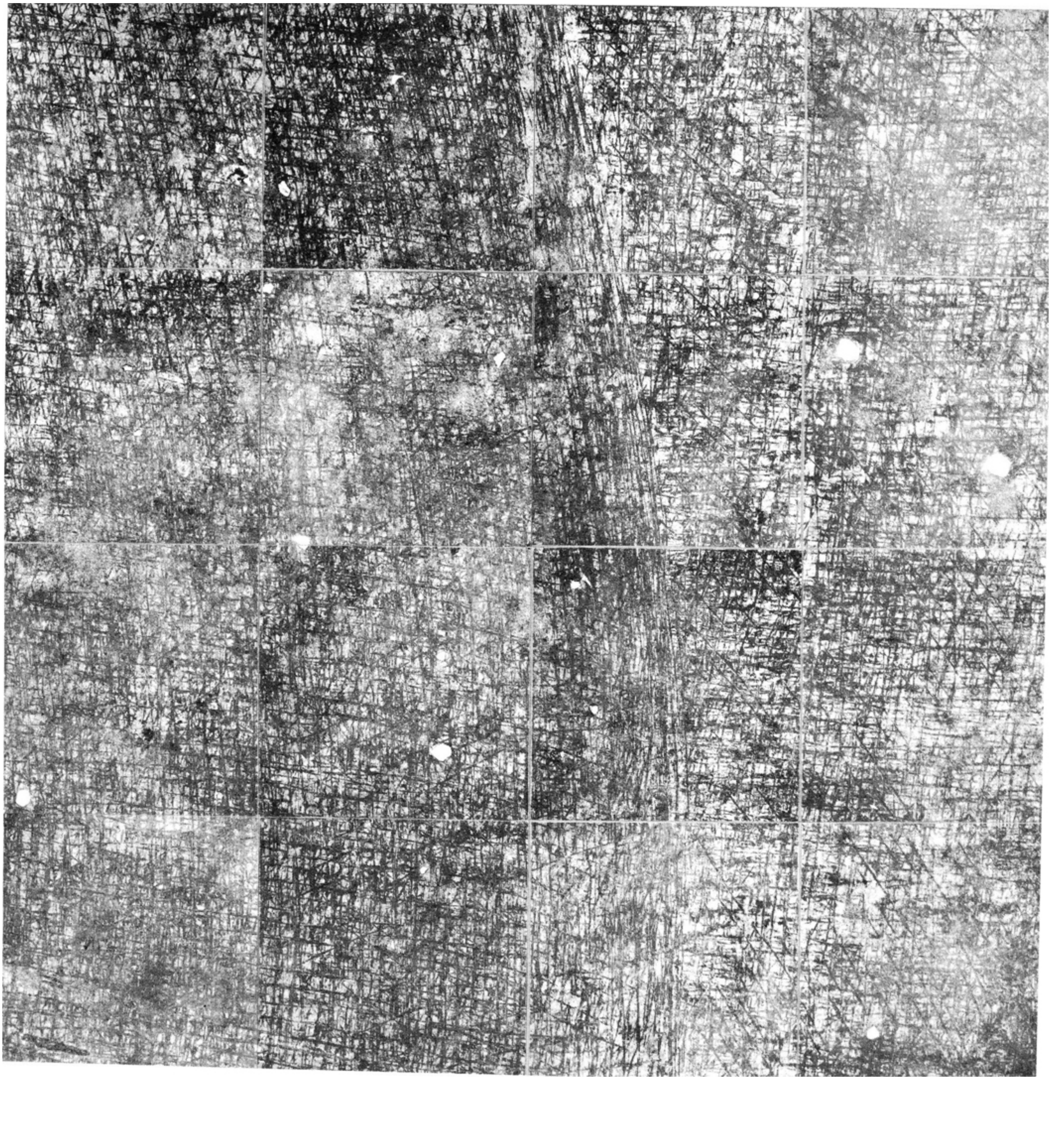


Fig. 10. 400 m^2 of the plough marks in the fields X125–Y350 and X145–Y335. To the W is seen the curved N-S ploughing of X125–Y350 and furrows at right angles to this as well as traces of ploughings in other directions. To the E are the furrows of the field C145–Y335 that may have lain fallow during the cultivation of the intruding X125–Y335. Photo: Gudrun Nielsen.

was cultivated, and the furrows also had to be evenly spaced so that the whole surface area was worked. When the sets of ploughmarks can with any confidence be regarded as deriving from the same episode, the furrows are normally about 25–30 cm apart, sometimes a little more, sometimes a little less. The ploughman would have had to concentrate hard on this if awkward and time consuming reploughing was to be avoided.

The distance between the furrows may vary, depending on whether the soil was being broken up or loosened, or whether seed corn was being ploughed in. For instance, during the ploughing in of seed corn it was important that the seed in a furrow was not further covered with soil from the neighbouring furrow.

It can frequently be seen that parallel marks, presumably from the same ploughing, run alternately in opposite directions. Ploughing was thus done from one end of the field to the other, where the plough was raised, turned about, and then taken back alongside the first furrow.

At the ends of the furrows the plough would be lifted or pressed down within a particular area, although not along a fixed line. The rather uneven ends of the furrows near the field boundaries are made more uniform by the ploughing of the bunches of parallel marks along the edges. These even out the irregularities, make the field edge usable as a seed bed, and also keep back the weeds that could otherwise infest the crops. The bunches of parallel marks are, as mentioned, of varying widths, but often c. 2 m, which must more or less be the length needed for the manoeuvre of turning the team of oxen. It is quite clear that these bunches of parallel marks run along and are synonymous with the edge of the ploughed area.

The pattern created by the ploughing has its functional starting point in the field boundary or the edge of the ploughed area. The direction of ploughing can only be described meaningfully in relation to this.

Field X170–Y345 is typical of the normal cases. It is almost rectangular and the furrows run parallel to the sides, except that they turn off slightly a few metres before they reach the bunch of parallel marks at the end boundary; this presumably indicates the turning direction, and causes the furrows to approach the field edge at a slightly oblique angle. There is no definite evidence of ploughing in any other directions in this field.

In principle the same pattern is visible in X125–Y350; one element is formed by the curved N-S ploughing, which is constricted from the NE towards the SW, and the other by furrows at right angles to this. This field, however, has clear evidence of other ploughings, at an angle to its sides. There are at least three: NNE-SSW, ENE-WSW, and WNW-ESE, with some variability particularly in the corners. Some of the furrows in the corners are so short that it is problematic whether there was space enough to turn with a team of oxen.

These marks at an oblique angle to the field edges can be interpreted as the result of ploughing to break the ground, in order to work over the whole field and break up the lumps and root systems. This involved the need for more ploughing than just that parallel to the field edges. The furrows were aligned obliquely so that the plough should not slide down into them during later cultivation. Breaking the ground like this may have been done in several phases, involving first the making of a cut, and then ploughing along it. Another explanation for oblique furrows – when they are both later than the standard ploughing and deep – might be that subsequent cultivation of the field took place with the soil loosened, so that the plough penetrated deeper. In this case, too, it would also have been important to avoid sliding into the earlier furrows.

The furrows in X145–Y335 seem to have followed the same pattern. This may have lain fallow during the cultivation of the small field inserted into it. This small field also contains numerous marks aligned with the boundaries, as well as two sets of diagonal marks, and weaker traces with yet another orientation. This means two to three episodes of ground breaking.

It is characteristic that some of the so-called ground breaking marks seem to be secondary, in that they run through furrows of earlier ploughings and are thus the youngest furrows in the field. This may mean that, after the initial ground breaking, cultivation only involved the working of the upper layer of soil, and did not result in maks being made in the sandy subsoil.

The foregoing has dealt with what one can call complete fields and their working. What can the rest contribute?

The small corner of X200–Y325 only shows ploughing in the directions of the field boundaries. The neighbouring field to the W, X200–Y340, has besides this at least two fairly prominent diagonal ploughings, NE-SW and NW-SE (Nielsen 1970, fig. 1). To the W, X185–Y380 has no clear southern boundary with the strange open area which decided the direction of ploughing. It is clear that there was an intensive ploughing parallel to the N-S edges, and also (though somewhat curved) at right angles to this. In several instances furrows go down towards the boundary to the neighbouring field to the S, X155–Y365. One of these is marked by the deep furrows of a ground breaking episode, and curves to the W, so the open area in this phase was constricted into a funnel-shape towards the W. Another set of furrows curves towards the S. A similar but less diffuse ploughing is visible in X155–Y365. This is dominated by a N-S ploughing parallel to the sides, and has corresponding E-W furrows; the N side curves funnel-like towards the SE, but apart from ploughing parallel with this curve in the N part of the field, no other directions are visible.

X180–Y325 has only one definite main direction, oblique or strongly curved in relation to the field edge. This could be evidence that this field was only ploughed once; but an alternative explanation is that this represents a ground breaking episode, after which cultivation did not go so deep. The furrows in X150–Y320, rare as they are, do on the other hand appear oriented parallel to the sides, at least E-W and N-S, and the furrows in the separated area within X125-Y315 are partly aligned this way as well. X125-Y315 is, however, later in date than the two fields previously mentioned, and apparently only has furrows oriented parallel to the edges.

In X105–Y345 the ploughing is apparently similarly oriented, except for an oblique one running NE-SW, which diminishes to just a few metres in length in the corners. This oblique ploughing is later than the rest of the furrows. The same is true of X105-Y365, where two oblique ploughings that cross each other postdate those aligned parallel to the field edges. The broadest and deepest is the one oriented NE-SW, and is apparently the last ploughing of the field to have made marks in the subsoil.

SUMMARY

Even though the excavation only covered c. 5000 m^2 in all; *even though* conditions of preservation were variable in places and sometimes bad; *even though* the evidence from the furrows is limited because much cultivation would have taken place in the humus layer and would not have made marks in the subsoil; and *even though* the deeper ploughing also varied in depth, so individual furrows cannot be traced; *still* the material has far extended our knowledge of prehistoric ploughing in Denmark, and contributed to a more varied picture.

The main pattern in the ploughings is a back-and-forth movement, creating parallel furrows immediately beside one another, and taking as their starting point a line – usually, but not always, a field boundary. The plough is lifted at the edge of the ploughed unit, turned about, and re-inserted; the turning operation is often begun with a slight curve away from the line a few metres before the plough reaches the end.

Generally, ploughing subsequently (or at the same time) took place at right angles to the original line, and this may have been sufficient to create a seed bed, particularly if the field had been ploughed several times and worked regularly.

Besides this cross ploughing, there are also oblique ploughings; in several instances these are prominent, and result from deep ploughing. This may have been part of a more thorough working, either part of the ground breaking process or at a later stage. In both cases it was important to avoid sliding into the earlier furrows.

The resulting patchwork pattern can be very hard to interpret, and indicates several ploughings within the same process. Interpretation clearly becomes even more problematic when several contemporary ploughings, perhaps with more than one plough, intersect each other.

The final piece of work was the ploughing along the edges of the ploughed units. This has left traces in the form of the bunches of parallel marks.

The boundaries of the fields or ploughed units seem somewhat random. In several cases there appears to be no boundary; in others they are formed by strips, worked less than the fields and in which the sandy subsoil appears paler; only rarely could boundary banks be recognised. With regard to the last point, the only possible conclusion from this material is that banks or other fixed boundaries were not a necessary part of the cultivation process, and were definitely unnecessary as far as the use of individual ploughed units was concerned. They may have served other purposes to do with ownership rights.

As a result of this, there is a considerable irregularity in the shape of the ploughed units, and in some cases this is connected with the existence of open areas which were not ploughed. Another result was that boundaries of ploughed units could be moved. Despite this, one can talk in terms of broadly rectangular areas – an inevitable result of the ploughing pattern – measuring c. 750 m^2 and 1500 m^2 in area.

An enlargement of the excavation, and detailed study of the internal relationships between furrows, might extend the picture.

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NOTES

1. The uncovered area with plough marks in Store Vildmose is probably the most extensive of its kind. The material can be extended almost unlimited within the 200 ha area where plough marks have been demonstrated to exist.

So far this material will to some degree be setting a standard, with due regard to differences in cultivation methods caused by topography or soil conditions.

The material to some extent confirms what could be concluded from earlier more restricted or fragmentary sites, including that of the first seasons in Store Vildmose (Nielsen 1970). This also applies to the interesting and important find of plough marks at Grøntoft (Becker 1971). Among the features common to the two sites were the dense ploughing parallel to the boundaries. But in the interpretation of this phenomenon there is a difference, in as far as I presume that they mark a finishing process for the edges of the fields. In Grøntoft is also seen the slight curvature of furrows towards the edge of the fields. The corresponding curvature in Store Vildmose marks the initial phase of the turning manoeuvre, not continuation of ploughing along the boundary. Other common features are the fluctuations in respect to the ploughed units and thus the varying boundaries. Different from Store Vildmose are the clearer and more stationary limits seen at Grøntoft, i.e. boundary banks, lynchets, and trenches, and hence a more well defined framework for the ploughing. Probably the special conditions formed by terrain and soil in Store Vildmose may have caused the relative looseness characteristic for the ploughing as well as for the shapes of the fields.

This will be relevant to the extensive British finds as well. These are also confined by more established limits.

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Aspects of Viking-Age Shipbuilding

in the Light of the Construction and Trials of the Skuldelev Ship-Replicas *Saga Siglar* and *Roar Ege*

by OLE CRUMLIN-PEDERSEN

The study of archaeological remains of ships from the past has considerable potential. Ships are built to serve specific purposes, such as the conduct of trade or war, the procurement of food or general transport; and the structure of these activities is reflected in their design. Shipbuilding is normally based on the best technology locally available at the time. Ships provide indication of fluctuations in the availability of know-how and materials, and they cast light on local building traditions as well as on impulses from outside. Thus, shipfinds are valuable not only for the study of technology but also for that of many aspects of the social structures and economies related to maritime activities.

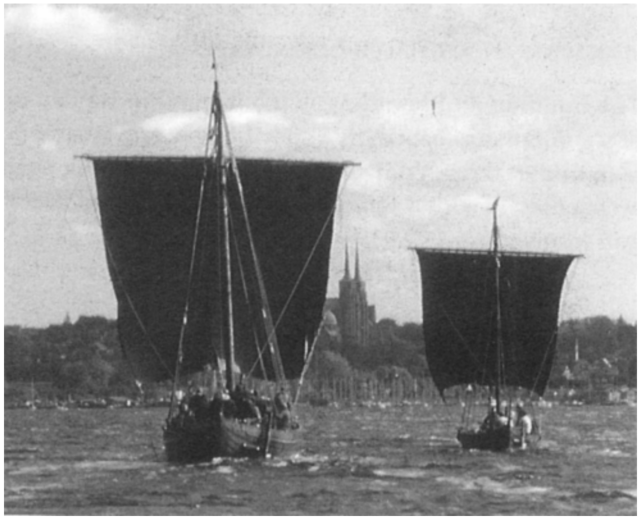

Fig. 1. Rendezvous of the Skuldelev ship-replicas SAGA SIGLAR and ROAR EGE in Roskilde Fjord in June 1986.

Ships are moveable objects and they need not have close relations to the findspot. However, detailed study of materials and techniques, the context and associated objects of a particular shipfind may serve to identify the region where construction took place and to cast some light on the history and activities of the ship during its lifetime (Cederlund 1984, Crumlin-Pedersen 1985A).

For well-preserved shipfinds it is possible to prepare reconstruction drawings which are based much more firmly on recorded facts than are, for example, most replicas of prehistoric farmhouses. On the basis of these plans the carrying capacity and likely performance of the ships can be established, even if these calculations may need verification, in the case of shiptypes unfamiliar to modern experience, by model-experiments and trials with fullscale replicas. Such studies and trials lead to a wellfounded knowledge of the characteristics and data of a number of ships which actually sailed in our waters in the past. We may discuss the representativity of these ships, as well as details of function and ownership. But we cannot deny that these particular ships were actually built and used, even if some of them may be in conflict with our preconceived ideas of, for example, maritime trade in the period in question.

The five ships excavated in 1962 near Skuldelev on the Roskilde Fjord and now exhibited in the Viking Ship Museum in Roskilde offer good opportunities for such detailed studies. They represent five shiptypes of the 10th–11th centuries with varying functions and places of origin (Olsen & Crumlin-Pedersen 1958, 1968 and 1978). These ships are well known today in Danish waters, as the Skuldelev ship Nos. 1, 3 and 5 have served as basis for several replicas built in Denmark and one built in Norway (Crumlin-Pedersen 1984A, Vadstrup 1986, Thorseth 1986). Only one of these, the Skuldelev 3-replica ROAR EGE, has been built primarily as an archaeological experiment, the ROAR-Project in Roskilde. The Skuldelev 1-replica SAGA SIG-

LAR from Norway, however, is also of archaeological interest. For this ship the design of hull, rig and sail and the trials programme were worked out by the Roskilde Viking Ship Museum. Although the scope of the two projects differs, they both contribute to our understanding of Viking shipbuilding and seamanship. At the same time these two replicas may serve as good examples of some of the methodological problems inherent in such projects, – and of some of the results which may be gained through archaeological experiments of this kind.

PLANNING AN ARCHAEOLOGICAL EXPERIMENT

The building and handling of a Viking-ship replica or of a similar ship based on a specific boatfind is a complex undertaking, confronting the experimenting ship archaeologist with a series of problems to be discussed and resolved:

A. Questions related to the documentation of the archaeological sources:

1. Is the documentation of the original shipfind sufficiently precise and detailed to record all important features and to serve as a basis for the analysis of construction principles, shape, extent of repairs and alterations, wear marks, propulsion and steering etc.?
2. Have the materials involved (wood, iron, caulking, tar etc.) been properly identified and studied as to quality and processing (e.g. radial or tangential splitting of planks)?
3. Have original toolmarks been recorded and identified on the ship's timbers, and can these marks be related to known types of contemporary or younger tools?

B. Questions related to the processing of archaeological data and the preparation of a reconstruction plan of the ship:

1. Does the shipfind in itself allow a complete reconstruction of the hull, defined within narrow margins on the basis of possible near-symmetry port/starboard, fore/aft or from the run of the lines over missing parts?
2. If this is not the case, can a hypothetical reconstruction be drawn up within a narrow margin of error on principal dimensions, or would it be preferable for two or more alternative hypothetical reconstructions to be investigated along parallel lines?
3. Should the reconstruction plan represent the ship as built or should it take account of repairs and alterations as found?
4. Is there a basis for a reconstruction of the arrangements for steering and propulsion in the shipfind itself, or can this be based on other relevant evidence?

C. Questions related to the construction of the replica:

1. Should the replica be constructed from the same kind of materials as the original ship and should these be treated in similar ways as in the original construction, or should other techniques and materials be permitted, e.g. the use of sawn timber or laminated elements?
2. Should the replica duplicate the original ship in all details, involving a copying process requiring the use of moulds and other non-authentic measuring techniques, – or should the building process aim at following authentic procedures, as far as these can be established, even if this may lead to slight deviations from (or corrections to) the shape drawn up in the reconstruction plan?
3. The building period will generally be longer for the replica-project than for the original ship. How will this time-factor influence the experiment, and how can it be counteracted?
4. To what degree should present-day techniques and conditions in general be allowed to play a rôle in the project?

D. Questions related to the sailing trials:

1. Even if an overall plan of the rigging can be drawn up on the basis of traces in the original ship, many questions will usually remain to be solved concerning the properties and details of the sail and rig. The same applies to the rowing and steering arrangements, ballasting etc. How are these problems to be dealt with in the experiment?
2. Handling a sailing ship calls for an intimate familiarity with the type of rig and hull to be sailed. Experience can be built up over a period of years but it is

unlikely that brief periods of holiday cruising in a ship replica will lead to a familiarity with the ship comparable to that of the sailor of the past, working professionally under sail in all weather conditions for a whole lifetime. How can the replica-skipper prepare himself best for a realistic trials-programme?

3. How are the results of the trials to be recorded and presented?

These questions should all be discussed and resolved before a proper archaeological ship-replica project of this complex nature is launched. Other replicas may be built to suit purposes such as recreation, filming or PR-activities. In that case it is not customary to go into such questions at any length, although some of the other Danish replica-projects have been strongly motivated for archaeological experiment. These vessels may be able to give a first indication of the performance of such ships and they may serve as training ground for builders and sailors of proper experimental replicas. Up to now these other vessels have yielded few reliable data, as there has been no tradition for a precise recording of trials. Recently, however, the various groups of people who are sailing replicas for recreational purposes in Denmark are finding inspiration in the conscious experimental activities around the ROAR EGE. It is to be hoped that in the future the potentials of the other Danish replicas may be brought out to a higher degree than has so far been the case.

It is not only from the trial's programme that the results of the experimental activities with a ship are to be derived. In fact, naval architectural calculation is a much cheaper and faster way of obtaining several of the data of the ship than is a trial's programme with all its inherent problems (McGrail 1986, Vinner 1986). The principal gain from the experiment consists in the widening of the field of experience of the ship-archaeologist and the revelation of several aspects of shipbuilding and seamanship of the past which would probably have remained unnoticed and unexplored if the replica had not been built and tested.

THE *SAGA SIGLAR*-PROJECT

In 1982 the Norwegian journalist and adventurer Ragnar Thorseth commissioned a replica to be built of the Skuldelev 1-ship, a 16,5 m long deep-sea cargo-carrier, possibly the type known as *knörr* in the sagas. It was Ragnar Thorseth's plan to navigate along the old Norse route across the North Atlantic in the ship, as he had done earlier in more modern boat-types. He was thus following a good old Norwegian tradition of investigating ancient seafaring around the world in replicas of ancient vessels (Christensen 1986, Heyerdahl 1986). He even aimed to take the ship around the world in continuation of the trip to Greenland and Newfoundland.

As Ragnar Thorseth was approaching the subject on the basis of careful preparations, he soon came to an agreement with the present author as to mutual cooperation in the project. The replica was constructed on the basis of detailed studies of the hull and rig of the original ship, carried out in Roskilde by Erik Andersen and Ole Crumlin-Pedersen as part of the preparations for the definitive publication of the Skuldelev-ships. The hull was built by the very competent boatbuilder Sigurd Bjørkedal, working in his old workshop in the Bjørkedal valley near Ålesund in Western Norway. Rigging and sailtraining were supervised by Jon Godal on the basis of his studies of the living tradition in Western Norway of techniques of handling the local square-rigged boats around 1900 (Godal 1986).

The voyage across the North Atlantic took place in the summer of 1984, after initial trials and trips to harbours around the North Sea and the Baltic, including Roskilde, in 1983. The SAGA SIGLAR was met with heavy drift ice near Greenland and ran into a hurricane with wind speeds up to 65 knots on the passage to Labrador. The hull, rig and steering arrangement, however, functioned perfectly and ensured a safe passage. The ship carried modern navigation and safety equipment, and a 22HP dieselengine was fitted for propulsion in harbours and canals.

After a period of six months in North American waters, the voyage continued through the Panama Canal and across the Pacific to Australia and Singapore. Then SAGA SIGLAR sailed across the Indian Ocean and through the Red Sea, the Suez Canal, the Mediterranean and the rivers and canals of France back to North European waters, with a visit to Roskilde in June 1986, before returning to Norway for future exhibition as part of the Sunnmøre Museum at Ålesund.

Thus the SAGA SIGLAR fulfilled the aims of Ragnar Thorseth by setting two different maritime records, being the oldest boat-type ever to circumnavigate the

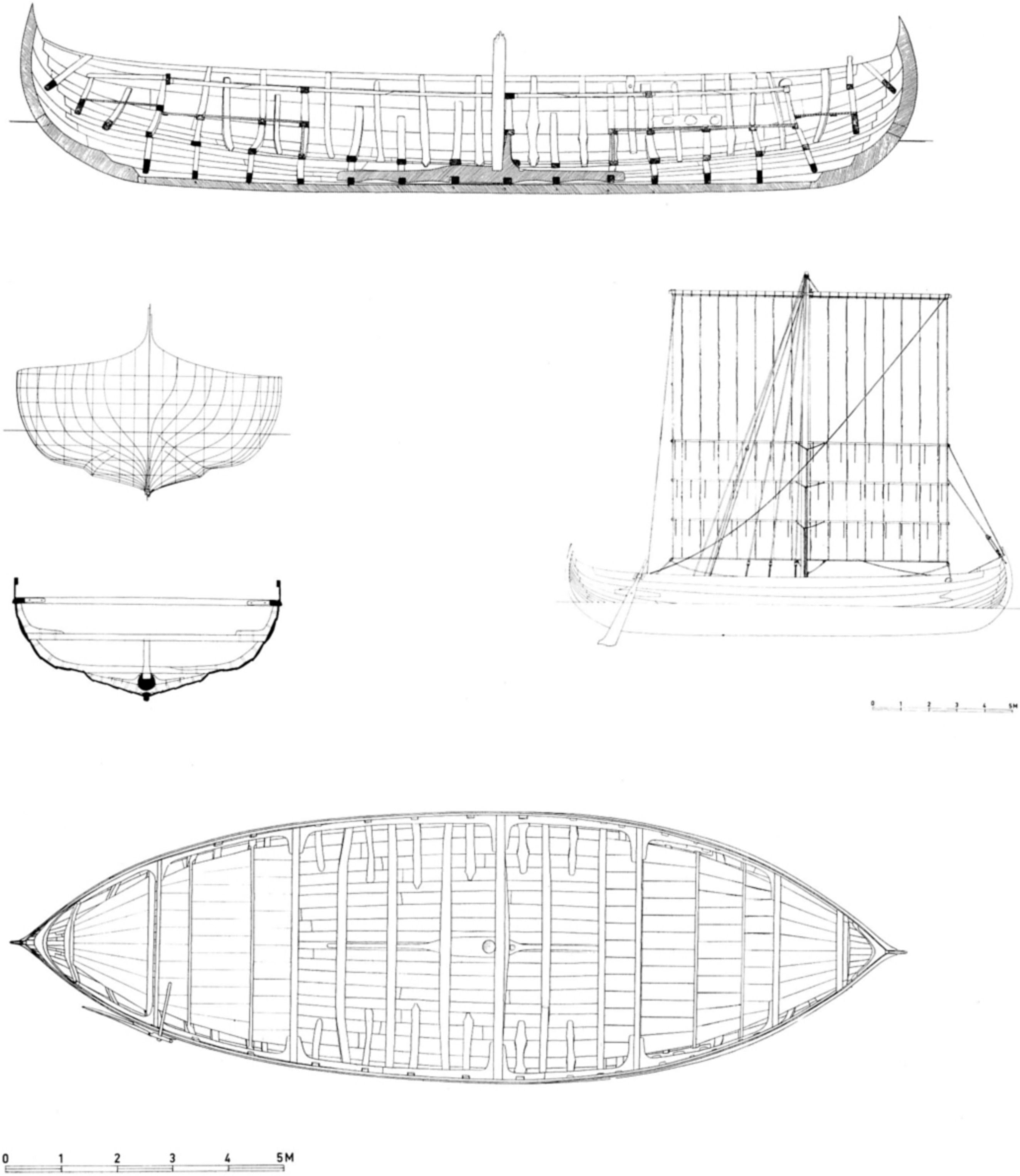

Fig. 2. Preliminary reconstruction plans of the Skuldelev No. 1 ship. These plans formed the basis for the construction of the replica SAGA SIGLAR.

globe, and the first open, undecked vessel to do so. The voyage, however, also provided practical proof of the workability of the reconstruction and of the great seaworthiness of the shiptype. In the hurricane south of Greenland SAGA SIGLAR logged a speed of 8.5 knots over 2–3 hours, sailing on the rig alone! The total mileage of the voyage was c. 35.000 nautical miles, and the ship covered 3.200 miles from Galapagos to Marquesas in French Polynesia in 22 days, giving a mean speed of 6 knots over this entire period.

The ship's tacking ability depends on windspeed and wave-height, giving an efficient angle of 60° to the wind under normal conditions. A detailed report of these observations and the results of systematic trials to be held after the return to Norway will be prepared and published by the Viking Ship Museum, Roskilde, in cooperation with Ragnar Thorseth and Jon Godal.

Fig. 3. SAGA SIGLAR beating against the wind in Roskilde Fjord in June 1986.

THE *ROAR*-PROJECT

The idea of building and sailing a replica of the Skuldelev 3-ship, a 14 m long coastal carrier of elegant and slender design, was born soon after the excavation of the ship in 1962. It has been materialized within the framework of the ROAR-Project, with a first phase comprising the construction and first trials of the ship in 1982–84 (Crumlin-Pedersen 1986A). The second phase, covering the years 1985–87, will explore details of Viking rig and sail, and also seek information about properties of hull, rudder and rig through model tank and wind-tunnel tests.

The aims of the ROAR-Project, as these were laid down in 1981–82 at the preparatory stage, are

1) to promote research on Viking shipbuilding and seamanship as an integral part of the study of aspects of the Skuldelev ships,
2) to provide a floating full-scale reconstruction of the best preserved of the Skuldelev ships to present vis-a-vis the original ship in the museum,
3) to provide an opportunity for training in the skills related to Viking shipbuilding and seamanship, and
4) to provide possibilities for a visual recording of scenes illustrating aspects of Viking crafts for presentation to the public.

The main principles of the experiment were also fixed before work was started:

The project was to be under the direction of a steering group chaired by the present author and comprising experts actively engaged in the study of various important aspects of the experiment, such as the building process, rig and trials (Søren Vadstrup, Erik Andersen and Max Vinner respectively).

The construction work was to be carried out by a group of young people with previous experience from other replica projects in Denmark, working at the Boat Yard of the Viking Ship Museum in Roskilde.

In principle, the same kind of materials, tools and techniques were to be used in the construction of the replica as in the original ship. Special studies were to be undertaken during the process to cast light on matters that could not be resolved on the basis of the evidence of the original find alone.

The ship was to be built to match the original ship at the time this was new, excluding later repairs.

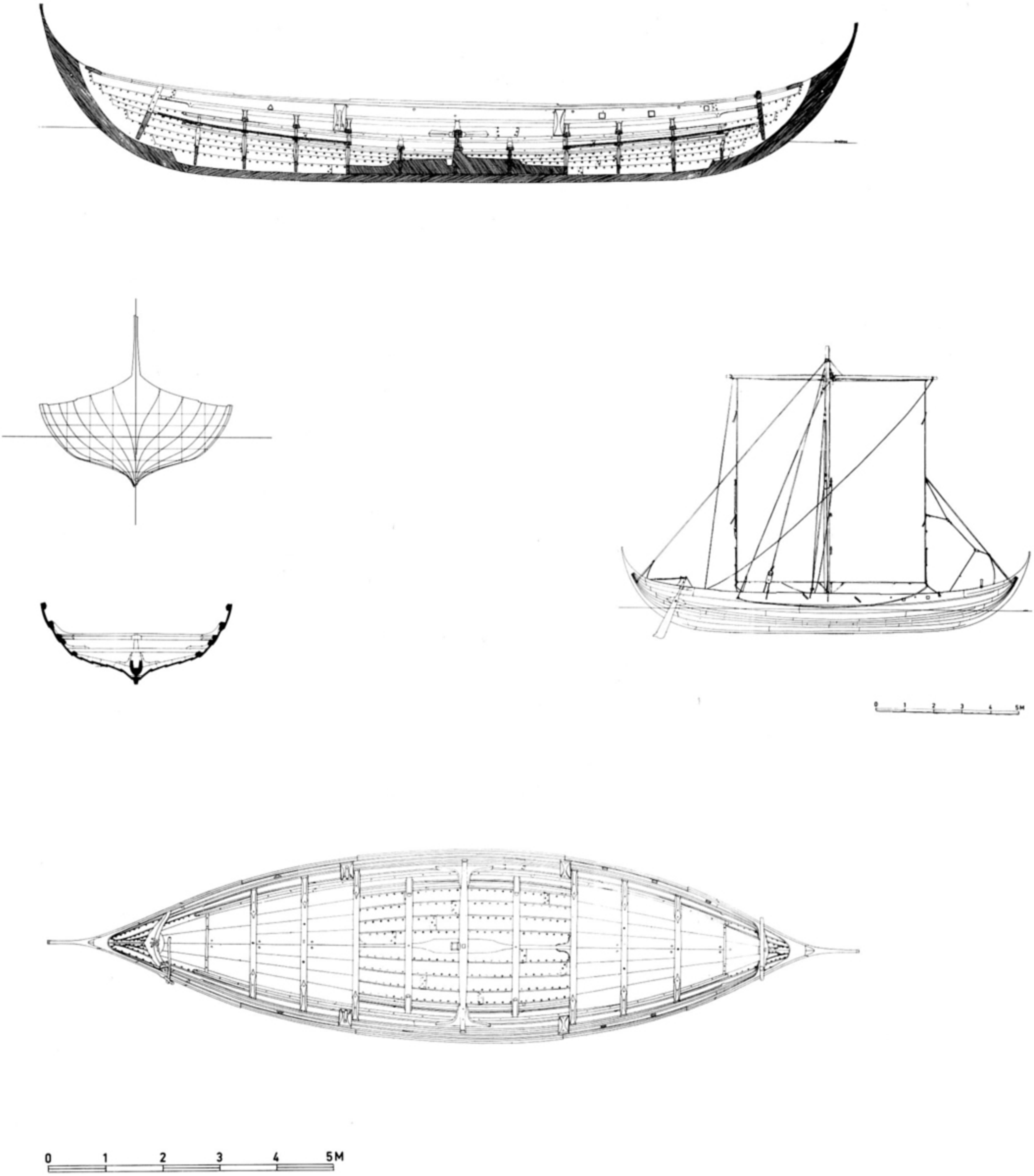

Fig. 4. Plans of the ROAR EGE based on the reconstruction of the Skuldelev 3-ship as built (prior to repairs).

Fig. 5. ROAR EGE under construction in Roskilde in October 1983. The bottom planks have been fitted and are held in position by sticks from below and stones from above.

Extensive systematic trials were to be undertaken after launching, based on the sailing technique practised over several years in the Nordland-boat RANA, belonging to the museum (Crumlin-Pedersen & Andersen 1980, Andersen & Gøthche 1981), and logged via a suitable data-recording system.

All phases of the work were to be recorded in writing, photos and film/video, to provide for the publication of a definitive report on the project as well as for exhibits, popular articles etc., and a film for the general public.

On the basis of a project-description outlining these aims and principles, the museum received a grant of 1.0 mill. D.kr. from the Velux Foundation. Work was started by October 1982 with the selection of the first trees to be felled for the keel and stemposts, and the manufacturing of tools for the job. By May 1983 the keel had been laid and stem and stern mounted. Bottom planking was ready by February 1984 and launching took place on August 25th 1984.

During the building period, members of the steering group prepared preliminary reports on studies in special subjects of importance for the project. These reports were typed and distributed as "ROAR Notes" to everybody participating in the project. Between November 1982 and June 1984 a total of 19 reports were issued, covering topics such as:

Documentation
Tools for shipbuilding
Selection and cleaving of oak
Reconstructing the shape of the hull
Keel, stem and stern
Tools and techniques for controlling hullshape
Iron-nails
Plank cutting and shaping
Building sequence
Rudder system
Mast and yard
Principles for trials

Trials were undertaken in 1984 and 1985 with a pilot rig of hemp for cordage and canvas of flax. In the course of these two years the ship has been under sail for c. 120 days, including seven weeks of intense trials. Rather

Fig. 6. Fitting topstrakes and beams in ROAR EGE in Roskilde in July 1984.

late in the season of 1985, the first trials with a wool sail were started, to be continued in 1986 and 1987. During this period the hemp-materials of the rigging will gradually be replaced by the materials most likely to have been used in the original ship, including walrus-hide, bast rope and withies.

In the course of 1985 and 1986 further "ROAR Notes" have been issued, reporting on work on various aspects of the project, and a good description of the practical work in the boatyard was published 1985 by Henrik Juel, a member of the building group (Juel 1985). The official detailed report on the first phase of the experiment 1982–85, the construction of the ship and the trials with the pilot rig, is being prepared for publication in 1987.

PRINCIPLES COMPARED

The SAGA SIGLAR and ROAR EGE have a common base in the fact that both ships have been built under the guidance of the shiparchaeologist responsible for the excavation, restoration and publication of the original ships. The studies undertaken in relation to the two ship-replicas should be seen as a stage in the preparations for the final publication of these two Skuldelev-ships. Thus the practical experiments with the replicas have been integrated in the archaeological analytical process, and a wider range of relevant evidence has been at hand for these projects than would have been the case if the replicas had been built in another context. It has been possible to include parallel material, such as finds from the Hedeby harbour and the Fribrødre shipyard site, which are at present under analysis prior to publication, as background evidence for tools and rigging.

For both ships, a complete set of tracings in scale 1:1 has been prepared from all surviving parts (Crumlin-Pedersen 1977). 1:10 versions of these drawings have served as the basis for work-models to determine the shape of the hull. Two models were built for Skuldelev 1 and three models for No. 3 in the process of establishing the original shape of the ships and eliminating repairs. In both cases sufficiently large portions of the

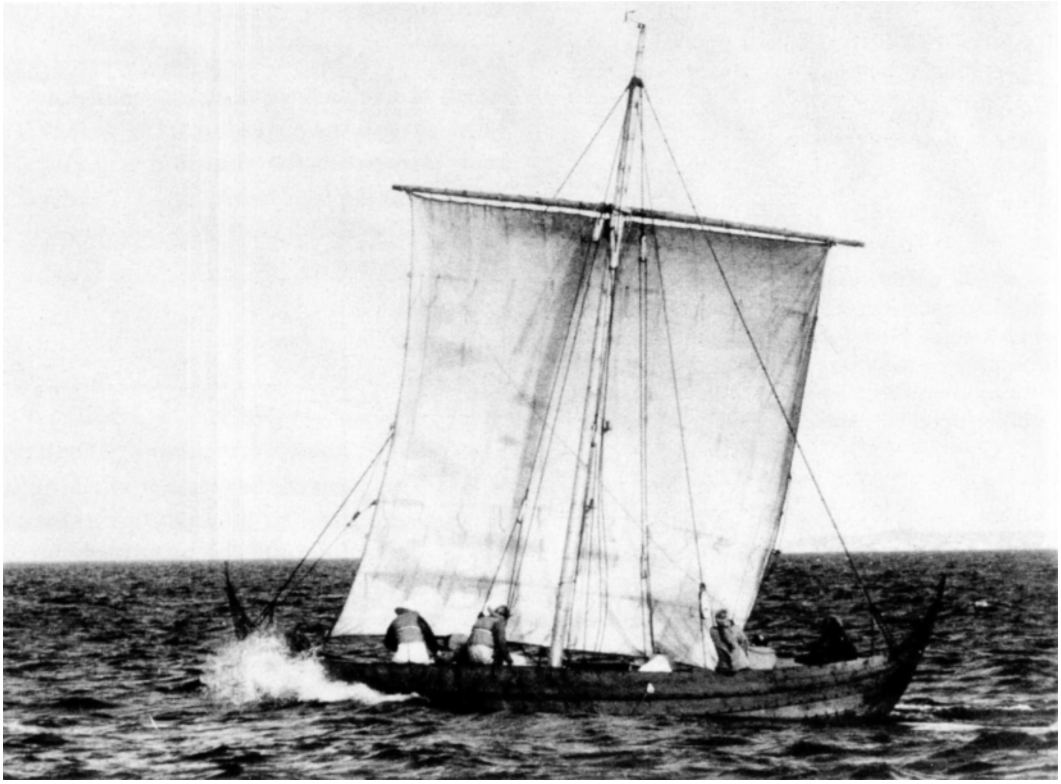

Fig. 7. ROAR EGE on sea-trials with a wool-sail in Isefjord, September 1985.

original ships have been preserved to make it possible to define all the basic elements in the ships as well as the overall dimensions within a margin of c. 0.2 m.

The steering arrangement was based on evidence from other finds, mainly Vorså (Crumlin-Pedersen 1960, 1966) and Fribrødre (Skamby Madsen 1984 A, B), and the concept of the balance between hull and sail, ballast and rudder followed that known from the square-rigged boats of Western Norway (Andersen 1986). Similarly, the sail and rig were reconstructed on the basis of extensive studies in relevant archaeological and ethnological material, including significant traces in the original ships of the way the rigging and sail were worked (Andersen i.p.).

The building materials were selected with the aid of the same criteria for both ships, – that they should represent the same qualities of wood as those employed in the original ship. Sigurd Bjørkedal found the trees for hullplanks, including some extraordinarily long and wide lengths of planking, as well as the grown timbers for knees etc. in the pine stands on his own land. The long lengths of oak for keel, stem and stern were imported from Denmark. In Skuldelev 1 some of the knees and beams are made of lime-tree. They were cut from pine for the replica, as no large stands of lime with such naturally grown shapes were available. In ROAR EGE the materials, oak for everything in the hull except treenails of willow and cleats of beech, were found after intense searching in the forests of Southern Denmark. Here the large straight-grained trunks needed for the radially split planks were very difficult to find because of the present forestry policy of growing oak in monocultures over a maximum of c. 200 years.

Thus far the basis for both replicas was very similar. But the building processes differed considerably. For ROAR EGE the planks were split and cut to shape with an axe. In this case the manual labour was unavoidable, as the radially split oak planks could only be made this way. The SAGA SIGLAR was built from sawn timber and the chain saw took over most of the work which the boatbuilder used to do by the axe until a few years ago. In this ship, whose original was built from tangentially split pine planks, this technique was acceptable, as the sawn planks had the same orientation in the trunk as

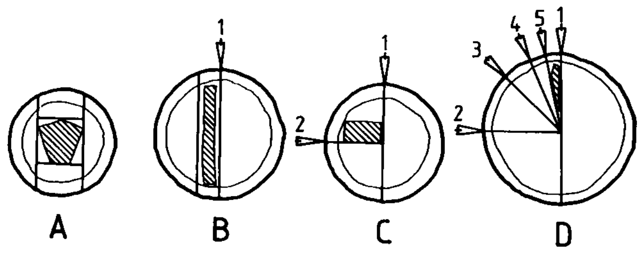

Fig. 8. Schematic representation of the four pricipal ways of working the elements for shipbuilding from a log in the Viking age. *A*: cut directly from the log or branch (for keel, stems, frames). *B*: log split in two, each half worked down to one element (for long, wide planks and stringers). *C*: log split in four, each quarter worked down to one element (for beams and stringers). *D*: radial splitting into "cloveboards" by repeated halving (for planks).

the original planks. Sigurd Bjørkedal and his two sons managed to build the hull of SAGA SIGLAR within a period of 6 months, whereas the building process for ROAR EGE took 22 months. This caused severe problems for the building team of ROAR EGE during the summer months, as the stemposts tended to warp and crack and the unfinished plank elements to dry out and harden unless they were stored in water.

The fact that SAGA SIGLAR has an engine with a propeller shaft through the sternpost makes navigation in narrow waters much easier than it was a thousand years ago, and it has been a precondition for the PR-activities of the ship in various harbours. On the other hand, the propeller gives a slight reduction in speed when going under sail. In this ship, modern anti-fouling bottom-paint was employed, whereas no such modern material has been used in ROAR EGE. This fact tends to influence the results of the trials, as the speed of ROAR EGE varies over the sailing season as a result of the varying effect of algae-growth on the bottom of the ship. This prompts considerations as to remedies for anti-fouling in the Viking Age and these should be searched for and studied in future shipfinds.

SOME OBSERVATIONS RELATED TO THE BUILDING PROCESS

Here a few examples will be given of some of the special studies which were undertaken during the initial stages of the ROAR Project (Crumlin-Pedersen 1986B, Wagner 1986).

Provision of timber

It was necessary to know the orientation in the tree-trunk of the various building elements of the ship in order to plan the provision of the timber. To begin with each element in the ship-find was classified as to its position in the tree-trunk. The 117 individual elements found in the Skuldelev 3-ship represented the following conditions (see fig. 8):

A: 24%
B: 8%
C: 16%
D: 52%

This reflects, however, the damaged and repaired shipwreck. The plans of the original planking as found (fig. 9), therefore, had to be analyzed to locate the repair planks and to identify the most probable positions for the original scarves for the plank-lengths in the ship as built. Thus a reconstruction of the original pattern of the planks, the strake diagram, including the missing stern part outlined on the basis of the models, could be drawn up (fig. 10).

When the maximum length/width of each of these planks is plotted in a graph, it is possible to identify groups of planks of similar length and width. In fig. 11 three groups of such planks are marked A–C, comprising all radially cloven planks in the hull of the replica. These groups may serve as a guideline for determining the number of logs needed for the hull planking.

Experience has shown that the radial cleaving of a log must follow the pattern shown in fig. 8D, where each section of the log is split in halves, leading in principle to a division in 4, 8, 16 or 32 parts of the same size and wedge-shaped cross-section. In practice we have experienced that splitting into 8 parts is relatively simple but that further splitting is critical for long lengths of planks. Instead of splitting purely radially into 1/16s a slightly different technique may be used which produces one broad and one slightly narrower plank out of each of the 8 basic elements. Thus we should expect to get a maximum of 16 planks out of each log.

Now we may investigate if the boxes A, B and C in fig. 11 are likely to represent the three oak-logs needed for providing the cloveboards for the planking:

Group A represents 4 planks c. 0.4 m wide, and 8 planks c. 0.3 m wide, with a length of 4.6–5.8 m.

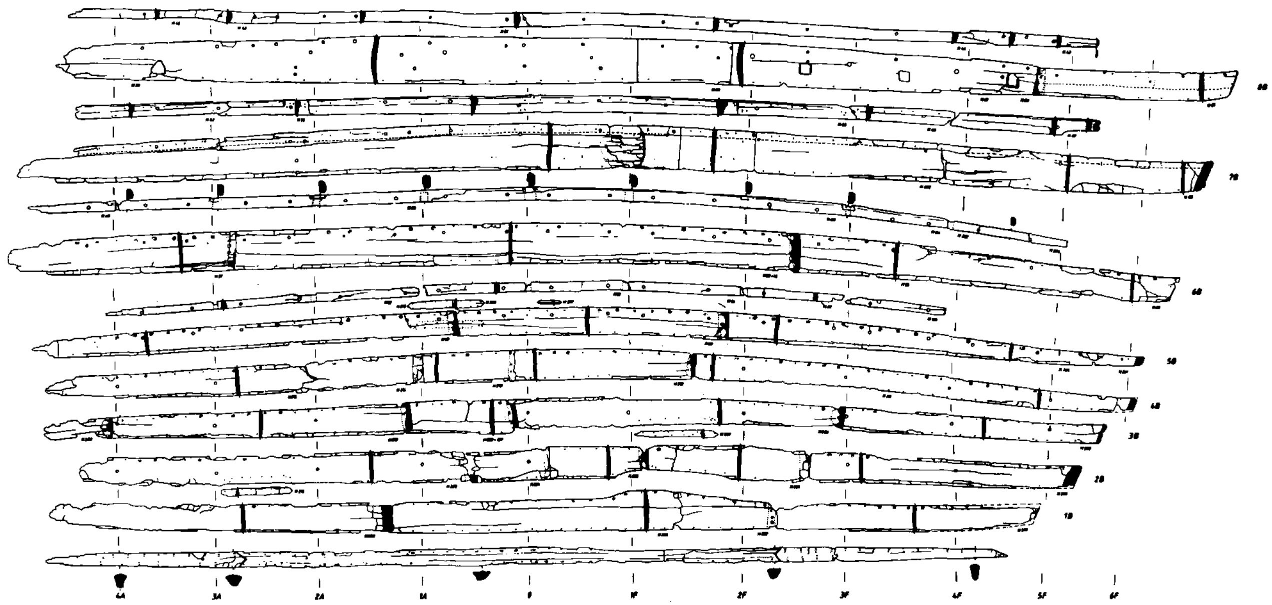

Fig. 9. Port-side planking of Skuldelev-3 as found, showing repairs and missing stern end.

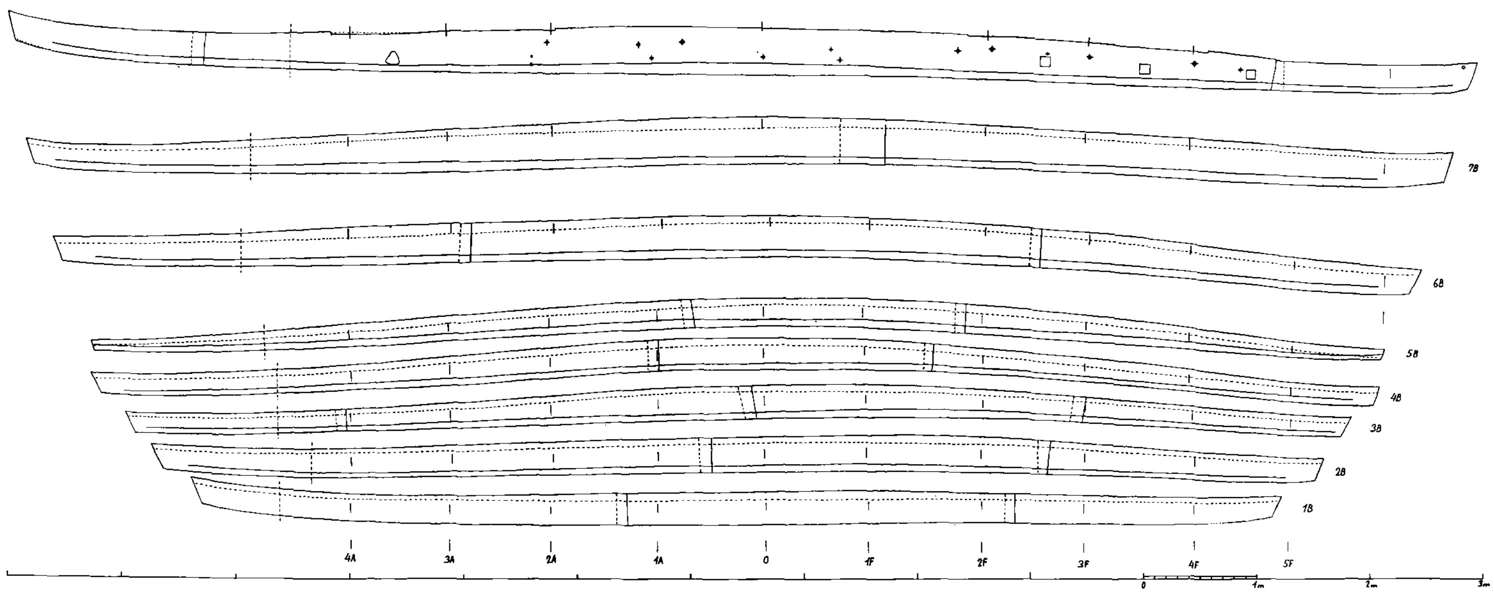

Fig. 10. Strake diagramme prepared for port-side planking of ROAR EGE, after analysis of scarf pattern, lines of afterbody etc. in Skuldelev-3 as built (cf. fig. 9).

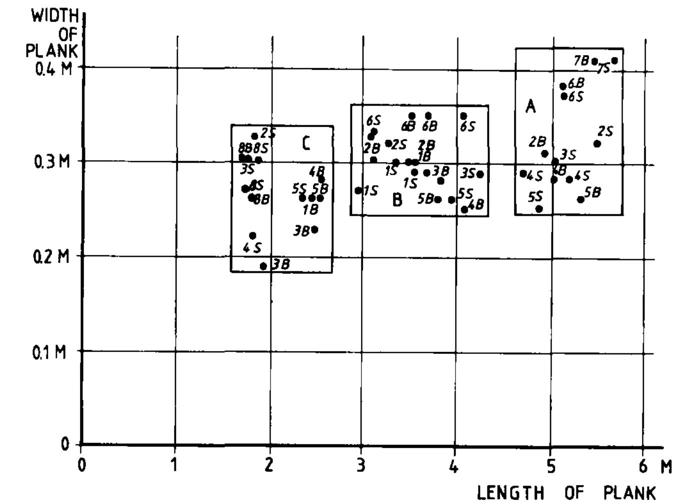

Fig. 11. Graph showing all radially split planks in the planking of Skuldelev-3 as built (cf. fig. 10), plotted according to length and width of planks.

Group B represents 4 planks c. 0.35 m wide, and 14 planks c. 0.3 m wide, with a length of 2.9–4.3 m.

Group C represents 13 planks c. 0.2–0.3 m wide, with a length of 1.7–2.6 m.

It makes good sense to look upon each of the groups as representing one log, except that the four planks in group B should be transferred to group A.

Thus the largest log would need to have a minimum length of c. 6 m and a diameter of 1.1–1.2 m to provide 8 wide planks (34–41 cm) up to 5.8 m in length and 8 planks of normal width (25–33 cm) of a length of 4.7–5.5 m. The remaining 14+13 planks should then be obtained by splitting two further logs, 4.5 and 2.6 m long and 0.9–1.0 m in diameter, into 18 parts each.

We searched for oak-stands with straight and knot-free trees of these dimensions. As a result of an initial lack of experience in selecting logs without spiral growth or internal defects, however, we had to fell more than three trees for the clove-boards of the ship. Quite evidently it is extremely difficult to find logs of the dimensions and quality needed for even such a small ship in the present-day Danish forests.

This gives rise to some questions about the provision of materials for the intense shipbuilding activities of the Viking Age. There are in fact indications of the recycling of shipbuilding materials in the 11th century (Crumlin-Pedersen 1968, 143f, 1986B, 50, Skamby Madsen 1984A, B) and of a later decrease in the average length and width of the planks if those of the Skuldelev 3-ship are compared with the planks of the mid-12th century Lynæs ship (Crumlin-Pedersen 1986B, fig. 8). On the other hand, certain ships show their high prestige value not only in their exquisite workmanship but also by the fact that extraordinarily high quality materials have been used in them, such as the up to 10 m long lengths of radially split planks in the 11th-century warship Hedeby 1 (Crumlin-Pedersen 1969, Schietzel & Crumlin-Pedersen 1980).

Shaping the stempost

The elegant shape of the stempost of Skuldelev 3 showed up clearly during excavation and later (fig. 12). Now it was necessary to take a closer look at this element in order to approach the question of how the Viking-Age shipbuilder determined the shape of this important part of the ship. Various loose stemposts found in bogs, especially in Norway, indicate that the Viking boatbuilder cut such elements to shape and stored these in water prior to construction. One of these stemposts, found on the island of Eigg in Scotland (Shetelig 1940, 179–80), is a very close though smaller parallel to Skuldelev 3 (fig. 13). This stem had been cut to final shape, including the curved lines along the sides and the steps for the planking, before being laid down in the water. It is evident that the stem had not been taken out of an old boat, as the scarves for the keel and plank-ends had not been cut, and no holes for fastenings were present.

Thus we had to accept the idea that the stemposts, even those of Skuldelev 3, were cut to their final shape as one of the very first jobs undertaken by the boatbuilder when constructing the vessel. But how could he design this complicated element, which is the key to the overall lines, the height of the ship's sides etc., in advance without having drawings at hand? And there are certainly no indications that construction drawings were used in Viking or Medieval shipbuilding in Scandinavia.

The most reasonable answer to this question seemed to be to assume that the boatbuilder had worked from a set of rules-of-thumb as known from recent boatbuilding practice. Here the concept of the boat is usually firmly based on traditions of shape and lines, and the scantlings of the actual vessel to be built are

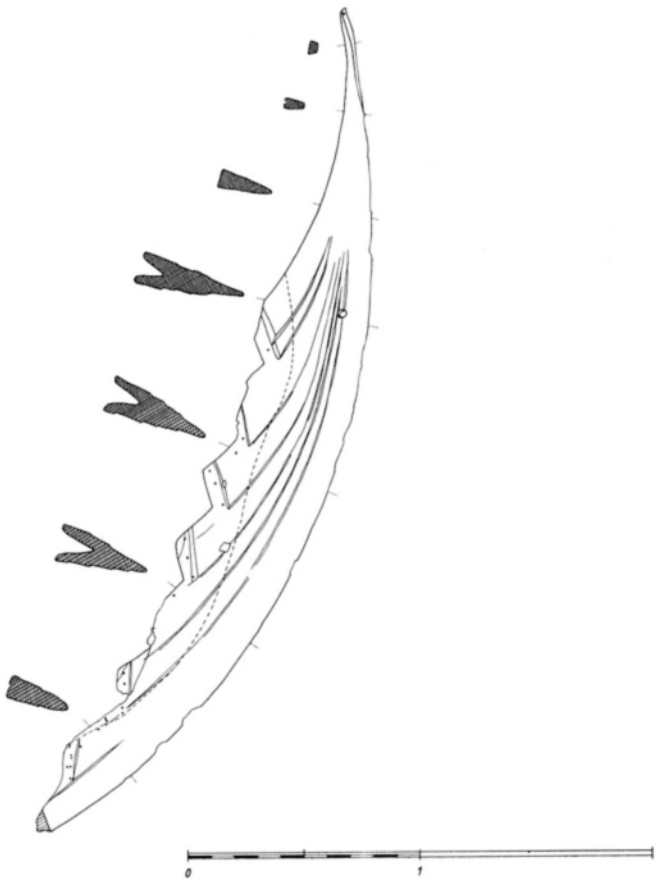

Fig. 12. The stempost of Skuldelev-3 as found.

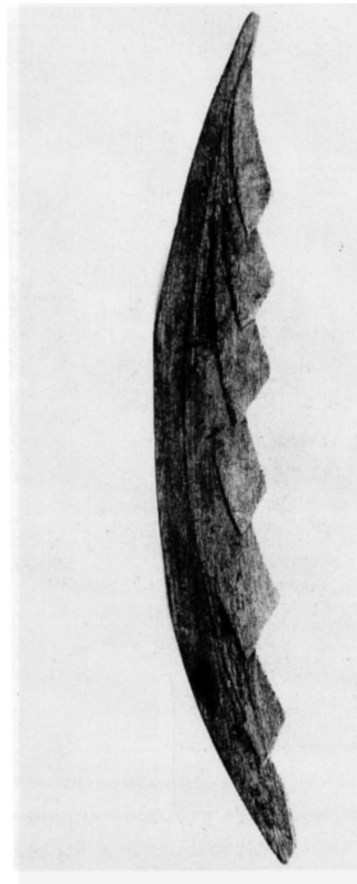

Fig. 13. Stem piece, 1,93 m in length, found in a bog on the island of Eigg in Scotland. Photo National Museum of Antiquities of Scotland.

based on proportions determined from, for example, the dimensions of the keel.

The shape of the stem was therefore analyzed to see if it was possible to describe it in simple geometrical figures to be drawn up with the aid of a string and a piece of chalk, i.e. straight lines and circles. The result of this investigation was most interesting (fig. 14). It showed that the curved lines on the stem were segments of circles, and that those following the edges of the stem were interrelated in length of radius og position of centre, with a small excentricity at the tip of the stem.

The radii of these circles are 6.0 m and 3.0 m. The upper curvature has a radius of 1.55 m, and the divergence of the tip has been achieved by shifting the centre of the upper curve 5 cm away from the midpoint of the line connecting the intersection of the 3 m and 6 m curves with the 3 m centre. Only after having observed this interrelationship did we notice that the keellength of the ship is 9.0 m.

These observations of the sequence 9–6–3–1.5 m strongly support the assumption that the boatbuilder did in fact work from a set of rules-of-thumb when constructing this ship in the late Viking age. We have probably only traced a very few of his rules, and we do not even know his units of measurement with certainty. The sequence points to units of 25, 30 or 50 cm in length, indicating a hypothenical foot of 25 or 30 cm or an "alen" of 50 cm.

In the boatyard it was easy to trace out the stem according to these principles. Here the difficulties once again lay in the provision of tree-trunks of the right shape, size and quality. In addition, the stem dried out, cracked and warped in the sun to such a degree that it

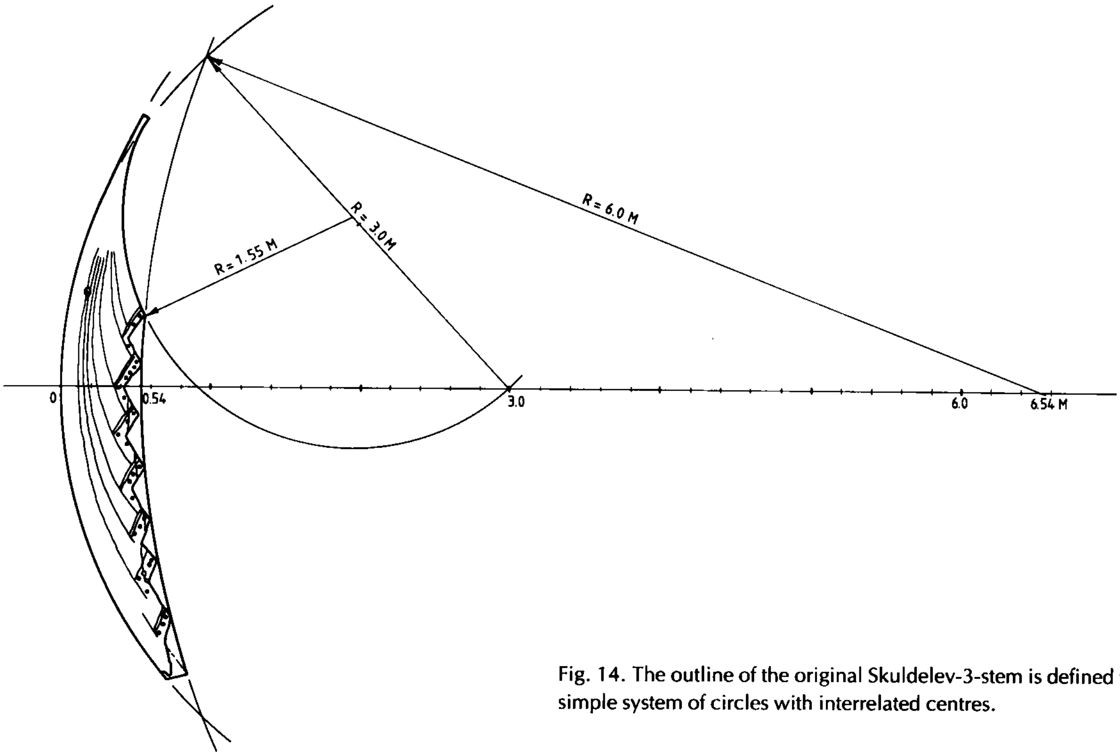

Fig. 14. The outline of the original Skuldelev-3-stem is defined within a simple system of circles with interrelated centres.

caused severe problems. This indicates to us that the stems found in the bog were probably stored there in order to stabilize the wood rather than for other purposes. A prolonged water bath, preferably in a stream, is still used in Japan to wash out some of the sap of oakwood to stabilize it against changes in humidity (Suenson 1922, 92).

This analysis of the stempost would probably not have been undertaken if it had not been needed for the construction of the replica. A similar analysis may be carried out of other well preserved shipfinds, and they will probably show different proportions between keel-length and radii for the stem-circles, as these relations are bound to vary in ships built for different purposes.

This example illustrates that with Skuldelev 3 we can come into close contact with some of the underlying design principles. The raison d'être for such principles is to guide the boatbuilder in the construction of several ships of roughly the same type and size, and it is therefore permissible to look upon this ship as a representative of an established shipttype rather than as a unique, individual vessel. Further steps along these lines can be taken by studying other elements in this ship and by comparing it with the other ships in the Skuldelev find, taking repairs etc. into consideration.

Axe-work

The tools and techniques used in the past for a specific construction process may be studied with the aid of archaeological finds of

the tools
the finished products,
the semi-manufactured products, or
the debris of the manufacturing process.

The study may even include an analysis of

contemporary written sources,
contemporary iconographic evidence,
possible ethnological/ethnographical parallels
and the evidence from archaeological experiments.

In the ROAR Project all these potential sources of information were kept in mind, even if they were not all analyzed in detail in each case. The most important non-archaeological source for us was the Bayeux Tapestry, which depicts the shipbuilding scene on the shores of Normandy prior to William's conquest of

England in 1066. The archaeological evidence was primarily drawn from the Skuldelev-, Hedeby- and Fribrødre-finds.

We shall here consider one aspect of the shipbuilding process, the transformation of the radially split plank elements, the cloveboards, into ship's planks of individual size and cross-section.

For this task the building team of previous Danish ship replicas had used copies of the broad adze from the Mästermyr find from Gotland (Arvidsson & Berg 1983). This was in good accordance with the recent tradition for using the adze as a shipbuilder's tool for trimming the shape of frames, planks etc. in carvel built ships. But the planks cut with this tool differed in character from the original planks. These are neither plane nor parallel-sided, as they would have been if they had been sawn. They are generally slightly thicker in the middle than along the edges and their cross-section has been shaped to fit hullshape – with an inner face which is convex for the lower planks and concave for the upper planks, and vice versa for the outside.

Because of the nature of the stroke of the adze from a position at right angles to the plank it is relatively easy to cut the hollow sides of the planks with this tool but difficult to avoid making the convex or plane side of the plank hollow too. Thus the planks of the other replicas tend to be thinner along the middle instead of thicker, when cut with the adze.

In addition, the tool-marks to be seen on the planks of e.g. Skuldelev 3 (fig. 15) had a different character from those left by the adze. Evidently some type of axe with the cutting edge parallel, or almost so, to the handle would be a more appropriate tool to use in order to imitate the original work process.

On the Bayeux Tapestry two axe types are shown in use for the felling of trees and the cutting of planks for William's invasion fleet. The ordinary axe with a long handle is shown in three cases in use for felling the trees and possibly for the first stages of splitting and cutting the planks (fig. 16). A very different axe, with a short handle and a broad curved cutting edge, is also shown three times (fig. 17). This is evidently the shipbuilder's tool par excellence for it is shown in the hand of the master-shipbuilder, who is seen receiving orders from Duke William to build the ships for the invasion fleet. Then a man straddles a cloveboard and dresses the side of it to fit one of the ships with the aid of this broadaxe. Finally in one of the ships a man with a broadaxe in his hand is communicating with another person standing outside the ship who is fairing the lines by eye.

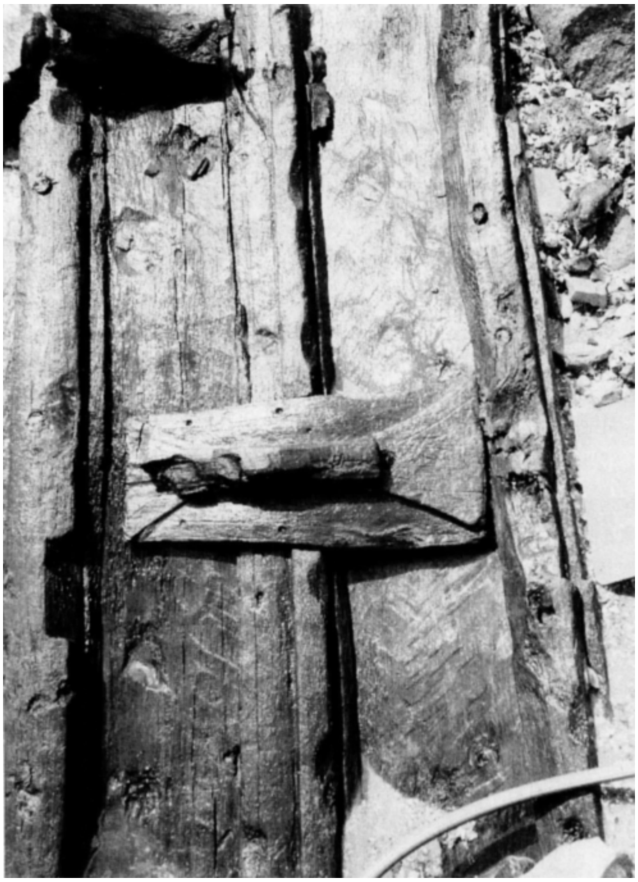

Fig. 15: Axe-marks on the inside of the planking of Skuldelev-3. Photo taken during excavation 1962.

These scenes indicate a light broadaxe with an offset or curved handle as the tool we were looking for. A broken broadaxe of this nature has been found in an 11th-century pit in London (Schofield & Dyson 1980, 40). In this case the straight handle could be shifted from one side to the other by moving an iron wedge in the shaft-hole. Nevertheless, neither this find nor the illustrations on the Bayeux Tapestry proves the existence of such an axe in late Viking-age Scandinavia; it might have been used only in Western Europe.

The Scandinavian axe-finds have not been studied in detail by us, as with axes found without a handle it is not usually possible on the basis of publications to distinguish between battle-axes and work-axes.

During the harbour excavations in Hedeby 1979-80,

Fig. 16: Long-handled axes used for the felling of trees for William's invasion fleet in 1066. From the Bayeux Tapestry.

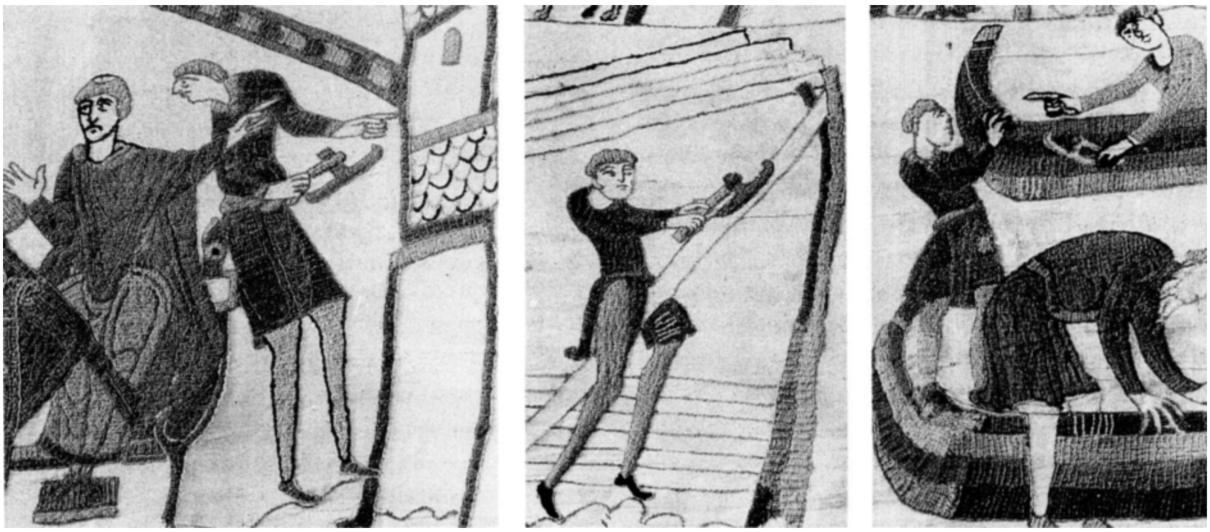

Fig. 17. The short-handled broadaxe is shown in the Bayeux Tapestry in the hands of shipbuilders: 1) receiving orders for the construction of the fleet, 2) dressing the sides of the cloveboards for planking and 3) adjusting the sheerline of one of the ships.

however, Kurt Schietzel spotted a very special axe-head among the tools and weapons found in the harbour. He provided us with a cast, which showed clearly that this axe had only been sharpened from one side and that the shaft-hole was pointing slightly to the same side (fig. 18). Here was definite evidence in a clear Viking context of a specialized woodworker's tool of the kind shown in the Bayeux Tapestry.

A blacksmith provided us with a number of working copies of this light broadaxe, which has proved its value as a handy and efficient tool for dressing the sides of the planks to achieve the correct cross-sections as well as toolmarks of the same nature as those observed on the original planks.

In this case the experimental work guided us on to a search for a specialized tool which was eventually found. The particular features of the Hedeby broadaxe, demonstrating its nature as a woodworking tool, are

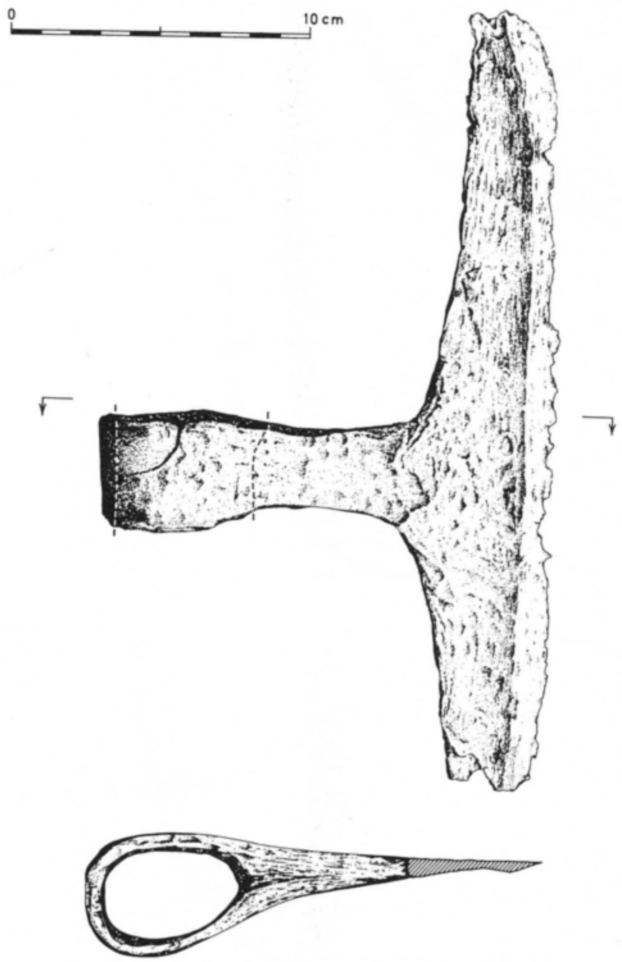

Fig. 18. The broadaxe found in the harbour at Hedeby in 1979. Drawn by W. Karrasch.

clearly to be seen on both the original axe and the cast. But on a standard two-dimensional photo or drawing these features may well remain hidden. Therefore studies of this kind must be based on firsthand evidence. It should also be noted that the wooden chips and shavings left over on the construction site of a woodworking craftsman may, after systematic analysis, offer a good clue to the nature of his activities.

PRELIMINARY ASSESSMENT OF THE RESULTS

The construction of SAGA SIGLAR at Sigurd Bjørkedal's yard gave rise to few questions. He handled the building of the ship with a splendid combination of old traditions and modern tools, and he solved the problems arising during the process before we even realized that there was a problem. Thus the ship itself, and not much more, was the result of this work.

With the ROAR EGE conditions were very different. The prolonged building period was needed to deal with the many problems arising out of the process. Here a few of these aspects have been presented and discussed, and the value of such an approach to the archaeological evidence has, I hope, been demonstrated.

The complex problems of sail and rigging have not been described here. Even though there has not been as much evidence to build upon for the rigging as for the construction of the hull, we feel that we are on relatively safe ground, even with such complex arrangements as the tack in Skuldelev 1. This subject is still under investigation, however, and the results will be reported at a later date.

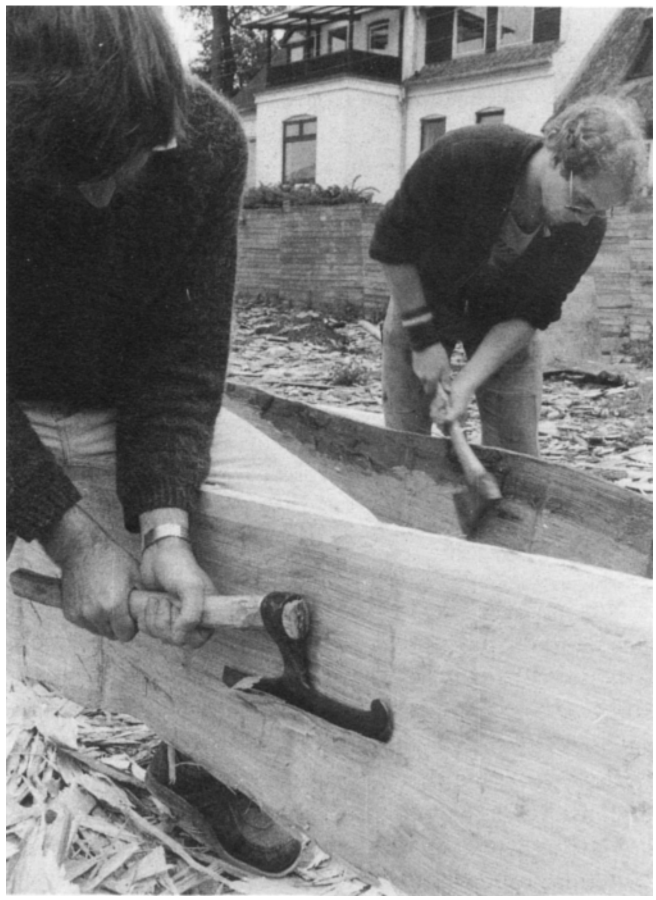

Fig. 19. A replica of the Hedeby broadaxe in use in the ROAR Project.

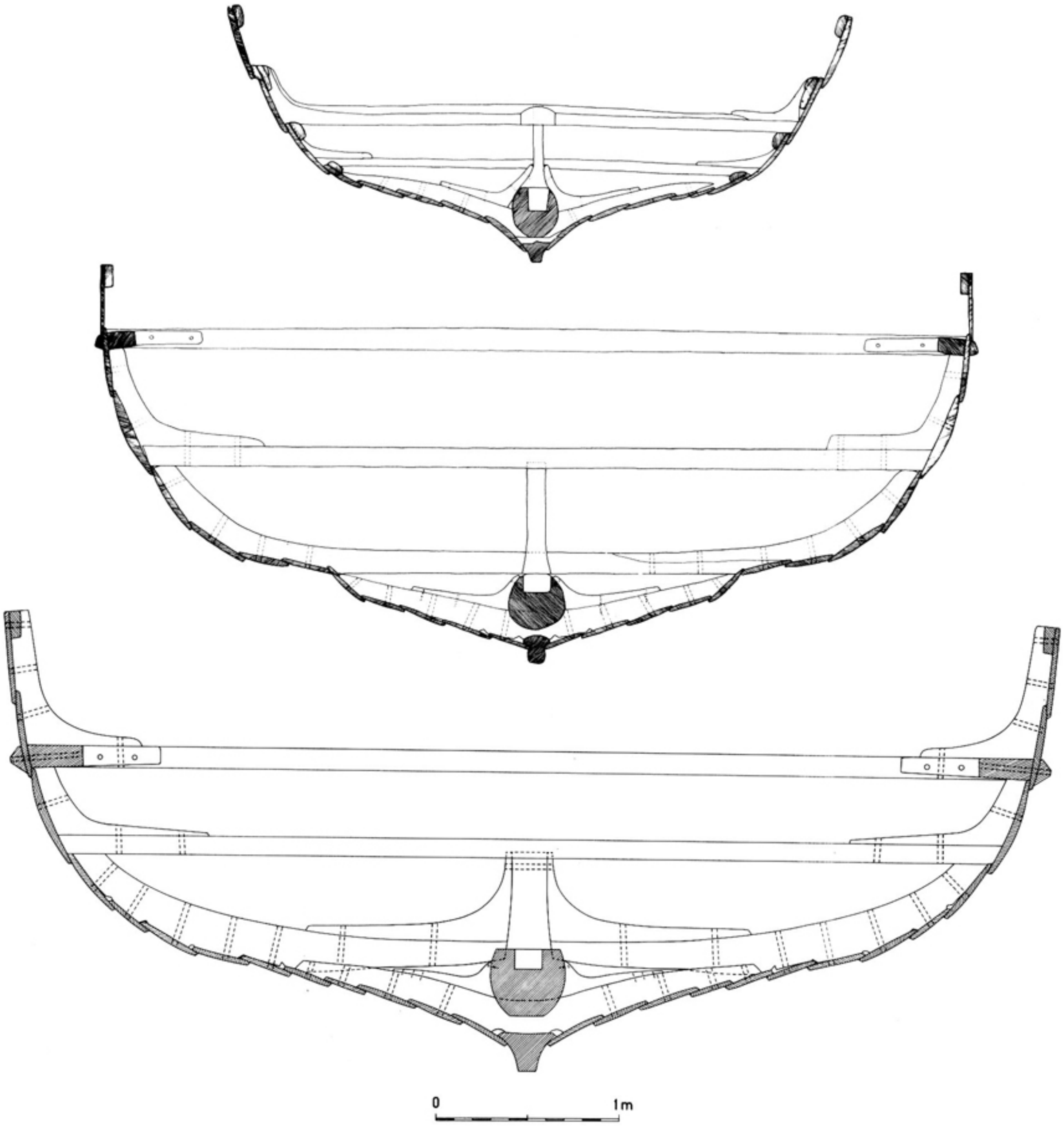

Fig. 20. Cross-section amidships of the late-Viking-age cargoships Skuldelev-3, Skuldelev-1 and Hedeby-3.

Nor have the trials of the two ships yet been brought to an end. Both ships, however, sail very well under all conditions in comparison with the standards of other ships of the age of sail. They do not match modern yachts in their extreme ability to tack against the wind but, on the other hand, few if any of these yachts can match a Viking ship in beaching on an open coast.

Starting from the "load-line regulation" given in the 13th-century Icelandic *Grágás*-text, the cargo capacities of Skuldelev 1 and 3 have been calculated at c. 24 tons and c. 5 tons respectively, corresponding to a payload of 4 tons and 1 ton per crew-member in the two ships (Crumlin-Pedersen 1985B, 84–85). These figures are related to a free-board of 2/5 of the total height of the ship amidships. Trials with the two ship-replicas indicate that this *Grágás*-rulse may relate to a rather unsafe loading tradition by today's standards, but one well known from the 19th-century Norwegian coastal jekts. A safe loading condition for the Skuldelev 1 and 3 ships in the open sea at wind-speeds above 10 m/sec.

is rather to be found with cargoes of 16 tons and 4.5 tons respectively. Even with these figures the capacity of Skuldelev 1 indicates a pattern of trade in the late Viking age involving commodities of large bulk and relatively low value.

Further support for this idea is supplied by the recent find in the harbour at Hedeby of a wreck similar to Skuldelev 1 but much larger. Only parts of the ship have been recovered but sufficient to establish the cross-section amidships (fig. 20), and measurements made by the divers indicate an overall-lenght of c. 25 m. A conservative estimate would suggest that this ship carried c. 38 tons of cargo at a *Grágás*-freeboard (Crumlin-Pedersen 1985B, 87). The ship has been dated by its context to the late Viking age.

Thus we have very solid evidence of late-Viking-age ships carrying shiploads of c. 16,–20,000 kg and c. 35,–40,000 kg respectively per voyage. I shall leave it to other archaeologists to consider the nature of the goods in these shiploads but on the basis of the experiments with SAGA SIGLAR and ROAR EGE I can confirm that these vessels were well suited for their purposes, being well built and seaworthy to standards which have hardly ever been surpassed by other undecked vessels in the entire age of sail.

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Debate

Where did all the Hunters go?

An Assessment of an Epoch-Making Episode in Danish Prehistory

by TORSTEN MADSEN

Traditionally, the explanation of culture change within European archaeology, and hence Danish archaeology, has been a dichotomy between slow, internal cultural development, and abrupt cultural breaks caused by migrations of people. Some scholars systematically used invations to explain any change that looked abrupt in the archaeological record. Thus Brøndsted (1962: 491) claimed no less than 10 invations in Danish prehistory. Others tried, and still try, to create transition phases to explain the changes as internal development.

The question that should be asked today is, whether abrupt change cannot take place where invations of people did not occur, or were negligible? Indeed, cannot abrupt breaks in the cultural record be caused by slow, ordinary, everyday changes in local society? Increasingly, scolars have begun to believe this quite possible and even uncontroversal (Friedman 1982, Renfrew 1978, 1979, Renfrew and Poston 1979, Zeeman 1982). In doing so they draw heavily on recent trends in Natural Sciences that allow for sudden breaks in a continuous development, called a catastrophe, caused by the interplay of ordinary, well defined, continuous variables. As expressed by Zeeman:

> By the word catastrophe in this context we mean some discontinuity in the structure of society brought about by gradually changing circumstances. At first sight it is not clear why gradually changing circumstances should produce a discontinuous effect – indeed it violates the intuition, since continuous causes normally produce continuous effects. However, there has been a considerable advance in the mathematical understanding of such phenomena during the last decade, and the method of modeling them is called catastrophe theory. (1982: 316).

Catastrophe theory is foremost used in the study of biological evolution, where it supplements the more traditional systems theory, but it is also applied to the study of thermodynamics and the life cycles of the universe.

The application of catastrophe theory on the development of sociocultural systems is not straightforward and uncomplicated. Of course it is not difficult to conceive of a society drifting towards some impending "abyss" (recent political jargon in Denmark), with the individuals in that society aware, yet apparently powerless to prevent it. But it is very difficult to imagine how, if at all, such a society can switch over and restructure itself in a completely new way, as would be assumed from the application of catastrophe theory. We could speak in terms of a revolution, of the decision making capability of human beings, of mans free will, etc., but that would only serve to cover up for a profound lack in understanding of the nature of the human elements in such a process.

Another point to make is that the archaeological record cannot be taken to represent the knowledge and possible choices present in a society. It merely reflects its habitual and chosen ways. This implies that a vast amount of ideas and factual knowledge may be latently present, but perhaps never used, as it cannot be fitted into the established ways of the society. We may speak of an "information bank" (expression coined by Binford in another context (1983: 208)) that plays only a small role in the everyday life of a smoothly operating society, but which in case of malfunction or inflicted change may play a vital role in the subsequent restructuring of society.

Much of the knowledge in this "bank" stemed from the life experience of the members of the society themselves, obtained within their own cultural setting. Other parts of the "information bank" definitely came from contacts with other societies. Very often we can acknowledge these contacts through the spread of artifacts (whether as exchange goods, or copies of such goods), but very seldom we are given even the faintest clue as to what knowledge and what ideas were communicated through these exchange networks. Only occasionally, during periods of change and restructuring of society, may these ideas surface, and all of a sudden we may find ourselves confronted with phenomena that have no visible internal background, but for which we may indeed find parallels quite far away.

A third point to make, concerns the conditions for a change from the life way of the hunter-gatherers to that of the farmers. Some years ago it was established that the life of hunter-gatherers is not a harsh one. Indeed, it sems to be a far more easy going one than that of the farmers (Binford 1968: 328, Flannery 1969: 75–76, Cohen 1977: 140). Hence, it was considered necessary to establish a reasoning as to why at all a change from hunter-gatherer to farmer took place. And not only in the first place, but also in the following sequential spread of farming.

This "Garden of Eden" argument, as Binford termed it in a later critical assessment of his own and others writings (1983: 199), makes the origin and spread of agriculture very difficult to understand, and it has been used to explain why some hunter-gatherer societies lingered on for many centuries in potentially very good agricultural areas, opposing the "threats" of farming.

Most of the "Garden of Eden" argumentation is held within a systemic approach to culture, where the principle of homeostasis is the crucial element of system control. This makes explanation of abrupt change extremely difficult, and it calls for a cause external to the system, and hence beyond its control, to inflict the change. The cause preferred by most scholars in connection with the introduction of agriculture has been population pressure, either directly through uncontroled population growth, or indirectly through some unforeseen event like a change in the natural environment, creating a drop in the amount of food available.

Personally, I do find the ideas of general systems theory very useful when dealing with cultural systems, but if we are going to use systems theory for more than descriptions of, and explanations within basically stable cultural systems, and indeed if we try to incorporate catastrophe theory, we have to allow for other ways of looking at maintenance of stability than the homeostatic model. We could for instance accept a model of homeorhesis, which is a stability of directional change. That is, we allow for a directional change of the system, and yet maintain stability around the trajectory of change (Friedman 1982: 177). Indeed we may go as far as saying that many systems cannot be stable unless they change. An ultimate condition of system stability can thus be a directional change within the system that keeps it in constant nonequilibrium. This model gives us quite different possibilities of dealing with change within a systems theory framework, as the system may be attributed dynamic elements in its own right.

Returning to the "Garden of Eden" argument, we may now realize that the problem is falsly stated. The claim is that hunter-gatherers live a secure life, and that stable equilibrium is the hallmark of their cultural system. Hence a change to a farming system is a paradox that needs an external cause to explain it. The flaw is the acceptance of cultural systems as unvariably regulated by homeostasis in order to maintain equilibrium. The way around the problem is to realize that important parts of the system, especially within the social sphere, need not be homeostatically controled, but can be homeorhetically controled. Change is then an inherent part of the system, and not something to be inflicted upon it.

Abrupt change is this connection is only a special condition of the general pattern of change. It occurs when a treshold of some kind is created by the interplay of various factors, including elements inherent to the system, historical events, and regionally determined differencies. A sudden abrupt change is thus basically a historical event that given the time and the place can be understood in terms of the operations of the system itself in its total cultural setting.

REVIEW OF OPINIONS

The research on the origin of agriculture in South Scandinavia was for long completely side-tracked by the opinion that the Late Mesolithic Ertebølle Culture (EBK) and the Early Neolithic Funnel Beaker Culture (TRB) ran parallel for a considerable period of time. It was a perception reached and "proved" by archaeology and by natural science during the thirties and early fourties (Becker 1939, Iversen 1937, Jessen 1937, Mathiassen 1940, Rydbeck 1928; 1930; 1938, Troels-Smith 1937; 1943), and it was firmly maintained into the sixties (Becker 1948: 75; 1954: 124; 1955: 79, Brøndsted 1957: 161; 1962: 103), although Troels-Smith complicated the issue somewhat by speaking of a part of the TRB evolved from the EBK (and considered by him to be EBK), and another part of the TRB as invaded (1953). No proper discussion as to the origin of agriculture was possible under these circumstances. Agriculture simply had to be the result of an invasion. Only when it was realized from a new evaluation of the archaeological material (Skaarup 1973a), and foremost from the rising number of C-14 dates available (Skaarup 1973b, Tauber 1972, Pape 1979: 24) that the TRB followed the EBK, a basis for a renewed and more qualified discussion was reached.

Two of the Old-timers in the discussions have maintained their points of view unchanged. Becker still hold an invaded TRB population responsible for the beginning of agriculture in Denmark (1973), and Troels-Smith still refers to a late EBK of a semiagrarian type as well as a contemporary invaded neolithic culture (1982).

All other authors with a research base in South Scandinavia, and who have delt with the problem since the beginning of the seventies, have more or less clearly expressed the opinion that it was the EBK that through a shorter or longer period of time, and with greater or minor influences from the south was transformed into the TRB (Andersen 1973; 1981: 154, Fischer 1982, Horwitz 1973, Jarman et al. 1982: 81, Jennbert 1984; 1985, Jennbert Spång 1982, Jensen 1979: 52, Madsen and Petersen 1984: 103, Mahler et al. 1983: 58, Nielsen 1981: 13; 1985, Paludan-Müller 1978, Rowley-Conwy 1983; 1984; 1985, Zvelebil and Rowley-Conwy 1984).

Naturally, all these authors do not share the same view on how the transition took place, and what caused it. Yet, on two points there is a high degree of mutual agreement. Almost everyone accepts that the transition can be understood as a continuous one. This is first of all true with Jennbert (1984; 1985 and Jennbert Spång 1982), who tries to demonstrate archaeologically the gradual change in the Scanian material. Others like Mahler et al. (1983) and Paludan-Müller (1978) implicitly assumes a gradual change without actually trying to demonstrate it. Others again acknowledge a very quick transition, but maintains that it was of a continuous nature (Rowley-Conwy 1983; 1984; 1985, Zvelebil and Rowley-Conwy 1984).

The other point of considerable mutual agreement concerns surprisingly enough the reason for the change. Almost all authors end up with population pressure as the ultimate cause. The influence from "new archaeology" and the "systemic view" of culture certainly can be felt here.

In agreement with the normally held position in New Archaeology since Binfords "Post-Pleistocene Adaptations" (1968), population pressure is not taken to be a direct cause. Population size is considered to be a factor that is fully controled by homeostatic mechanisms in the system. This means that population pressure cannot arise by itself. Some unexpected change in the equilibrium level of the system has to take place, and take the system aback, so to speak. Thus almost all the explanations using population pressure, do not refer to this cause directly, but argue by the help of some unforeseen event or sequence of events.

Some authors points to an assumed drop in biomass during the Atlantic period (Andersen 1973; 1981: 154, Jensen 1979: 52), others to the change in climate between the Atlantic and the Subboreal periods (Jarman et al. 1982: 81, Rowley-Conwy 1983; 1984; 1985, Zvelebil and Rowley-Conwy 1984), as elements that caused an instability between population level and available food, and hence kicked the society into a change.

Others again used Binfords (1968) much more complex, but indeed very elegant model, of an interplay between "Open Donor Type Systems" in optimal settings, and "Open Recipient Type Systems" in marginal settings. The dynamics in this model is created by the budding off of groups of people from the donor systems to the recipient systems. Due to their marginal settings the latter very quickly ends up with population pressure. Thus change takes place in the open recipient systems of marginal areas, and not in the optimal key areas. Such a model is used very directly by Paludan-Müller (1978).

A few (Mahler et al. 1983: 77) leaves the neo-positivist jargon behind in preference of a more modal, marxist one. It is difficult, however, to find much renewal in their actual explanation of the transition. They claim that an imbalance between population level and food resources created a growing sedentism based on seasonal resources (fish) that could be stored. The sedentism, then, resulted in a growing population, whose demands for food led to a perfection of the catching and storing technology, so that more fish could be "harvested". Subsequently, this development led to a depletion (over-fishing) of resources. The only possible answer to this was to adopt agriculture. In spite of the authors claim of a truer view of prehistoric changes, it is difficult to see that this proposition is basically different from those that they critisize.

The "New Archaeology" with its functional, systemic view of culture, then, certainly have had a marked impact on South Scandinavian archaeology, at least where the explanation of the advent of agriculture is concerned. Recently, however, a few alternative types of explanations have also been published.

Jennbert (1984; 1985 and Jennbert Spång 1982) does not use population pressure, or any other such type of conflict. Her explanation is based on the exchange relationships between the late EBK and the neolithic cultures of Central Europe. She considers grain and domestic animals to be part of the prestige, exchange network, and the first tender use of domesticates to be no more than a prestige undertaking. Domesticates would then slowly gain in importance, until, after many generations, they dominated the economy. An adjustment of the social institutions also took place parallel to this slow change. Consequently, she finds that the best description that can be given of the introduction of agriculture in Southern Scandinavia is as the "Fertile Gift".

Fischer (1982) holds a somewhat similar view, but he seems to speak mainly of a knowledge aquired through exchange, and he sets up two preconditions for this knowledge to be invoked. One is that the new form of production was economically advantageous. The other that the local societies were at a stage of social development that made an organization of food production possible. He specifically states that it should be at least a big-man society.

A survey of opinions thus shows that even though many authors have occupied themselves with the transition from the Mesolithic to the Neolithic, only limited variation in the approaches and the explanations offered can be found. It is symptomatic for many of the newer contributions that they base themselves to a wide extent on theoretical considerations, and make little or no reference to the actual archaeological record. Those who deal excessively with the archaeological record do this rather one sidedly, or they either work from an EBK point of view (Andersen 1973, Jennbert 1984), or from a TRB point of view (Madsen and Petersen 1984, Nielsen 1985).

Idealy a concern with the transition from the Mesolithic to the Neolithic, and an attempt to explain this transition, should base itself on both the Late Mesolithic and the Early Neolithic record, and these should be carefully compared in the light of what we know of the nature of the transition itself.

THE EBK RECORD

Some years back Troels-Smith (1960) gave a very vivid description of how he imagined the realities of EBK life. It was a picture that showed hunter-gatherers living in very small groups, moving along the coast from shell midden to shell midden in order to secure sufficient amounts of food on a year round basis. He found that the population density would have been extremely low, with only some 30 people living in Denmark as a whole at the beginning of the EBK period, but growing somewhat during its course.

Today our picture of EBK society is very different. It is now evident that the EBK population lived in relatively large groups along the coast and in the inland (Andersen 1975: 1981: 89, Jarman et al. 1982: 81, Jennbert 1984, 1985, Rowley-Conwy 1983; 1984; 1985, Zvelebil and Rowley-Conwy 1984). There has, however, been disagreement concerning the degree of movement between the settlement sites. Some have favoured a model of movements from site to site along the coast, and specifically between the coast and the inland (Andersen 1975; 1981, Jarman et al. 1982). More recently it has become clear that the settlement pattern was even more stable than believed earlier. We may probably speak of large base camps occupied most of the year, with a radial exploitation pattern of the surrounding area by the help of specialized satelite extraction camps (Andersen 1984, Jennbert 1984, Rowley-Conwy 1983, Vang Petersen 1984). This assumption has been reinforced by the C-13 investigations of human skeletal material from coastal sites (Tauber 1981a; 1981b; 1983). It turns out that the individuals examined almost exclusively have lived on a marine diet, and it is highly unlikely that they periodically moved inland for major exploitations of resources. The opposite, that the occupants of the inland sites almost exclusively lived from terrestial food seems also to be true, as C-13 investigations of dogs from inland sites on Zealand shows a clear terrestial pattern (Noe-Nygaard 1983).

The dietary habits of the EBK population becomes no less interesting with the realization of the sedentary nature of the society. It has been a commonly held opinion that the EBK had a broad-specter economy that optimized the exploitation of the available resources. This clearly was the guiding line of the ecologically orientated work of Paludan-Müller (1978), and even more so of the study of Jarman et al. (1982: 81). Based on a thorough analysis of a series of shell middens, the latter authors found that between 50% and 70% of the food-resources were marine. Yet, due to their bend towards economic determinism, they did not believe in these figures. Their site catchment analyses suggested quite different figures, and they came to the conclusion that the caloric importance of seefoods, perhaps with the exception of seals, were quite negligible. With the hindsight given by C-13 measurements, all their attempts to disclaim the archaeological record may be found a little peculiar, but it does, if anything, demonstrate the weakness of site-catchment analyses. The C-13 measurements leaves us no doubt that the predominant food source of the coastal population was marine (Tauber 1981a; 1981b; 1983). However, they do not in detail answer the question of, how large a part of the diet that came from marine sources, even though comparisons with C-13 levels in present day Eskimoes suggest that the percentage may have been as high as 70–90. In some newer studies (Rowley-Conwy 1983; 1984) the importance of seafoods – especially fish – has also been acknowledged independently of the C-13 analysis.

The dependence on marine foods of the EBK coastal population once more turn our attention to the settlement pattern. Paludan-Müller (1978), in his study of the ecological conditions of high atlantic food gathering, stressed the estuaries as those resource spaces that had the highest food capacities, mainly of a marine nature. And indeed, it is here we find the main clusters of settlement sites (Knudsen 1982, Vang Petersen 1984, Rowley-Conwy 1983). It is also in the estuaries that we find far the largest sites with evidence of an all year occupation constituting the base of a sedentary life. However, a full sedentism with a year round, steady life on the same site for all of the population cannot have been. There is a variety of sites spread all over the coastal area that represents specialized resource exploitations carried out at certain times of the year by task groups radiating from a base camp area (Rowley-Conwy 1983).

Such a settlement pattern must have led to a marked degree of territorial behaviour, and as the EBK wears on, it is indeed possible to see, not only a broad regional division of the culture, but also small groupings that can be spatially separated on a local level based on the style of artifacts (Vang Petersen 1984, Jennbert 1984).

The territorial behavior is also mirrored in quite a different and more tangible way. Of the growing number of human skeletons from the EBK, surprisingly many shows signs of violence, and some have also died from this violence (Andersen 1981, Bennike 1985: 98, Persson and Persson 1984: 48). A frequent type of injury is lesions of the skull probably caused by blows with heavy striking weapons (Bennike 1985: 98). Probably, this can be understood as evidence for a state of war between local groups. The same may also apply to the evidence for cannibalism known from the EBK (Andersen 1981, Vang Petersen 1982: 143).

The realization that the EBK had a large permanent coastal population with a well defined territorial structure that was maintained with a good deal of violence, is one of the major unveilings concerning the EBK in recent years. This place into focus the social structure of EBK society, as there seems to be a discrepancy between these findings, and the standard perception of the structure of a hunter-gatherer society (Service 1966). This impression is reinforced if we turn to other sources. By and by it emerges that if at all we should speak in idealized categories, we had better use the term "Tribesmen" (Sahlins 1968).

One such source is the EBK cemetaries that has been unearthed over the last decade (Albrethsen and Brinch Petersen 1976, Larsson 1984a; 1984b). These "Formal disposal areas" may in themselves be seen as an indication of a strong territorial behaviour in society (Chapman 1981, Larsson 1984a: 34), and they may also be seen as evidence for the existence of some form of corporate groups, most likely with a lineal descent pattern (Chapman 1981).

The pattern of age, sex and burial gifts in the graves of the Vedbæk cemetary seems to indicate that a persons role was determined primarily by age with three major age grades of under 18s, the 18–40 year olds and the over 40s. Sex differentiations seems to be less important, and there is no evidence of differentiations due to attained status (Orme 1981: 244).

Another source gives perhaps an even clearer indication of the "non-band" character of EBK Society. This is the extremely long exchange lines with which the EBK people were involved. Already Andersen (1973) expressed that contacts to neolithic cultures in Central Europe were of importance for some emerging elements in the EBK (T-shaped antler axes, shoulder blades with holes, and some aspects of the pottery), but he did not come to the point of stressing the importance of exchange in this connection.

The realization that the "Danubian Shaft-Hole Axes" ("Schuhleistenkeilen"), not unfrequently found in Southern Scandinavia, belonged to the EBK (Fischer 1982; 1983) suddenly made it clear that this culture was involved in an extensive exchange network that took items of prestige over hundreds of kilometers. The importance of this is twofold (Fischer 1982, Jennbert 1984). Firstly, we are here given very good evidence that the EBK had a social structure in which the acquisition of prestige was somehow important, whether by individuals or on a group level, and further that they took part in an exchange network on equal terms with neolithic groups to the south, which indicates that their social structure was not very much different from that found among these groups. Secondly, the exchange links established, probably were the "data bases" of an infinite variety of information that was layered in the society, even though it did not surface in those aspects that are visible to the archaeologist. Certainly, we can claim that the EBK became "loaded" with latent possibilities for change.

The outline given here is to a wide extent based on evidence from the coastal zone. How much of this do also apply to the inland? Indeed is the inland at all comparable with the coastal zone?

Naturally, one major difference was the resources. We have seen that the coastal population almost exclusively exploited marine resources, and as this more or less precludes transhumance between cost and inland, it can be of little surprise that we find evidence for a clear predominance of terrestial food in the diet of the inland population (Noe-Nygaard 1983). However, when it comes to an outline of the actual exploitation and settlement system of the inland population, we are not very well off. We do find clear evidence for inland populations in all areas: Scania (Jennbert 1984: 101), Zealand (Noe-Nygaard 1983, Andersen 1983), Fyn (Andersen 1984) and Jylland (Andersen 1975). Yet, our knowledge of their way of life is still very limited. Two important investigations do, however, shed some light on this problem. One is Noe-Nygaard's (1983) investigation of the Præstelyngen site on Zealand, the other is Andersen's (1975) investigations of the Ringkloster site in central Jutland.

The former demonstrates that the Præstelyngen site was a summer camp inhabited between March/April and September. She further demonstrates that aquatic resources taken from the lake were of great importance during this period. The latter demonstrates that the Ringkloster site primarily was a winter camp used between October and April, although a few summer indicators shows that it was also used at other times of the year. Fish is quite unimportant at Ringkloster even though the site is situated directly on the shores of a large lake. The resource of overhelming importance was the wild boar. If we compare with the Præstelyngen site, we may tentatively suggest that the winter and summer strategies of food acquisition for inland populations were far from being the same, and that the nature of the inland resources forced a somewhat greater variability on inland economy than it did on coastal economy. the Ringkloster site on the other hand is certainly not a small unimportant site. The settlement area itself covers 200 by 75 meters and includes numerous evidence for permanent structures, perhaps even timber built houses (Andersen 1979). One may see this as a discrepancy between what could be expected from an ecological point of view, and what really happened culturally. Indeed, the site seems to have held a rather large population on a quite permanent basis.

The presence of a rib of a bottle-nosed dolphin is another interesting element of Ringkloster. This find was interpreted by Andersen (1975; 1979) as evidence of transhumance between the coast and the inland. Based on our present knowledge, it may perhaps better be viewed as evidence for the existence of an exchange system between the coastal and the inland populations, and on a wider scale it indicates that the inland population also participated in the long distance, exchange networks with the south. The latter point is further supported by the finding of "Danubian Shaft-Hole axes" in clearly inland positions (Fischer 1982: Fig 3).

THE TRB RECORD

The assessment of the nature and development of the Early Neolithic period given by Becker (1948) had a great influence on European neolithic archaeology, and naturally especially on Scandinavian archaeology. So profound was the impact that except for his controversy with Troels-Smith (1953 and Becker 1955) nothing important happened, before Skaarup (1973b) noted that the C-14 evidence did not support the chronology that Becker suggested for his various Early Neolithic groups. Since then a series of works have added new information and new thoughts to this research area (Ebbesen and Mahler 1980, Koch Nielsen 1983, Larsson 1984c, Liversage 1981, Madsen 1979, Madsen and Juel Jensen 1982, Madsen and Petersen 1982, Nielsen 1985, Skaarup 1973a; 1975). Agreement, however, has only been reached on a few issues, and being a participant in the discussions myself, it is very difficult for me to present a balanced outline of our current knowledge. Consequently, the following represents a most personal view.

Beckers division of the Early neolithic pottery into A, B and C pottery, and the C into megalithic and non-megalithic pottery was a purely stylistical decomposition, which he found to have chronological and historical significance. However, the investigations during the last few years have indicated differently, and the situation seems to be even more complex than Becker envisaged. An outline of the oldest part of the Early Neolithic between apr. 3100 and 2800, as I would give it today (Madsen and Petersen 1984) has the following form:

What I prefer to call the Oxie group (Madsen and Petersen 1984), following a suggestion from Larsson (1984c), is the sole part (A group) of Becker's system that has survived more or less intact. Yet there are discrepancies between Becker's original descriptions (1948), and those forewarded in the most recent publications (Koch Nielsen 1983, Nielsen 1985). In order not to let the use of Becker's terms bring ideas to mind of relations and conditions that are no longer warranted, I find it better to use a new "unloaded" term for this group.

Clearly, the Oxie group has an eastern distribution in South Scandinavia. This can be seen from its defining pottery (Nielsen 1985: Fig 14), and from the pointed butted flint axes that exclusively seems to belong to this group (Nielsen 1977: 69). The main concentration is found in Scania and on Zealand, while only a minor scatter of finds are seen in the eastern parts of Jutland and around the Limfjord.

Becker considered the material from this group to be chronologically older than any other neolithic material in South Scandinavia. The associated C-14 dates do not support this view. They do place it in the older part of the Early Neolithic between 3000 and 2800, but there are other groups that are just as old, and the oldest dates do not even come from the Oxie group (Madsen and Petersen 1984, Koch Nielsen 1983).

A comparison between the Oxie group and the late EBK shows several points of accordance. Thus, the pointed butted flint axe may be viewed as a grounded version of the specialized core axe of the late EBK, and the flint inventory as a whole has much in common with that of the late EBK both technically and in its inclusion of flake axes in the inventory (Nielsen 1985: 112). Another resemblance that immediately catches the eye, is how close the only known Oxie grave – the one from Dragsholm (Brinch Petersen 1974) – is to the EBK graves. It is the same type of simple inhumation grave with the body lying on its back, associated with a series of personal items that indicates a hunter and a warrior rather than an agriculturalist.

On the other hand, there are very obvious differences too. Thus the diet of the Dragsholm man was completely dominated by terrestial food according to the C-13 evidence, even though he was burried at the coast in connection with a shell midden (Tauber 1981a; 1981b; 1983), and of course both cereals and domestic animals are attested. Further, we find a scatter of small, agricultural sites on sandy stretches in the inland of Scania in a region where there are no EBK sites (Larsson 1984c). Finally, the resemblance one might see between the EBK pottery and the Oxie pottery is overshadowed by the almost identity between the Oxie pottery and pottery from the Sarnowo group in Poland (Kosko 1982, Wislanski 1973). Yet the Sarnowo group is clearly older than the Oxie group, and there is no way the two can be paralleled chronologically (Madsen and Petersen 1984, Midgley 1985: 7–9).

Another Early Neolithic group is the Volling group. It has a clearly western distribution, as it is known only from Jutland. In terms of Beckers divisions, the Volling group is an amalgation of B and North Jutish Non-megalithic C. Unjustly he claimed them to be two separate entities in that area. In fact, it was the richer decorated, and the lesser decorated pottery of the same group that lay behind his distinction.

The Volling group covers all of the Early Neolithic period and the associated C-14 dates point to a begining around 3100, suggesting an even earlier start than the Oxie group (Madsen and Petersen 1984). This means that to the extent the Oxie group is present in Jutland, there was an overlap in distribution between the two groups.

Unlike the Oxie group there is little to suggest a link between the Volling group and the late EBK, even in its earliest appearance as on the Mosegården site (Madsen and Petersen 1984). The pottery is elaborate, especially in its decoration, and constitutes a complete break with the EBK pottery. Despite this, it is not possible to come up with parallels to the South or elsewhere that convincingly can explain this pottery. Some weak parallels may be drawn to Rössen derivatives on sites like Hüde I and Boberg, but chronologically they are older than the Danish material (Madsen and Petersen 1984: 104).

The thin butted flint axe, characteristic of the Volling group had no morphological predecessors in the EBK in the same way as could be suggested in connection with the pointed butted axe. If it is not a unique innovation, the only possible "explanation" seems to be that it was a copy of flat-axes of copper (Randsborg 1979). The latter could for chronological reasons easily have been present already in the late EBK by way of the exchange network. We know for certain that the polygonal copper battle axes, like the stray find in Scania (Brøndsted 1957: 181), were here from the outset of the neolithic, as we have their stone immitations in the graves on a very early date, both in the Volling group (Fischer 1976) and in the Oxie group (Brinch Petersen 1974).

The remaining flint inventory is more flake dominated than that of the Oxie group, and it does not look as "mesolithic" as the latter. Also, flake axes are not common on Volling sites (Madsen and Petersen 1984).

The graves constitutes a very conspicious difference. From the outset of the Volling group we have very elaborate burial customs (Fischer 1976, Madsen 1979; 1980, Madsen and Petersen 1984). We find burials in wooden chambers situated in often huge earthen long barrows. The barrows may be surrounded by palisades, and in one end we may find heavy set transversal wooden structures that was the foci of rituals and offerings. There is quite clearly no local background to be found for these monuments so we have to turn our attension elsewhere.

In the northern parts of Poland and Germany just south of Denmark we find "unchambered long barrows" (Midgley 1985). However, when we start comparing details, they are far from being as good parallels as the partly older, partly contemporary British "unchambered long barrows" (Madsen 1979). From almost any point of view this is quite puzling, but the parallels are in part so close that they precludes any suggestions that the Danish long barrows are indigenous innovations.

The settlement system of the Volling group is also very different from that of the EBK. In the coastal zone we find small short lived agricultural sites on the sandy soil, often quite close to the coast, but situated very differently from the EBK sites, and not attracted by the rich coastal resources (Madsen and Juel Jensen 1982). However, some of the EBK shell middens are still in use as specialized, occasional hunting and gathering stations (Andersen n.d., Madsen 1982, Madsen and Juel Jensen 1982), but the TRB layers are clearly separated from the EBK ones by a series of differences that indicates a marked change in the exploitation patterns (Andersen n.d.).

The sites discussed by Madsen and Juel Jensen (1982) were all situated in the coastal zone, and thus in the generally same area that carried the main part of the EBK population. However, if we look at the distribution of the long barrows (Madsen 1979: Fig 1) as well as Early Neolithic earth graves in general (Thorvildsen 1941), we receive the very clear impression that a large part of the settled area was now truely inland.

A third TRB grouping found on Zealand, and dating to the first part of the Early Neolithic must also be taken into consideration. In terms of Beckers system it corresponds quite closely to the B group, but includes in my opinion also his Zealandic Non-megalithic C, as he made an artificial separation of the two components in exactly the same way as it happened in Jutland. I have previously suggested that the name Svaleklint group should be used for this Zealandic parallel to the Volling group (Madsen and Petersen 1984), but unfortunately I thereby violated the original contents of this concept given by Ebbesen and Mahler (1980). Consequently, in the following I shall refer to the Zealandic Svaleklint/B group, meaning the total of this complex, which I find to be basically one group. In this connection I should not conceal that there are quite contrary opinions to both grouping and chronology of this material (Nielsen 1985).

In some aspects the Zealandic Svaleklint/B group pottery lies stylistically between that of the Oxie and the Volling groups. However, an all over consideration place it as a regionally differentiated parallel to the Volling group, even though some of the dominating features in its rim decoration is known only from the Oxie group (Madsen and Petersen 1984).

Chronologically the Zealandic Svaleklint/ B group is parallel to the Oxie group, and we might even see a hint in the C-14 dates of a slight antecedence, but this is rather uncertain (Koch Nielsen 1983, Madsen and Petersen 1984). The simultaneousness with the Oxie group is very intriguing, as it does not seem possible to find any distributional differences between the two. Both groups seems to be present in the very same areas of Zealand at the very same time (Koch Nielsen 1983).

The burial practise of the Zealandic Svaleklint/B group is as yet little known. The long barrow at Lindebjerg (Liversage 1981), however, belong in this group, and this suggest the burial practice to be parallel to the one found in the Volling group, and thus probably different from the one found in the Oxie group.

FROM THE MESOLITHIC TO THE NEOLITHIC IN SOUTH SCANDINAVIA

The two most recent contributions to the discussion of the transition from the Mesolithic to the Neolithic were published side by side in the previous volume of this journal (Jennbert 1985, Rowley-Conwy 1985). They express almost completely contradicting views on the nature of the transition, and together with the two authors previous writings (Jennbert Spång 1982, Jennbert 1984, Rowley-Conwy 1983; 1984, Zvelebil and Rowley-Conwy 1984) they are good examples of the two major trends in current views on this epoch-making episode.

Jennbert on her side considers the transition to be a slow cultural build-up, where the formation of a growing social complexity within the EBK, combined with the access to agricultural goods through exchange networks, was of crucial importance. Her position is based on a theoretical attitude, where important agents for change primarily should be found within the social sphere, a point I agree with, but she also very explicitly (1984) tries to demonstrate the gradual nature of the transition, using the excavations at the Löddesborg settlement site. However, her use of the "stratigraphical sequence" at Löddesborg to show a gradual replacement of EBK elements with TRB elements is a very dangerous procedure at such a large and complex site. The possibility of undetected post depositional movements of materials between the levels is far too great. Apart from this, however, she certainly seems to have a strong case. The use in both the EBK and the TRB of the same very large, probably permanently settled site point to a high degree of cultural continuity. It is also a point in favour of her ideas that she – for the first time in Scandinavia – has found grain impressions in sherds that beyond doubt stems from EBK pots. On the other hand, it should not be forgotten that the study of Early Neolithic settlement patterns in Scania also shows a different picture, with a scatter of small agricultural sites over the inland at a quite early point in time (Larsson 1984c). This in some ways contradict Jennberts suggestions.

Rowley-Conwy in his explanation, on the other hand, stresses the importance of the economic conditions for the transition. He assumes that an imbalance between population and resources caused by the change in climate from the Atlantic to the Subboreal period was directly responsible for a change in the food strategy of the population. More directly he points to a decline in the availability of oysters as a triggering cause. He does this from the assumption that oysters were a crucial resource during the lean times of late winter and early spring.

Based on his knowledge of the EBK record in Jutland, and the conditions under which early TRB material is found on the EBK sites in this region, he also concludes that the transition was a very rapid one, although he more theoretically speaks of a series of stages in the transition (Zwelebil and Rowley-Conwy). Clearly, he has here an opposing view to Jennbert.

Personally, I am not happy with this explanation, and I find it hard to believe that no other immediate and less drastic means of rescheduling, than converting to agriculture, was not available in the face of a decline in a minor resource like the oyster. Storing techniques for fish would probably easily have been able to counter this problem. Also in this connection, it is relevant to mention that studies of shells from the Ertebølle midden itself shows that far the major part of the mussels were taken during the summer and autum, and only a minor part during the winter and early spring (Skalborg Jensen 1982). Further, it cannot be irrelevant that half of the coastal EBK population never had access to oysters due to low salinity in the south eastern parts of South Scandinavia.

Rowley-Conwy's statement of the rapid nature of the transition in Jutland, on the other hand, is unrefutable. The huge EBK base camps did not continue into the Neolithic (Rowley-Conwy 1983), and on those middens where there is a continuity into the Neolithic, there is a very sharp dividing line between the mesolithic and the neolithic components. The neolithic parts of the middens are dominated by ash layers and fire cracked boiling stones, never found in the mesolithic layers (Andersen n.d.) This implies a completely different exploitation pattern. Probably the coastal middens of the Early Neolithic were from the outset reduced to occasionally visited extraction camps, where food was conserved before it was carried away to the agricultural base camps placed in totally different ecological positions (Madsen 1982, Madsen and Juel Jensen 1984).

How, then, are we to perceive the transition? Was it a very rapid one, or was it a gradual element by element change? Personally, I have little doubt that it was an, archaeologically speaking, instant transformation that took South Scandinavia from a fisher-hunter-gatherer economy to a basically agricultural economy, and I doubt that we will ever be able to produce convincing assemblages that reveal the transition stage itself. This not only goes for Jutland, but also for Zealand and Scania, which means that I consider Löddesborg, and a number of other sites mentioned by Jennbert to show mixed assemblages between EBK and TRB deposits. I also believe that the difference in C-13 content between the mesolithic and the neolithic graves at Dragsholm, showing a clear dichotomy of marine versus terrestial diet, is not to be considered as the result of two extreme examples of a gradual changing relationship between sea and land over the 300 years that separates the two sets of dates. Even if only 50 years separated the two dates, I would still expect the same discrepancy in the C-13 level to have been present.

An explanation of the transition from the Mesolithic to the Neolithic in South Scandinavia may of course take many different forms. Even a full acceptance of the evidence sketched in the preceding pages may lead to very different attitudes among various researchers. The model and explanation to be offered here in the concluding lines thus makes no claim at all of being the truth, if such ever can be found. It is put forward in order to make clear a sequence of possible relationships and conditions that is worthwhile having in mind for further research, and it draws heavily on the more general considerations outlined in the opening chapter.

The coastal EBK society was involved in a process that took it through an increasing resource specialization and towards an increasing formalized group structure. The process was nurished by the possibilities imbedded in a sedentary settlement structure around localized optimal resource spaces that also had sufficient headroom for a considerable growth in population. I do not see any need for assumptions of a devastating resource pressure on this system. It probably was ecologically stable, and there is no convincing reason why fluctuations in the resource base could not be countered by the cultural system on its own terms.

There is, however, reasons to believe that there were considerable dynamic changes in the social system towards a growing complexity, and a formalized, rigid group structure. This follows from the evidence of violence probably indicating inter group stress, from the use of formalized disposal areas for the dead, and from the acquisition of "exotic luxuary" goods through exchange. Whether the monopoly of control and power was placed with individuals or with age groups is difficult to say, and currently of less importance. What is important is that the spatially limited resource areas were benefitial to those in control. Any formalized system of group access to such localized resources would be an invitation to an exercise of power for those who could gain control. In terms of dynamics, it would mean that the social system continuously would press for a narrowing of the resource base in order to consolidate the power structure of the system, and it would immediately try to counteract any tendencies for the inclusion of supplementary resources that were outside the defined areas of control. In this way the system painted itself into a corner from where only a leap could bring about renewal. I find that this social development is the main reason why the EBK was so completely unimpressed economically by the contacts with agricultural societies to the south for a period of almost a 1000 years, and why the transition, when it took place, had the nature of a replacement rather than of a gradual change.

The situation in the inland was clearly different. There was no spatially limited resource base of a magnitude comparable to the coastal one, and from a purely ecological point of view we would certainly not expect to find the same development here as at the coast. Nevertheless, we do find acquired luxury goods in the inland, and the Ringkloster site is evidence of very large, quite permanent residence units towards the end of the EBK. The only reasonable explanation for this seems to be that despite the different ecological and economic situation, a social development comparable to that along the coast took place inland at a late stage of the EBK. The reason for this can probably only be attributed to an intense contact between coast and inland, with a continuous, dominating "centerperipheri" influence from the former to the latter. Such a development in the inland social system would have very different conditions from the coastal one. Whereas the coastal system was working itself into an impasse, the inland system would be working itself into a very unstable situation, where the social system kept up an economic exploitation and sedentary pattern for which there was no immediate ecological sense. A restructuring would in this case be an unavoidable outcome of the continuous development towards larger and more sedentary units. However, the logics of a leap into agriculture rather than a gradual change may here perhaps be disputed.

One thing is to offer a social explanation for the overspecialization of the EBK economy, and the inevitability of drastic change. Quite another thing is to explain the complexity, and even heterogenity of what followed in the early TRB.

From the point of view sketched earlier in this paper (also Madsen and Petersen 1984) there were two major contemporary, overlapping cultural trends at the beginning of the Neolithic in South Scandinavia. One is represented by the Volling group and its Zealandic counterpart, the other by the Oxie group. The only cultural dichotomy that covers all of Scandinavia in the EBK, and which is not just a regional difference, is the opposition between coast and inland. It is just possible that behind the two main traditions of the earliest neolithic is this cultural, economic difference in the EBK, where the Oxie group probably would stem from the coastal aspect, to judge from its distribution.

Naturally, it is futile to look for a coast-inland dichotomy in the Early Neolithic, as the agricultural component introduced ment quite new economic conditions for both traditions, removing the original differences in their economy. The reason for the existence of contemporary groups, sharing the same general settlement area, would then probably be that their roots in the EBK were still visible through some sort of ethnic manifestation (c.f. Hodder 1982 for discussions of ethnic expressions from an ethnoarchaeological point of view). In Jutland where the precense of the Oxie group is rather unimportant, and probably short lived, we can still see its original coastal distribution, before it was overruled by dominance from the Volling group.

From the current available C-14 dates, we may assume that the initial transition occurred in the inland EBK, possibly primarily in Jutland resulting in the Volling group, and spreading from here eastwards. This would seem reasonable from the point of view that it was the inland EBK that moved itself into an unstable situation. The coastal EBK in its more stable impasse would probably be more inert. However, the filling of their backlands with farming people from a group of former "cultural relatives", may have constituted an initial kick to make also the coastal EBK change, possibly in the way that some people "rebelled", and moved away from the central settlement areas to form a new life on an entirely new base.

The Löddesborg site constitutes one major problem for this model. It is implicit in the model that the base camps of the late EBK should be deserted in connection with the transition, and that we should not find agricultural indicators (like grain impressions in pottery) in connection with EBK on these sites. Both of these non-fits, however, occur on the Löddesborg site, and the only way to escape this problem seems to be the assumption that Scania was so marginal to what was initiated in the west, that a partly different pattern of change evolved here. If, however, the "Löddesborg syndrome" irrefutably turns up further west, it will have a devastating effect on much of what is suggested here.

The transition itself: the rapid, discontinuous, morphogenetic change is not a concern of archaeological argument. If accepted, it is beyond the capabilities of archaeology to observe it, and its acceptance as a possible cultural process lies entirely within the realms of cultural theory. The same is true with the idea of a latently present "information bank", from which a system subject to restructuring can select new elements for its future structure.

Thus I consider the transition from the Mesolithic to the Neolithic to present a case of morphogenetic change, being to the achaeological point of view a true "black-box" problem. That is, we can observe and describe what goes in, and what comes out, but we cannot follow the process of creation itself. The people involved chose the contens of the system being formed from the "information bank" currently available to them. An agricultural economy, and a series of social, ideological, ritual, religious, etc. elements were picked up from surrounding, even far away, neolithic groups, and from their own past.

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The Beginning of the Neolithic – Assimilation or Complex Change?

by POUL OTTO NIELSEN

In recent years studies dealing with the introduction of agriculture in South Scandinavia have shown a greater interest in the Late Mesolithic than in the Early Neolithic. There may be at least three reasons for this: first the rejection of the invasion hypothesis forwarded by most earlier writers, next the advent of radiocarbon dating which separated the two periods in question, and finally the general trend of modern archaeology to investigate processes and to explain culture change. For all three reasons the interest is being directed towards the possibility of a gradual development of agricultural practices and husbandry within the Ertebølle Culture of the Late Mesolithic.

Anders Fischer (1982) and Kristina Jennbert (1984) advocate the view that the preconditions for the neolithic transition lie in the existence of an exchange network, which among other things enabled the diffusion of Late Danubian perforated axe-hammers to the North. Others seek evidence for a concentration of settlement and for increasing sedentism in the late Ertebølle Culture (Rowley-Conwy 1983) or present theories for a growth in population during that period (Paludan-Müller 1978). Environmental factors such as climatic deterioration and fall off in coastal resources at the time of the Atlantic – Subboreal transition have also been mentioned as possible causes of changing subsistence strategies (Zvelebil & Rowley-Conwy 1984:110). A survey of recent work on the subject is given by P. Rowley-Conwy in the foregoing issue of JDA (1985).

I would like to address my comments especially to two theories recently put forward: 1) the theory by Jennbert (1984 and 1985) on the prolonged process towards farming promoted by external contacts, and 2) the three stage development described by Rowley-Conwy (in Zvelebil & Rowley-Conwy 1984). Both of these writers introduce new concepts that deserve attention and provoke discussion.

The idea of a growing process within the Ertebølle Culture towards a farming economy, stimulated by the acquisition of 'fertile gifts' through exchange with neighbouring farming communities on the Continent (Jennbert 1984), calls for the concept of a transitional period with a mixed economy, for which neither the term 'Mesolithic' nor 'Neolithic' are adequate. Jennbert bases her interpretation of the archaeological evidence on this concept. In opposition to this, I should like to present the hypothesis that the Ertebølle and the early Funnel Beaker (TRB) Cultures represent two incompatible cultural systems, and that the introduction of the 'Neolithic' way of life meant a change of great consequence for all aspects of society. As I will try to show in the following, most of the available archaeological sources seem to be in favour of this view.

The settlement pattern, material equipment, and the associated fauna of the Ertebølle Culture indicate that the people were predominantly living by aquatic resources. Whenever an Ertebølle tool assemblage is found in a settlement context, the site is situated close to open water: sea, lake or fjord system. Hunting and collecting activities which added part of the diet and provided necessary raw materials, were organized from base camps always situated on the shore. Nothing in the conventional archaeological record signifies that the Ertebølle Culture took possession of inland areas for agricultural purposes. The pollen evidence is in support of this as far as South Scandinavia is concerned. Bones of domesticated animals have not yet been found in pure and sealed Ertebølle contexts. As far as can be judged from finds made of durable materials the Ertebølle people possessed a modest capacity for the storage of food. The range of ceramic types was limited and the amount of pottery found at the settlements is small. This should be seen in connection with the extremely confined settlement zone between open water and dense forest occupied by this culture which caused the pile up of refuse at the dump areas of the settlements being used repeatedly through centuries. These facts ought to be borne in mind when combining the elements of sedentism, group size, and storage capacity in an attempt to classify the Ertebølle among the advanced sedentary hunters – an attempt which may not be wholly irrelevant but which tends to exaggerate the clues.

As shown by Peter Vang Petersen (1984) there was a regional and a local differentiation within the Ertebølle Culture reflected in the spatial variation of certain artifact types. It seems to indicate smaller, territorial units within the otherwise uniform material continuum of the culture as a whole.

Within the narrow coastal and lakeside area occupied by the Ertebølle Culture a variety of ecological niches were exploited. Fishbones and fishing gear show the practice of both freshwater, inshore, and deep sea fishing as well as the use of fish traps. Dwelling sites may have been chosen in a way that different fishing methods could be employed at the same time (i.a. Tybrind Vig, Andersen 1985, and Ertebølle, Enghoff 1986). Hunting for seals took place at some stations (Sølager, Skaarup 1973). The probability that larger sea mammals were pursued at certain favourable locatious has also been pointed out (Vængesø, Andersen 1975a). Hunting comprised a variety of species and hardly two Ertebølle sites show the same composition of the game. There are inland lakeside settlements where hunting was the predominant occupation (Ringkloster, Andersen 1975b). Seasonal camps with an eye to bird hunting are also known (Aggersund, Andersen 1979). Beside the ample evidence of molluscs being collected, food gathering is a less well documented activity but may have included a variety of plant food. The Ertebølle hunter-fisher-gatherer was thus extremely mobile and highly capable of adjusting himself to different environments. He performed a series of techniques that were complementary throughout the year and made him move with the seasons within a fairly large territory.

Long after the introduction of farming and husbandry the hunting and fishing activities continued to exploit the same natural resources as before, using much the same techniques and locations as the Ertebølle people had done. However, in other respects the life-style had become fundamentally different. Settlement was no longer confined to coastal or lakeside environments, but was now mainly situated on high ground. Right from the outset of the Subboreal period we may speak of a dual economy chiefly centered in permanent, inland residence sites but supplemented by activities at the now secondary extraction camps situated in the coastal zone formerly occupied by the people of the Ertebølle Culture (cf. Madsen & Jensen 1982). The shift in emphasis towards stock raising and consumption of terrestrial rescources can be deducted from the measurements of the C 13 isotope in human bones, showing a decline from the beginning of the Subboreal. In contrast to the fishers' menu the first neolithic settlers enjoyed a predominantly terrestrial diet (Tauber 1981, 1983). Such profound readjustments of the settlement pattern and subsistence strategy may well have affected the whole behavioural pattern of the people.

It is an important point that animal husbandry changes the annual cycle. Livestock and the labour connected with it ties part of the family to home quarters during winter. Livestock also provides part of the diet during this season, as do the stored grains of cultivated cereals. Thus, a series of animal and plant food stuffs available throughout the year creates new dietary habits and requires new home crafts. The idea to accumulate food for storage may also have changed the way certain wild products were handled – meat, fish, berries and fruits. Facilities for storage may certainly have resulted from the desire to make better drinks. Access to a constant milk supply would soon affect conditions for infant survival. A different health situation would evolve from this, possibly affecting family size and mortality rate.

Settled life imposes a new social order. Possession and care of animals and land requires new rules of labour, of division of labour within both family and community, of internal group relationship, and of inter-group contact and commerce.

It is important that the archaeological evidence is in accordance with the concept of multiple and complex change. It does not sustain the idea of a long transitional period of gradual adaptation to the new economy. Imprints of cereals found in sherds of Ertebølle vessels at Löddesborg do not prove that cereals were actually grown in the Ertebølle period. They may be seen merely as support for Jennbert's idea of a long distance traffic in various commodities including articles for consumption during the time before the actual change in economy. Bones of domesticated animals found in an Ertebølle context might be interpreted similarly, if we put things to extremes. As long as there are no further indications in the archaeological record of a self-supplying food production under development, how can we assume that changes happened?

What were the circumstances, then, under which the new economy was finally introduced? The answer to this depends on the way we define the first period of the Neolithic in terms of archaeological context. There is no unanimous agreement on this issue among Danish and Swedish archaeologists. It is mainly due to a confusing series of radiocarbon dates for the period c. 3100–2800 bc. Both the Volling Group (Ebbesen & Mahler 1980, Madsen & Petersen 1984) and the Early Neolithic A- and B-Groups as originally defined by Becker (1947, 1955) aspire to be the earliest on the scene.

In the greater part of the area settled by the Ertebølle people there is good reason to maintain the priority of the A-Group ('Oxie-Group' in Swedish terms, cf. M. Larsson 1984). The ceramics of the A-Group are simpler and more similar to continental pottery than other EN pottery groups in South Scandinavia. Early C 14 dates are claimed for A-pottery found at Rosenhof in eastern Holstein in an interesting but probably accumulated deposit containing Ertebølle sherds and vessels of Michelsberg and Baalberge types (Schwabedissen 1972, 1979a, 1979b) – thus indicating some of the possible 'donor' culture systems for the early farming communities north of the Baltic.

In Denmark and South Sweden the A-pottery is found associated with early, pointed-butted flint axes, and the two kinds of artefacts share a confined distribution with the highest frequency in Sjælland and Scania (Nielsen 1985). If we disregard sites with a problematic stratigraphy (i.e. sites of 'Löddesborg character' for Scania, cf. Jennbert 1984) contemporaneity between the late Ertebølle Culture and the A-Group has not been demonstrated. It appears, however, from the distribution maps that there is an overlap between the territory occupied by Ertebølle sites and that occupied by A-sites. In most parts where Ertebølle sites are numerous, A-material has also been found. An interesting pattern emerges from the distribution maps of Scania shown by Jennbert (1984 figs. 65–69). They show a typical clustering of Ertebølle sites along the shores of the sea, the fiords, and the inland freshwater lakes. Near most major concentrations of Ertebølle sites there is a scatter of early agricultural settlements and finds of pointed-butted flint axes, which however also covers the wide, adjacent areas of high ground.

At the same time, these distribution patterns provide the most convincing argument for a local development of the new economy in South Scandinavia, as opposed to immigration. Furthermore, it seems clear that the initial process of clearing land and introducing farming was carried through simultaniously and consistently within the whole social territory of the Ertebølle Culture. The distribution of finds reflects the change of emphasis with regard to economy. The base camps (or residence sites) are now to be found on high ground and the coastal sites become – most often – secondary extraction camps. It is noteworthy that artefact material of the Early Neolithic (and of later periods, too) have been found at nearly all Ertebølle sites investigated. If the change in economy and settlement was due to immigrant farmers, how would we explain the continued occupation in the EN at exactly the same hunting and fishing stations as were used in the Ertebølle period?

From the relatively scarce find material from the base camps of the A-Group we gain just enough evidence to prove the existence of a varied farming economy right from the outset. Analyses of grain imprints in A-vessels show the cultivation of naked barly, club wheat, Einkorn and Emmer (Helbæk 1955, Hjelmqvist 1970, Nielsen 1985). A small sample of animal bones indicates a mixed husbandry at this early stage consisting of domestic cattle, sheep, and pig (Nielsen 1985).

Production based on these domestic resources would call for adequate means of storage and processing of food. This need explains the fully developed set of pottery types employed by the people of the A-Group. We assume that the pottery technology and the specific range of household ware was closely connected with, and conditioned by, the methods of preparing and storing animal and plant edibles. The uniformity of the early TRB pottery over wide tracts of Europe must reflect common ideas of how food was handled and consumed. In an attempt to assess the communication lines along which this new food technology reached the North, the author has found that the A-pottery combines both eastern and western elements of early TRB pottery traditions (Nielsen 1985). The A-pottery is not copied from any specific ceramic tradition outside its area of distribution. While form and function of the pottery were preconditioned by the mode of food production adopted, the style and technical details give the pottery an individual character which justifies the term 'Northern Group' of the TRB Culture from the beginning.

An analysis of the flint inventory at the Early Neolithic sites shows a continuity of some of the principal artefact types of the Ertebølle Culture. However, there are technical and probably functional differences from the typical Ertebølle tool kit, probably due to a series of new activities, and the relative frequency of the individual tool types is not the same. Most important is that the first farmers inherited the skills of producing the specialized tool kit already adjusted to the local environment and its raw materials. This is another clue to a continuity of traditions and of working methods from the Mesolithic to the Neolithic.

Moving from the level of food production and artefact manufacture we meet new activities that can only be understood in terms of social adjustment to new life forms – the practices of animal and human sacrifice disclosed by finds recovered in bogs (Bennike & Ebbesen 1986). The beginning at an early stage of this practice and of the custom of depositing single vessels (with food) in or near water, marked the beginning of a ritual behaviour that was to outlast the EN period. Whether the performance of sacrifice or feasting was the more essential, the regularity of finds indicates a rapidly established ritual institution.

Another early fixed pattern of regularity, and probably also ritualized, is the deposition of hoards with flint tools (Nielsen 1977, Rech 1979). Almost all hoards with pointed-butted flint axes belonging to the EN A have been found in Scania, distributed in the south-western part where natural flint resources are known to have been systematically exploited from the beginning of the Neolithic (Olausson, Rudebeck & Säfvestad 1980). The production and diffusion of flint axes rose to a grand scale during the EN. The axes are supposed to have had an important function in the exchange system and were most likely valued as symbols of status and wealth (Nielsen 1977, 1984).

From this it transpires that on different levels, from the basic food production to the ritual and social life, the fundamental structure was rapidly shaped in the first stage of development of the Neolithic society. The cultural behaviour determined by the events of the neolithisation process changed very little through the centuries succeeding the first period of the Neolithic.

Returning to the concepts 'substitution phase' and 'consolidation phase' used by Zvelebil and Rowley-Conwy, I feel that they do not exactly reflect the evidence. It becomes doubtful whether a 'substitution' of the economy would represent a phase of any length. Substitution implies that a function, or a behaviour, is replaced with another.

From this point of view Jennbert's idea of a long temporal overlap between an Ertebølle Culture being already half Neolithic and an Early Neolithic system of settlement and land use combines conflicting elements. It allows cultural aspects to be coexistent that should rather be viewed as the opposing strategies of two differently organized, cultural systems. The 'mixed sites' with Ertebølle and TRB material show a spatial overlap between these different subsistence and settlement patterns but they hardly indicate a temporal overlap.

In a narrow sense of the word we may, however, use the term 'substitution phase' as a designation for the time during which the new economy desseminated over the geographical area in question. Here we may profit from Jennbert's concept of 'a fertile gift' to explain the circumstances leading to the introduction of agriculture and husbandry. Imprints of grains in Ertebølle pottery, such as were discovered at the site of Löddesborg, may be evidence for food being part of the exchange between hunter-gatherers and farming communities south of the Baltic or in areas of South Scandinavia already carrying a farming population. The advantage of food production in periods of crisis was thereby easily percieved by the people dependant on natural resources alone. The possession of livestock may have been an active power in such situations. Rather than a war between two different populations we would envisage a competition between local groups to acquire the means of self-supply.

Necessary preconditions for the change may well be sought within the sphere of inter-group 'commerce'. The transition phase would have been one of intense traffic in livestock and cereal products demanding new controls and standards of exchange. One of the effects of this was the vanishing of the old social territories of the Ertebølle Culture and the establishment of new and larger ones, as reflected by the local stylistic groups emerging during the EN. Even wider lines of communication were established on the symbolic level by the take over of male status objects like the battleaxe of common European type, i.e. the perforated axe-hammers of Jazdzewski's type X, anchored in the EN A context in the male burial at Dragsholm (Brinch Petersen 1974).

The significance of the Mesolithic-Neolithic transition lies in the fact that the emerging Neolithic society formed a highly integrated, functional system right from the outset. The way production, exchange, and social organisation was ruled and regulated throughout the Early Neolithic and part of the Middle Neolithic seems to have crystallized during the very process of establishing the first food producing economy.

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Neolithization in Scania – A Funnel Beaker Perspective

by MATS LARSSON

INTRODUCTION

This contribution to the discussion concerning the neolithization of Scania and Southern Scandinavia serves two purposes: to reply to Kristina Jennbert and to view neolithization in the perspective of the Funnel Beaker culture.

In an article in this journal, Kristina Jennbert presented her view of the Mesolithic/Neolithic transition (Jennbert 1985). According to her, the Funnel Beaker culture is an integral part of the Ertebølle culture. Jennbert's model takes its starting point in the Löddesborg settlement on the west coast of Scania (Jennbert 1984). This settlement exhibits a large number of occupation layers, thought to represent four or five different settlement phases, depending on which part of the settlement is under discussion (Jennbert 1984:34). Great importance is attached to the circumstance that Early Neolithic Funnel Beaker pottery is found in all layers, though in increasing amounts the higher up in the stratigraphical sequence one goes (Jennbert 1984:51). This, in conjunction with the fact that no differences in craft techniques could be ascertained, is taken as an indication of synchronism between the Ertebølle tradition and the Funnel Beaker tradition. Jennbert furthermore maintains that corn-growing and stock-raising have been components of Ertebølle economy (Jennbert 1984:92ff.). That cultivation occurred at the Löddesborg settlement is also definitively supported by some impressions in Ertebølle potsherds (Jennbert 1984:94). In a highly original and stimulating thesis, Jennbert has thus attempted to convince students of the Mesolithic and Neolithic that we are actually dealing with different manifestations of the same thing. The present author is not convinced of the correctness of the interpretation of the course of neolithization and has therefore been inspired to present a deviant interpretation of neolithization and development during the oldest part of the Early Neolithic in Scania.

The basis for interpretation derives from two areas of Scania: the southwest and the region around Ystad in the southeastern part of the province. Material from the former area has furnished the basis for a division of the Early Neolithic into three groups: the Oxie, Svenstorp and Bellevuegård groups (Larsson, M. 1984:156ff.). In this division, the two first-mentioned groups comprise the oldest part of the Early Neolithic, whilst the last-named is the latest and constitutes a transitional phase to the Middle Neolithic.

In the following, a hypothetical model for the transition will be presented, after which the hypothesis will be tested against the knowledge we today have from southern Scania, both environmental and archaeological.

NEOLITHIZATION IN SCANIA – A MODEL

Towards the end of Late Atlantic times, we can distinguish a considerable number of important settlement areas of the Ertebølle culture in Scania: Jonstorp, Löddesborg, Malmö, Kämpinge, Skateholm, Öja/Herrestadmosse, and Simrishamn/Vik areas. All these, with the possible exception of Löddesborg and Vik, must have been archipelago- or lagoon-like areas. Put simply, they would have been ideal settlement areas. The settlements also give the impression of being increasingly permanent, but with seasonal encampments around the inland lakes and water-courses. The settlements near the coast have naturally been sensitive to changes in sea-level, which also brought altered conditions for the various fish and molluscs. It is clear that around 3200 BC (uncal.) something happened to change the conditions of life of the population. The latest dates for the Ertebølle culture also lie in the interval 3200–3100 BC, and it is what happened in this interval which is the whole problem. Archaeologically, then, the Ertebølle culture in its classical form stops around 3100, and around 3000 the oldest Neolithic culture, the Funnel Beaker culture, appears. The model for the phase which is presented here is hypothetical, and the indications will be discussed later in this article.

Around 3100 BC, the Ertebølle culture was under severe pressure. The Late Atlantic changes in sea-level had influenced and changed the environment in the above-mentioned areas so markedly that new strategies for subsistence had to be tried. Since people evidently already knew about corn-growing, and perhaps also pig-keeping, this could provide a useful contribution to the economy. In consequence, the settlement pattern was radically altered, and the emphasis shifted from the coast to the inland areas. That the Ertebølle people had already exploited the inland area for fishing, hunting and gathering appears from both settlement finds and finds of Limhamn axes. Evidence of inland forest clearance may also be observed in certain pollen diagrams. Altogether, this indicates that first and foremost the southwest Scanian hilly landscape was not terra incognita for the population. This area is also ecologically richly varied, with a considerable range of soils, watering, and vegetation. It is therefore not so remarkable that the oldest Early Neolithic settlements in Scania are found inland (with some exceptions). In contrast to the late Ertebølle culture, the earliest Early Neolithic settlements were undoubtedly of family size. The majority are located in hill tracts with light, sandy soils. Closeness to water was also an important attraction. This change in settlement pattern is accompanied by a change in social structure. An important indication for this is the lack of cemeteries from the older part of the Early Neolithic. The combination cemetery/settlement is found in several places, among them Skateholm in southern Scania, during Atlantic times, but is entirely lacking during the Early Neolithic. The long-barrow tradition, which seems to be already found in the early Funnel Beaker culture of Jutland, is evidently also absent from Scania. A division into smaller units, which occurred during the Early Neolithic, obviously gives a situation quite different to that which previously existed.

A hypothetical model for developments during the Mesolithic/Neolithic transition has been briefly presented above; in the following the environmental and archaeological evidence will be discussed. Emphasis will first and foremost be laid on the new investigations being carried out in the Ystad area in southeastern Scania. Since 1982 this area has been the object of a multidisciplinary research project designated "The Cultural Landscape during 6000 Years", or as it is popularly called, the "Ystad Project" (Berglund 1984; Berglund & Stjernquist 1981; Berglund 1985). By way of introduction, the in some respects interim results of the palaeo-archaeological investigations will be discussed, followed by the archaeological evidence in south Scania.

PALAEO-ARCHAEOLOGICAL INVESTIGATIONS

Within the area of reference of the Ystad Project, 7–8 pollen diagrams will altogether ultimately be available. At present, pollen diagrams from four localities exist (Gaillard 1984, 1985; Hjelmroos 1985; Nilsson 1961; Berglund 1985). Two of these, Bjärsjöholmssjön (lake) and Fårarpsmosse (bog), may be said to be near the coast, while the two others, Krageholmssjön and Vasasjön (both lakes), are inland localities. Between these four localities there are interesting differences that can only be briefly touched on here. During the latter part of the Atlantic period, human influence on the landscape can be distinguished in the diagrams from Bjärsjöholmssjön and Fårarpsmosse (Berglund 1985:44f.). Artificially open areas have been demonstrated through the presence of *Plantago lanceolata* (ribwort), *Artemisia* (mallow) and *Chenopodiaceae* (the goosefoot family). In addition, there is occasional pollen of *Cerealea,* though *not* of *Triticum* (wheat) or *Hordeum* (barley) type (Berglund 1985:45; Hjelmroos 1985:48). A possible interpretation of these clearances is that they were made by Mesolithic man to encourage game (Mellars & Rheinhardt 1978:282).

The elm decline has been the object of fierce debate for a very long time (for a summary, see Larsson, M. 1984:189ff.). Today, most palaeo-ecologists hold that the elm decline was an ecological catastrophe caused by natural agencies such as Dutch elm disease and climatic changes (Berglund 1985:45). In conjunction with the elm decline, or shortly after it, the first traces of cultivation appear in the diagrams from Bjärsjöholmssjön, Fårarpsmosse and Vasasjön (Nilsson 1961: supplement 1; Hjelmroos 1985:48; Berglund 1985:fig. 4). This stage is now dated to 3000–2600 BC and is termed "expansion phase 1". During its course, stock-raising seems to have been predominant. Hans Göransson terms the stage a swidden and pasturing phase (1982:208). There is, however, no palynological evidence in the area under consideration for his idea of pollarded woods (Berglund 1985:45).

The interesting part is that expansion phase 1 can be demonstrated in only three of the four pollen diagrams under discussion. In the diagram from Krageholmssjön in the inner hilly landscape, this stage is completely absent, and no traces of human impact can be ascertained earlier than the Late Neolithic (Gaillard 1985:19). What, then, can this difference be due to? In the following, the archaeological evidence will be discussed.

THE ARCHAEOLOGICAL MATERIAL

The archaeological investigations in the Ystad area can be said to comprise three levels: inventorization of museum and private collections, perambulation, and archaeological excavation (Larsson & Larsson 1984). The aim has been that all accessible land shall have been inventorized by the end of the project, and this large data bank will in conjunction with the archaeological excavations and collections constitute the basis for an evaluation of Neolithic settlement in the Ystad area. Here, the material can be only briefly touched on. During the course of the work, it has become apparent that precisely the area around Krageholmssjön is relatively poorly furnished with find material. Evidence of an Early Neolithic settlement is entirely lacking around the lake. This constitutes good correlation with the pollen diagram. Around the other localities, perhaps primarily Vasasjön and Fårarpsmosse, there are a number of Neolithic settlements, several of which have been investigated, among them the interesting Karlsfält settlement (Larsson, L. 1985). This comprises two occupation horizons: an Early Neolithic and a Middle Neolithic, agreeing nicely with the results of the pollen analysis. A very likely explanation for the difference in settlement pattern is the great differences in soil conditions between the various areas around Krageholmssjön, the soils are mostly stiff clays, whereas around Fårarpsmosse and Vasasjön there are considerable tracts of sandy soil – again clear evidence that areas with light soils have been attractive during the Early Neolithic! This combination of sandy soil and settlement is repeated throughout the Ystad area.

The archaeological results hitherto from the Ystad area may be summarized as follows. The oldest settlement is located in two zones: the inner hill country and the coastal zone. In the latter area, the evidence is not very strong, although two settlements have been encountered and investigated. A study of the distribution of pointed-butted axes gives the impression, however, that the oldest Funnel Beaker culture is an inland phenomenon (Hernek 1985). This is even more apparent in southwestern Scania (Larsson, M. 1984: 207ff.). It is clear that at no site is there any contact between the late Ertebølle culture and the early Funnel Beaker culture. This has also been demonstrated in the Skateholm area, nearly 15 km west of Ystad (Larsson, L. 1984). The Neolithic settlement is somewhat later, EN C, however, but furnishes clear evidence that the environment was altered so much that a relatively abrupt change occurred (Larsson, L. 1983:35ff., 1985:3ff.).

It is my opinion that no contact between the Ertebølle culture and the Funnel Beaker culture occurred; that development was continuous and the Funnel Beaker culture built on a tradition which had its roots in the Ertebølle culture is quite clear, however. This is noticed first and foremost in similarities in flint implements, but the differences in material culture are nevertheless considered to be relatively great. Quite new types of pottery vessels and axe shapes were developed already during the earliest phase, but we should be fully aware that development may have been very different from one region to another. As early as the first part of the Funnel Beaker culture, there are clear differences in material culture between, for example, southwestern and southeastern Scania. As an example may be mentioned that the flake axe is completely missing in the oldest Funnel Beaker settlements in the latter area. This development can also be traced in Denmark (Madsen & Petersen 1984) and Britain (Bradley 1984:12). Something which cannot be explained away in Jennbert's reasoning, however, is the presence of corn impressions in the pottery from Löddesborg. But this does not mean, as discussed here, any coevality between the Ertebølle culture and the Funnel Beaker culture.

Can we say whether the hypothesis is valid? The answer can be summarized in a few important points which for the most part, in my opinion, bear out my hypothesis.

1. CLIMATOLOGICAL CHANGES

That the climate deteriorated during the Atlantic/Subboreal transition could be demonstrated in bogs, also in Denmark. In the bog at Draved, Aaby could establish that the degree of humus development in peat was low around 3100 BC (Aaby 1974:95). This shows striking agreement with the new dates for the elm decline, which is put at 3200–3100 BC. Through studies of the fluctuations in water level, Gaillard has within the frame of reference of the Ystad Project been able to demonstrate low water-levels, i.e. a warm and dry climate, during large parts of the latter part of the Atlantic period (Gaillard 1985:17). Around 3050 BC, however, a change can be registered: higher water-levels which can be attributed to increased precipitation and a climatic deterioration (Gaillard 1984:30–31). As will be apparent, there is a correspondence in time between all these factors. It really can be a matter of "ecological catastrophe", as Berglund expressed it (1985:45).

2. PALAEO-ECOLOGICAL CHANGES

In the new pollen diagrams from the Ystad area, there are indications of human influence during Atlantic times, probably clearances to encourage game. There is sporadic evidence of cereal pollen but *not* of the usual types of corn: it is a question of large species of grass (verbal information from Prof. Björn Berglund). Evidence of pollarded woods, as suggested by Hans Göransson, is not found, and the period is characterized by a stable forest ecosystem (Berglund 1985:45). The real change occurs with the elm decline around 3200–3100 BC. As mentioned above, this stage is characterized today as an ecological catastrophe. The first indications of human impact do not appear until around 3000 BC. At this stage, there is evidence of cereals and pasture-indicators like *Plantago.* This stage is, however, not synchronous over the whole area, unless metachronism is involved. In particular the coastal zone and the inner hilly landscape give the impression of having been attractive in the initial stages.

3. THE ARCHAEOLOGICAL MATERIAL

Since it is primarily the Ystad area which is discussed in this article, I have to focus on this area when the archaeological evidence is considered. This discussion can for reasons of space be only brief, but some points are worth discussing in this summary. Finds or settlements which should suggest circumstances like those at Löddesborg have not occurred in the Ystad area, nor in other parts of south Scania, apart from some corn impressions in Ertebølle pottery from Vik (Jennbert 1984:93). In the Ystad area, the oldest Neolithic settlements are found partly on the coast and partly in the inland hilly landscape, where above all the sandier soils were settled. Within the Ystad area, and in southwest Scania, the hypothesis advanced here gives a plausible picture of the development during the Mesolithic/Neolithic transition. The finding of corn impressions in Ertebølle pottery can, though, as mentioned, not be explained away, but why try to parallelize two essentially different traditions like the Ertebølle culture and the Funnel Beaker culture? Other explanations must, in my opinion, be applied to Löddesborg and other so-called "mixed sites". Space does not allow this, but there is reason to return to the question.

Translated by Peter Crabb.

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Reviews

MAGDALENA S. MIDGLEY: *the Origin and Function of the Earthen Long Barrows of Northern Europe.* BAR International Series 259. Oxford 1985. 330 pp.

The geographical area covered by this book is Poland, northern Germany, and Denmark. The subject is early TRB long barrows without megalithic chambers (though usually they are megalithic to the extent of having large kerbstones). The definition of the subject is not an ideal one, as megalithic and non-megalithic structures are so closely related that they must be taken together to understand them properly, and moreover Middle Germany cannot properly be left out. However there are limits to what a scholar can reasonably be expected to do!

Even as it is the task is an ambitious one. To begin with it requires a knowledge of the Slavonic and Scandinavian languages as well as German. Magdalena Midgley obviously has this qualification as far as the Slavonic languages are concerned, and she seems to have been well helped in this country, so her lack of Danish has not caused any problems. The biggest problem, however, is the quality of the primary data. Non-megalithic grave and ritual structures are perhaps the hardest of all objects to excavate well, and the quality of the excavations has been most uneven. On top of that many of the sites, probably a majority, are only available through interim reports, short notes, and the like, so the information is to a large extent just not sufficient. However the author has been well helped in Poland as well as in Denmark, and the book includes what you could almost call pre-publications of exciting new Polish excavations. The reader may be surprised at the quantity of the material. The most carefully excavated sites seem to be in Denmark, but there are some fairly up-to-date excavations from Poland. It is hard to judge them when one cannot read the original publications (the summaries in foreign languages are only a few lines), but the original reports when you look at them seem rather short and the photographs suggest a rather simple excavating technique. The author does not really tell us enough about them. The German excavations are few and not very informative. In England there are several full publications of substantial excavations, and though they fall outside the area of study, they contain enough analogies to be useful in interpreting results from northern Europe. In an appendix the author lists 168 localities where unchambered long barrows occur singly or in groups. Her general conclusion is that they show "a pool of architectural, ritual and constructional elements, of which only a selection will be apparent within any one monument". Some of the main elements of this pool are as follows.

There is always an enclosure, rectangular or trapeziform, usually of big stones, but sometimes taking the form of a palisade and on rare occasions of a plank wall. Within this enclosure soil has usually been added, creating a barrow, but flat monuments without barrow do occur. Obviously a palisade is meant to be free-standing and is adapted to a level enclosure, while a stone kerb or a plank revetment is intended to hold in the earth of a barrow, but from the way she deals with the subject it is not certain that Midgley has fully appreciated this distinction. Inside the enclosure are found graves, and sometimes other structures as well, which do not immediately invite description as graves. One end of the barrow is more important than the other, whether it is marked by a timber facade, as seems often to have been the case in Denmark, or it is built wider and with larger stones, as in Poland. Some of the Polish and German structures have internal cross-walls, which Midgley sees as essentially the same as the cross walls of hurdling occasionally found in early Danish long barrows. She suggests tentatively that these divided the barrows into segments with different functions in the ritual use of the monuments.

Because of the excavational problems it is hard to know what all the internal structures were, but there is a major division, which Midgley does not sufficiently emphasise. This is the dichotomy between closed graves and re-enterable chambers – which is the essence of Torsten Madsen's Konens Høj and Troelstrup types. On the other hand she fully appreciates that wood was the most important material in grave and chamber construction, even though all that remains is the supporting stones. Of course the same dichotomy goes again with megalithic structures. Though there are two chambers at Wietrzychowice barrow 3, re-enterable chambers like the Danish ones seem to be rare in Poland and Germany. Some late Kujawian monuments have at their eastern ends very curious large wooden rooms with heavy post construction. These do not seem to have counterparts in other regions, but megalithic construction never reached Kujawy, so earthen long barrows had a longer life than elsewhere. They may perhaps be compared with the Danish mortuary houses.

Much interesting information is put together in this book, but it must be admitted that it is not always easy to discover exactly what has been found and which generalizations the author thinks may be drawn. No doubt the main difficulty originates in the problems of the original sources, but the lack of conciseness of the book itself is also a problem. It is all too obviously a thesis for a higher degree at a British university, being issued with little or no re-writing. The author of a thesis has to demonstrate wide knowledge and exhibit the ability to sift and evaluate, is *au courant* with the newest new archaeological speculations on the megalithic phenomenon and on occasion is able to disagree with them, and knows the various archaeological cultures inhabiting the north European plain. Mere presentation of facts is frowned upon in this context, but curiously enough it is just this that the ordinary archaeological reader requires. Thirty or forty pages telling about the present state of research into these structures, the emerging picture, and the problems that ought to be addressed in the next decade, would paradoxically convey more information than the present 330 pages, which it may frankly be admitted will be studied carefully by very few, and then mostly for the bibliographical references. Nevertheless Magdalena Midgley is to be congratulated for taking on this very difficult task, which enables the non-Polish reader to get an idea of the latest Polish excavations and of the number of field monuments that have been recorded. We may hope it will inspire to the publication of the many unpublished or inadequately published excavations, and will contribute to a better international coordination of research into the construction and use of Neolithic ritual and burial monuments.

David Liversage

BEN A. NELSON (ed.): *Decoding Prehistoric Ceramics.* Center for Archaeological Investigations, Southern Illinois University at Carbondale, Publications in Archaeology. Southern Illinois University Press, Carbondale and Edwardsville, 1985. 411 pp, 52 tables, and 82 figs.

This collection of articles carries on an American tradition of providing, periodically, a survey of theoretical discussion relating to a subject. The genre has famous models, such as A.P. Vaydas' *Environment and Cultural Behaviour*, 1969, and S. and L.R. Binford's well-known *New Perspectives in Achaeology*, 1968. The book under review here is less ambitious in its scope in that it grapples only with a section of the problem of archaeological efforts to reconstruct social development, namely work upon pottery. Those articles within it which are focussed upon theory-formation give expression only to the wish to develop and refine theories of the type Binford refers to as 'midrange theories'.

The source of the book was a symposium held at 'the forty-fourth annual meeting of the Society for American Archaeology in Vancouver' under the title of 'The Explanation of Ceramic Variation'. Since then several articles have been added, some have been withdrawn, and others have been revised.

As Ben A. Nelson admits in the foreword, the division of the book into chapters has been agonized over. It is divided into five parts:

Part One: Stylistic Variation and Social Organisation
Part Two: The Organisation of Ceramic Production
Part Three: Assignment of Form, Function and Context
Part Four: Further Lessons from Ethnoarchaeology
Part Five: Comment

In fact six of the book's fourteen articles form a compact group in that they all consider how variations in style – principally, here, decoration and surface treatment – are to be interpreted relative to social development. These are articles by authors much concerned with the formation of theory relevant to this issue. This group comprises the five articles in Part One and the one article in Part Five. The remaining articles in the book have more diverse subjects, though no less interesting: Part Two comprises two articles which in contrast to the rest of the book deal with more specialised pottery production – the possibility of identifying specialised pottery production sites, and how the style in and the location of specialised production reflects structural aspects in the relevant societies.

Parts Three and Four comprise articles on how a pot's function is reflected in its form, based on ethnological examples, and on studies of the functioning life of a pot. There are finally two articles on checking an intuitively formed classificatory system by cluster analysis and on the uncertainty of measurements of a pot's rim diameter, with a new instrument for this purpose introduced.

The central theme is thus illuminated from many angles. Those articles which are probably of widest interest are those on style theories, also because these theories are relevant not only to ceramic material but also to other objects with other than technologically determined features.

The best survey of the style theories which are the basis of the theoretical discussions in the five articles of Part One appears in Part Five, in J.N. Hill's article 'Style: A Conceptual Evolutionary Framework'. He works through the two concurrent style theories which are developed in the articles in Part One and attempts to integrate them within a single conceptual framework. It seems therefore sensible to begin a survey of the book's contents by reviewing the main parts of J.N. Hill's article.

The source of the discussion of pottery styles as an expression of social development is the classic works of J. Deetz (1966) on the development of the Arikara indians' pottery in relation to the historically known development in the settlement pattern of these indians, together with the two works by W.A. Longacre (1970) and J.N. Hill (1970) where the division of decorative styles within two pueblo societies forms a basis for conclusions about the social structure on the sites. The style theory which the two latter in particular gave expression to has since been christened 'the social interaction theory'. Put most simply it implies that the closer the social connection between two groups of potters the greater will be the similarity between their pottery. Style is socially inactive, and once learnt is not changed. A style's dispersal takes place through simple diffusion: a person adopts style elements simply because he comes into contact with them, and changes in style will only happen through changes in the process of learning, as a consequence of a break in communication between pottery-producing persons or groups or as a consequence of disruption of the cultural process. This theory has subsequently been strongly criticised both from archaeological and ethnographical quarters, and J.N. Hill also regards it in a particularly critical light.

The second theory is called 'the information exchange theory' and was originally formulated by H.M. Wobst (1977), who uses, however, a very narrow definition of style. He defines style as a term denoting 'the formal variability in material culture that can be related to the participation of artifacts in the process of information exchange', in contrast to the more common understanding of style as all the features of an artefact which are not the products of practical (i.e. functional in a technological context) determinants. Despite this narrow definition, the 'information exchange' theory has become widely disseminated, and it has transpired that some of its presumptions stand up within a broader definition of the term. The idea of treating style as a vehicle for messages, partly serving to delimit groups relative to one another and partly marking an individual's membership of a group, has proved to be of considerable theoretical interest.

It is this conceptual framework, with greater of lesser adjustments, which is used in four of the five articles in the first part of the book. This style theory offers a much greater opportunity of explaining abrupt stylistic changes spatially and temporally, in that style becomes an expression of the social limitations which weigh upon the individual potter's choice of features rather than an expression of which features are known to the potter. Style thereby becomes something socially active, where in the 'social interaction' theory it was socially passive.

As J.N. Hill indicates, there are also problems with the 'information exchange' theory. Obviously not all features of style are used for the exchange of social data, and style also varies over time without there being any case for any significant social variations. J.N. Hill therefore develops a new conceptual framework for the explanation of style development in which the concepts are compared with and explained through concepts from the biological theory of evolutionary development. He also emphasizes, as indeed is done in several of the articles in the first part of the book, that style is to be regarded as a structured entity with many hierarchical levels, like a spoken language with 'a combination of phonemes to create morphemes, morphemes to create lexemes, lexemes to create phrases, phrases to create clauses, clauses to create sentences and sentences to create texts' (p. 375). He thus stresses that the choice of sub-elements, elements and the spatial disposition of decoration are separate choices which may well reflect the expression of different phenomena, individual peculiarities as well as a wish to mark one's membership of a certain household, family, group and/or some greater community. The items, of all levels, from which the choice is made, are those which are represented in the individual's 'style unit pool', namely all the style units the individual knows or can invent. The composition and range of this style unit pool will be dependent upon just those factors which the 'social interaction' theory stressed, the intensity of the social interplay between potters, and is dependent upon the same two phenomena which were determinant here, diffusion and innovation. Thus in J.N. Hill's new conceptual framework these two concepts are reduced to be those factors which form the 'style unit pool', whence new decorative details are drawn as required. When and to what extent that happens is an option dependent upon the potter's social context. On top of this the concept of 'drift' is also introduced, used to explain minor changes in style through time: this may well be characterised as something like chronological tendencies which do not necessarily signify any more than a certain opposition between generations.

This treatment of the concept of style with terms borrowed from biological developmental science looks immediately provocative, but in fact is very illuminating. J.N. Hill's article is thought-provoking, and can be recommended to all who work upon changes in style.

The five articles in Part One of the book can thus be regarded as examples of the practical application of the 'information exchange' theory in particular.

The first of them, M.W. Graves, 'Ceramic Design Variation within a Kalinga Village: Temporal and Spatial processes', describes analysis of ceramic material collected in connection with an ethnoarchaeological investigation of pottery production in a few villages in northern Luzon, one of the Philippines. The analysis seeks to assess the number of bands of decoration on pots in relation to pottery sizes, and the year of birth, family and work group of the potter. A clear relationship was found between size of pot and the number of decorative bands, and between the age of the potter and the number of decorative bands, but this latter relationship in particular varies somewhat from work group to work group and family to family. Analyses of other features than the number of decorative bands of the pottery decoration have shown certain differences between families but not between different work groups. (These analyses are reported only very fleetingly in the article). The change which is reflected in the analysis of the number of bands on the pots is thus a slight change in style over time, and is compared by M.W. Graves with the concept of 'genetic drift'.

The other two articles from the first five which I found particularly interesting are J.L. Brunson's 'Corrugated Ceramics as Indicator of Interaction Spheres' and D.P. Braun's 'Ceramic Decorative Diversity and Illinois Woodland Regional Integration'.

J.L. Brunson's article is particularly interesting for her theoretical assessment of (*inter alia*) borders between groups, where, on the basis of ethnographic examples, she develops the concept of 'semiclosed boundaries', cases of boundaries crossed by a flow of individuals or indeed groups such as, for example, when several groups can enter into a single resource area, so that there is a certain overlapping of the different groups' territories. She also works with a division into MES-groups, 'the minimal number of individuals a group would require to remain a viable functioning entity', bound together by a network of exchange and ritual communication. It is a most interesting way of understanding the social structure, but I have some doubts as to whether it is reasonable to use these terms borrowed particularly from works on hunter-gatherer communities, on technologically more complex communities.

D.P. Braun analyses the variability, i.e. the range of ornamental details, both elements of decoration and how they are arranged, on rim sherds from settlements in five localities lying within a mutual distance of about 100 km. The period under investigation is very broad, *circa* 200 B.C. to 600 A.D., although with an emphasis on the period 200–600 A.D.

The goal is to look more closely at social co-operation between groups in this perid, which hitherto has been treated as a period in which there is growing isolation and failing contact between the groups, while D.P. Braun rather believes that there must have been increased co-operation between them. One of the reasons for believing in increasing isolation between the groups has been that individual groups' ceramic decoration becomes simpler. D.P. Braun is able to show that this simplification of decoration does not only take place in individual localities but is also apparent when one treats a larger area as a unit. His opinion is that this must be interpreted as a common tendency which is in fact an expression of increased co-operation. I would regard this as a theory which cannot be supported by pottery evidence alone, but since there are also other factors which indicate increased co-operation between the groups one may concede to D.P. Braun that there is nothing in the pottery evidence to contradict this.

So much for the articles on the formation of theory for the interpretation of pottery styles.

Several of the remaining articles in the book are also of interest, such as M.F. Smith Jr.'s article 'Toward an Economic Interpretation of Ceramics: Relating Vessel Size and Shape to Use'. The subject of this article, how a vessel's use influences its form, is a problem which everyone working with the clasification of pottery should give closer consideration to. M.F. Smith Jr.'s article includes a survey of the morphological variables which she believes it is reasonable to define on a pot and their functional significance, together with a list of morphological features which constrain a vessel's usefulness, both developed on the basis of ethnographic studies. Although these two lists could well be extended by considering what use a pot can be put to, and may subsume some rather too narrow interpretations of features on the pots, they are nevertheless thought-provoking to anyone who has or is working upon the ceramic material from a settlement site.

M.F. Smith Jr. also constructs a little test of the possibility of recognizing the function of a small number of pots from an ethnographic context with a known function on the basis of their formal attributes. She concludes that the features which are best suited to dividing them up into groups are the accessibility of the contents, expressed by the rim-diameter and volume, and the volume itself. It is hardly remarkable that the accessibility of the contents and the size of the pot are most decisive as regards function, but it is reassuring to find this confirmed. M.F. Smith Jr. reaches some rather finer results, leading her to venture propositions of more specific correlations between pot-form and function. The broad validity of these correlations is however debatable: for example the requirement that vessels for transporting liquids will always have a small diameter mouth. This appears most reasonable and will certainly apply as a rule, but is contradicted by the existence of the common water bucket. But she also points out that most pots' forms are dependent upon several considerations which are often conflicting. The form of the bucket is thus more closely determined by another of her rules: 'Orifice size is proportional to the rate of changeovers in pot content'.

M.F. Smith Jr. also presents a very sophisticated method for calculating the volume of a pot which requires, however, access to a very advanced data technique, and she further analyzes the possibility of recognizing the functionally-determined features of a pot on the basis of sherds. Unfortunately the factors which she isolates as the most important, the grouping of the sherds into categories of different profile-angles, is just what must be regarded as one of the most difficult aspects of sherd material, but the second most important is the differentiation of the sherds' diameters which are rather easier to determine.

Ben A. Nelson's article 'Ceramic Vessels and Their Systemic Contexts' also deals with different points which are very interesting in connection with practical studies of settlement-site pottery. He spends some time upon a practical method of measuring and reconstructing vessels and calculating their volume, a somewhat coarser and simpler but also more practical method than the one presented by M.F. Smith Jr. He also gives an account of a successful attempt to interpret the sequence of layers in the fill in the rooms of a pueblo through mapping sherds from a single pot. He was thus able to show that there were separate activity zones on the roof of the rooms, and the mapping of large storage jars has also produced interesting information on the structuration of storage capacity on the site. He finally enters upon an ethnoarchaeological study of pottery from the Mayan Highlands in Guatemala. In this context he has also provided a summary of the number of pots in the individual households of seven separate ethnographic societies wherein pottery production is undertaken on a domestic level. This is a most interesting but rather discouraging table, since the number varies from 5 to 129 vessels per household as minimum and maximum between 6 and 62 vessels per household on average for the individual cultures.

The two articles in Part Four both deal with the calculation of vessels' 'use-life'. The first of them, W.A. Longacre's 'Pottery use-life among the Kalinga, Northern Luzon, the Philippines' adds to the results of the investigation which M.W. Graves also treated, while by contrast W.R. de Boer deals with data collected as part of an ethnoarchaeological study of pottery production amongst the Shipibo-Conibo indians in Peru.

Both reach the general conclusion that large vessels, rarely moved and/or used, live longer than small and medium-sized vessels which are in daily use. In other words one should expect large vessels to be relatively under-represented in an archaeological context while medium-sized cooking pots, for instance, will be over-represented relative to the number of vessels which in fact are in contemporary use on a settlement site.

W.A. Longacre also considers how an economic change in the direction of increased wealth influenced the Kalingas' pottery composition. Many took the idea of replacing traditional water jars with more expensive plastic vessels, and the increased wealth led to more feasts, which in turn increased the need for large cooking vessels to cook the food in.

As was mentioned in the introduction, two of the book's articles stand apart from the others in dealing with specialised pottery production as opposed to domestic production. These are the two articles in Part Two, B.L. Stark, 'Archaeological Identification of Pottery Production Locations: Ethnoarchaeological and Archaeological Data in Mesoamerica' and G.M.

Feinman, 'Changes in the Organization of Ceramic Production in Pre-Hispanic Oaxaca, Mexico'.

B.L. Stark concerns herself with how we may locate specialised pottery production sites through the combination of various sources of evidence, such as stamps, possible kilns and piles of wasters. G.M. Feinman describes how one can say something about the connection between the economic and administrative structures in a state-society through integrating changes in pottery style and the placement of pottery production places within the settlement pattern. Both articles should interest researchers working upon late Danish prehistory and the Middle Ages.

Finally an account of P. Froese's 'Pottery Classification and Sherd Assignment' is required. In this article the authoress attempts to replicate the intuitive classification of a number of pots through cluster analysis on the basis of a number of formal attributes. The credibility of her analysis is unfortunately somewhat weakened in that the eight groups produced do not look very logical: there are very diverse vessels in each group, and conversely similar vessels in different groups. P. Froese nevertheless believes that she can see a confirmation of the intuitive classification in the cluster analysis.

As has been indicated, there is a great deal of discussion about style in this book, and it would perhaps be reasonable to cast a critical eye upon certain points of the book's own style.

A slightly irritating feature is the rather self-conscious scientific language. A second point is the use of very complicated statistical analyses, which do indeed now and again give an improved overview, but at other times appear more to cloud facts, or attempt to include so many variables in a single analysis that an overview is lost. An example of this is D.K. Washburn and R.G. Matson's analysis of symmetry in the composition of painted patterns on Anasazi pottery in the article 'Use of Multidimensional Scaling to Display Sensitivity of Symmetry Analysis of Patterned Design to Spatial and Chronological Change: Examples from Anasazi Prehistory'. In this a smooth transition between two apparently rather different, separate periods is indicated. Another example is K.W. Kintigh's analysis of the distribution of styles in the Cibola pottery from three pueblo locations 'Social Structure, the Structure of Style, and Stylistic Pattern in Cibola Potery'. In this such varied features as vessel-type, fabric-type, colour slip, colour and gloss of painting, elements of ornamental detail and various traditional style-groups such as St. John's Black-on-Red or Kwakina Polychrome are analyzed in one go, and I, for one, could not maintain any overview. Otherwise the statistical analyses are often so briefly referred to that it is difficult to evaluate their application in these articles. The use of complicated statistical analyses appears to be a style-feature used by the group of recent, theoretically-inclined American archaeologists to differentiate themselves as a group.

Another feature of the book's style is the use of illustrations. Very consistently two types of illustration are used, ethnographic pictures and graphs. The former are both very illustrative and charming: the picture of a little girl learning to make pottery from her mother is worth the whole book put together (p. 11), and a picture of a dog stealing food from a pot on p. 341 shows clearly what forces we might reckon with limiting the life of a vessel on a settlement site.

The graphs are also often very illuminating and also often necessary to understand the analyses referred to, while at the same time giving the book a respectable, technical stamp.

One misses, however, pictures of some of the objects which the analyses, after all, are based upon. The general validity of the theories would not suffer from the reader getting to know what a 'corrugated' vessel or an example of St. John's Black-on-Red actually looked like. We should certainly not forget that archaeology is about people, but neither should we forget that the raw material we actually work with is objects and layers. And it is precisely in books which are directed at a wider, theoretically-inclined public, as one must presume this one is, that one cannot suppose all readers to be familiar with all the fine points of American archaeological typology. But it is part of the style in books of this type that artefacts are not illustrated, and after having read about the essential role of style in maintaining and distinguishing the group one scarcely dare urge a stylistic rupture. [Translated by John Hines]

Eva Koch Nielsen

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Pia Bennike: *Palaeopathology of Danish Skeletons. A Comparative Study of Demography, Disease and Injury.* Akademisk Forlag, Copenhagen 1985. 272pp.

As Roy L. Moodie introduced the name "palaeopathology" in his "Standard Dictionary" 1895 – a term which originally means the study of diseases and injuries of man of prehistoric and nonliterate societies – several works on the subject had already been published. However, it was during the following 30–35 years this discipline flourished, mainly by works of anglo-american scientist like Elliot Smith, Wood Jones, Ruffer, Hrdlička, and others.

After the last war palaeopathology again became an "accepted" science, and has since got followers all over the world.

Today the international "Palaeopathology Association" has more than 400 members.

Within Scandinavia Denmark has actually been the "leading country" in this discipline, and scientists like f.ex. K. Fischer-Møller, K. Isager, and V. Møller-Christensen, only to mention a few, have become names of celebrity.

During the last years a new generation of Danish anthropologists have proved to carry on this tradition. Among them Pia Bennike is already well known as an author of several papers of palaeopathological nature, and she has been employed for as a lecturer in European countries as well as in the USA. The investigation and book in question earned her a medical Ph.D. at the University of Copenhagen.

"Palaeopathology of Danish Skeletons" is indeed a promising title for a scientific work, with a great responsibility laid on the author, because it is the first time such a work has been undertaken. Thus, we are told the prehistoric health conditions of a whole country presented after examinations of almost 2000 individuals.

The book opens with an introduction showing the distribution of the examined finds – skeletons from Stone Age to Medieval Ages – in geographical (with the main part from Zealand) as well as historical-chronological connection. Particularly meritorious is the data recording system developed by the author, related to this work, where more than 300 data have been registered for each individual find. Standard reports of sex and age are given. Also the average individual stature for the single periods is indicated in tables, and it is conspicuous – in spite of a comparatively modest amount of material within the single groups – that the stature seems to have been significantly higher than the estimates from other countries. Perhaps these figures are related to the well known assertions of Caesar, Tacitus or Jordanes, mentioning their tall, Nordic neighbours.

The actual pathology is divided into 4 sections, each describing the most usual discoveries which can be made on human skeletal remains. It is common knowledge that only a few of the diseases of man leave traces on the bone itself. The present investigation shows for instance that the frequency of bone fractures is dispersed among male and female individuals in a similar degree to today. But in distinction from modern people, the fractures of ulna (the elbow bone) take up a dominant position, which undoubtedly must be related to injuries of violence. Other forms of traumatic lesions are also reported.

An important part of the chapter is devoted mention of trepanned skulls. These put Danish anthropology into a very special position, as Norway, for instance, only can display one uncertain case, while the present book refers to 18 cases altogether.

In the second section cases of osteo-arthritis are mentioned, i.e. conditions of rheumatic or attritional influence of the bone. A proportional high degree of this can probably be connected with the hard way of living in the past, but possibly a basis of individual sickness (f.ex. scurvy) also exists. However, the material is too small to draw certain conclusions in that way.

The dental health of the past has been given a detailed mention. Also in this investigation it is stated that the people in older days had their teeth worn to a significant higher degree than today. Striking is the higher amount of caries than what people today generally connect with the traditional, good dental state of the past, even if this seems to have appeared in adult/mature age, in contrast to our time where already the major part of the children are affected.

Almost sensational is the find of a neolithic male skull with a drilled hole – possibly made with a flint borer – in a carious tooth!

In the last part of the book "special finds" are mentioned, such as occurrence of tuberculous bones, osteomyelitis, rheumatoid arthritis (which perhaps should have been included into another section?) and tumours.

Each chapter is introduced by a general and historical survey of the single diseases and those are again described in the "reports", with find sites, museums, find numbers etc. specified. The book is primed with illustrations and well arranged tables.

Of course some of the cases and diagnoses in this book could possibly be subject to some further discussions. It is, as one may realize, not always easy to make a thousand years old diagnosis with certainty. However all things considered, the present work is of a very solid kind, which will make it a standard work within palaeopathological literature.

Per Holck.

INGA HÄGG: *Die Textilfunde aus dem Hafen von Haithabu.* Berichte über die Ausgrabungen in Haithabu. Bericht 20, 1984. Mit beiträgen von G. Grenander Nyberg und H. Schweppe. Karl Wachholtz Verlag, Neumünster. 290 pp.

With the *Bericht 20,* a new substantial North European textile collection is published, and Hedeby/Haithabu can be added to Elisenhof, Hessens, Birka, and the many Danish and North German Iron Age textiles from bogs and burials. Some minor groups of Hedeby textiles have earlier been published (Ullemeyer 1970, Bericht 4, and Hundt 1984, Bericht 19) but its 170 fragments make this collection far the most important group. Moreover, details on many of the textiles show that they once were parts of garments, and this feature is used as basis for the identification and discussion of Viking Age Scandinavian costume.

Inga Hägg, who has been chosen for the task of publishing the Hedeby textiles, has earlier examined the vast textile material from Birka and in her dissertation from 1974 she presented her interpretation of this important material; this (and her other published works) is concerned more with costume than with the textiles themselves, and the same bias is felt in the Hedeby publication.

After an introduction, a presentation of working methods, and a description of the secondary use of the textiles (as tarrags and caulking for boats), the book's first main section is concerned with the description of each of the pieces found;

under the headings leg-garments, a pinafore, tunics, over-clothing, and felt. A second main section is headed "The Weaves", and describes the cloth types found in the Hedeby material; each type in turn is compared with contemporary parallells. After a short section on seams the third main chapter puts the garments and parts of garments from Hedeby in a wider context; here, again, each type of garment is described separately. Finally a short section on weaves and cloth types in a broader context and a summary (in both German and Swedish) complete the text. Pp 230–57 are tables of weaves from Hedeby and the other sites used as comparative material; pp. 258–60 contain a code to the drawings, and a short dictionary of textile vocabulary; pp. 261–70 is the catalogue (in tabulatory form). An index (pp. 271–72) and a bibliography (pp. 273–86) complete Hägg's part of the book; pp. 287–90 contain two small contributions by G. Grenander Nyberg (on Z- and S-spinning) and H. Schweppe (on dyestuff-analyses).

The first main section of the book, the description and interpretation of the various textiles as parts of garments, is the most important, but also the most controversial part of the book. Almost all of the 170 textile fragments that were salvaged from 93 tarred rag-balls are identified as parts (or probable parts) of garments; the documentation is mainly meticulous drawings of each piece, supported sometimes by photographs of the same piece, or parts of it. Some pieces are easily identifiable, like leggings (fig. 10–12) or the sleeve of a tunic (fig. 35–38); others are mere rags, although the shape resembles what Hägg suggests as an identification – a good example is fig. 44, a part of a doublet. Some do not even resemble their suggested identification very much, like the so-called face-mask of a calf (fig. 46–47).

In some cases, Hägg's documentation does not seem quite quite sufficient, and the reader is left with the impression that the author is pressing her identifications a bit too far. It seems too much of a happy accident that almost all textiles should be remains of garments; after all, textiles are used for a multitude of purposes, and even sailors have bedclothes, towels, carpets, tarpaulins etc., not to forget the sails of the ships; and one would expect such things to be represented in a collection like this. Still, many of Hägg's identifications seem fully justified, and under all circumstances it is a very important task for textile scholars to go beyond the study of weaves and make a bid for the reconstruction of garments and costumes. In Denmark and North Germany, we are blessed with a unique collection of completely preserved costumes from Antiquity, and in many ways this singular material has made us blind to the possibilities of rags and fragments. Most textile scholars studying such rags (including the reviewer) restrain themselves from reconstructing more than very vague outlines – well knowing that any such will be grabbed by eager hands and used repeatedly, and well over any scientifically defensible limitations, to illustrate life in the past. It takes courage to put forward a qualified bid for an interpretation of prehistoric clothing, which is far much more difficult than criticising a proposition already set up. Therefore, the reviewer welcomes Inga Hägg's interpretations warmly, although not believing in all of them.

The second main section of the book is the description of the weaves and cloth types, including comparative material from North Germany, the Netherlands, and Denmark. This section is the weakest part of the book: the author's background as a student of costumes rather than textile technique is clearly reflected.

Technically, some weaving terms are wrongly used: e.g. the word *Spitzköper* is used instead of *Fischgratköper*; the two words correspond to two different weaves with an important technical difference – point repeat or displacement, which in turn are related to the horizontal loom and the warp-weighted loom respectively. *Spitzköper*, with point repeat, is according to the illustrations not the one found in the Hedeby material. Similarly, *Rautenköper* is used instead of the more precise *Diamantkaro* (and *Spitzkaro*, which corresponds to *Spitzköper*). Other unfortunate details are that thread counts are made over 2 cm, not over 1 cm – all European textile researchers except of the Textilmuseum Neumünster and now Inga Hägg count over 1 cm; further, the description of the cloth types would have been more precise if the textiles had been grouped not only according to weave and quality, but to spin direction as well.

Hägg invents a new textile term: *Gewebedichte*, which means the number reached when adding weft-count to warp-count, and expresses the quality of the weave. The term is intended to overcome the problem of deciding which cloth is the finer: the one with count 9,5/9,5 (*Gewebedichte* 19) or the one with count 11/7 (*Gewebedichte* 18). The usability of the term is not yet quite clear – future work will decide whether the invention is a useful one or not.

The comparative material used by Hägg is restricted to a few North German, Dutch and Danish sites,plus the Birka material; both settlements (Elisenhof, Hessens & Middelburg) and cemeteries (Dunum, Thumby-Bienebek, Stengade, and Birka) are employed, and Hägg emphasises the differences between these two groups. Here, and in chapter 8, Hägg discusses the predominance of Z/S-spun fabrics in settlements, and Z/Z-spun fabrics in graves, and suggests that the difference is best explained by a difference in quality: the settlements contain remains of everyday wear, the graves the formal clothes of the upper classes. Thus Z/S-spun wool cloth is interpreted as the normal fabrics of Viking Age Scandinavia, although it is very rare in the graves, whereas Z/Z-spun linens and fine worsteds are argued to be luxury fabrics only worn by the few. Here, the reviewer has a different view and my main comment is that Hägg's comparative material is too limited. Hedeby was situated close to the border between three major cultural provinces: Viking Scandinavia, Carolingia, and the Slav region. A wider comparative material would have revealed that the picture is much more complicated (Bender Jørgensen in press).

The limited comparative material is a main weakness in Hägg's work: of the Danish material only the small Stengade cemetery is drawn in; two Viking cemeteries with textiles published by Østergaard (1977, 1978), and the Århus material (Lorenzen 1971), ought similarly to have been used, and the same goes for Margrethe Hald's standard work (1950, 1980) which has several Viking Age finds. Similarly, H.-J. Hundt has published over 100 German graves from the 5th–8th centuries with textiles; these, too, would have supplied a useful addition to the comparative material.

The third main section, on garments and costumes seen in a wider context, is the strongest part of the book; here, Hägg is quite evidently on her home ground. She provides an excellent combination of research history and source criticism, and surveys European dress from the Roman Period to the Late Middle Ages. The types of garments identified at Hedeby are discussed one by one in the light of all available evidence, which includes preserved costumes, pictorial evidence and written sources. But again, Hägg seems to have overlooked the contents of Margrethe Hald's work: she seems unaware of some medieval garments from Danish peat bogs, most conspicuously the tunic from Moselund with a split lower part not unlike those depicted on the Bayeux tapestry and by Hägg claimed as a possible parallel to fragment 66 from Hedeby.

The summary emphasises five main results of the work: that the Hedeby costumes is the product of a well-developed tailor's art, far removed from "primary garments"; that the cut of the garments is closely connected with medieval costumes, like those from Herjolfsnæs on Greenland (and the tunic from Moselund); that there is a close connection between the type of garment and the cloth type used for it; that the Hedeby costume reflects a stratified society; and that the costumes of soldiers in the Roman provinces, especially those of the Eastern frontier, had a strong influence on the shape of the garments found at Hedeby.

Of these five points, numbers one, two and four are safely brought home; point three is not quite as evident, and point five will probahly remain a matter of discussion.

A minor point: on p. 208 the author declares dyeing to be a novelty; in that case it is a 1,000 year-old novelty, since dyeing is common in Danish and Scandinavian textile finds since the 1st century AD onward (Hald 1950, p. 81; Munksgaard 1974, p. 24; see also Bender Jørgensen & Walton in this volume).

The two appendices explain the difference between Z- and S-spinning (Grenander Nyberg) and present the results of dye analyses on the Hedeby textiles (Schweppe) – in the latter case with surprisingly meagre outcome, as only walnut (*Juglans regia*) and a lichen dye (*Xanthoria parietina*), and perhaps alder (*Alnus glutinosa*) have been found; contemporary material from other sites has yielded a much wider range of dyes (e.g. Taylor 1982).

The book is well produced and is characterised by German thoroughness; this is especially evident from the many cross-references and the meticulously explained code to the drawings and vocabulary. Inga Hägg's book is an important and courageous contribution to the study of European costume and textiles, and it is sure to provoke discussion for years to come.

Lise Bender Jørgensen.

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ELSE ROESDAHL: *Viking Age Denmark*. London 1982. 272pp.

One might think that the need for books about the Viking period should have been satisfied long ago. Recent years have seen a torrent of composite works which have looked at this period from various angles. Several studies have been published in connection with the great Viking exhibitions which have been mounted in Scandinavian and other museums.

Nevertheless the publication of Else Roesdahl's *Danmarks Vikingetid* in 1980 appeared as an important and welcome event. The area of Denmark is certainly that in which the most important recent finds have been made, finds which have largely supplemented or changed our image of the Viking period. Roesdahl's book is also particularly based upon the archaeological evidence. The previous comprehensive presentation of the Viking period in Denmark from an archaeological viewpoint was J. Brøndsted's of 1960.

Viking Age Denmark, 1982, is an English version of the book of 1980. With a certain expansion of the bibliography, it follows the Danish original closely. That this important study has been made accessible to a wider readership can only be commended.

The book deals with the Viking period in Denmark. Denmark means here the old Danish area from the River Ejder in the south in what is now northern Germany round to and including Halland and Skåne in modern Sweden. The emphasis, however, lies upon present-day Denmark.

The study in fact covers not only Viking-period Denmark but also Viking-period Danes. Scandinavians' activities outside Scandinavia are thus included, especially in western Europe, on the continent and in England. It is commonly accepted that it was particularly in this direction that Vikings from Denmark directed their interest. Many spectacular aspects of the Vikings' world, journeys in the east along the Volga and Dniepr to Byzantium, the colonisation of Iceland

and Greenland and the discovery of America are mentioned very briefly if at all.

Nevertheless the period described is so rich and multi-faceted that it must be regarded as a wise move by the author to limit the survey to a "domestic perspective". This geographical limitation probably does greater justice to the rich and varied source material.

Viking Age Denmark presents a many-sided picture. Many topics are dealt with. The book gives an account of the most important of the different sets of problems which have been the subject of research in recent times.

As has been noted, the survey is based upon the archaeological evidence, but written sources of diverse kinds, which may illuminate or supplement the picture, are thoroughly described. The study as a whole is characterised by clear source criticism. The values of diverse sources are probed, and continually evaluated against one another.

The book is divided into twelve chapters: one introductory and a concluding one, and ten chapters in between devoted to different topics.

Chapter 2 is entitled *The Country and the People.* In this chapter the physical qualities of both the land and its Viking-period inhabitants are described as they appear from topography and climatic studies and skeletal material. The author is strikingly cautious in drawing conclusions and the material is extremely scanty. The number of inhabitants of what is now Denmark can perhaps be calculated by extrapolation from later medieval sources. The population could have been between half a million and one million in size. It is an estimate, but one qualified in such a way as helps us to appreciate what it is reasonable to postulate.

Social relationships can be assessed both from written and archaeological evidence. This is vague and inconsistent, but points nevertheless to a complex society with diverse status-positions and classes.

The pinnacle of society was represented by the king and his family and other major landowners – "undoubtedly proud, well-nourished, well-dressed people with a certain fixed set of moral standards and rules for good behaviour". Archaeological material seems to be directly proportionate to individuals' and groups' power and social influence. At the lowest level were found slaves and landless men, who only exceptionally have left any traces of themselves.

In Chapter 3, *Transport and Communications,* generous provision is made for the description of boats and seaways. Recent years' investigations have revealed harbour structures at Hedeby, Birka and Kaupang. A massive construction project such as the Kanhave Canal on Samsø also serves to illuminate both the provision for and the importance of seafaring. The evidence for communications on land may initially appear scanty, but fragments of wagons and riding gear from graves show something of how the leading members of society got about.

Chapter 4, *Settlement and Survival.* It is particularly useful to find here a brief but nonetheless full summary of recent years' major studies of rural settlement in the Viking period. However most of the comprehensive excavations which have taken place, principally in western Jutland, are the subject only of preliminary publication.

This material, centrally important for the understanding of the period as a whole, was hardly known just a few years ago. The impressive results are due to research which has been simultaneously pursued along diverse lines: regular excavations in existing or abandoned villages in order to trace them back to their foundation, systematic trial excavations in villages with various name-types in order to establish the date of their emergence, major systematic excavations of Viking-period settlement with the aim of establishing their plan and extent (e.g. Sædding, Trabjerg, Vorbasse and Omgård), excavation of greater or lesser parts of Viking-period settlements which have come to light through building work or excavations with different aims (e.g. Aggersborg and Lindholm Høje, where traces of a settlement in fact appeared as a by-product of the excavation of a cemetery and a stronghold), and finally registration of settlement traces through systematic surveying, field-walking and the study of aerial photographs.

The greater part of this new material is not as yet processed: amongst other things the datings are preliminary. However a definite pattern is emerging in which a much discussed problem is that of the shifting settlements, which are moved at intervals of a couple of centuries. The questions concerning the shifting of the Iron Age, and the fixed location of settlement sites from the beginning of the Middle Ages are briefly discussed. Else Roesdahl appears primarily to see agricultural techniques as factors behind the changes, but the interest of those with power in a more regulated settlement pattern, perhaps for taxation purposes, is presented as a reasonable hypothesis.

The wealth of Viking-period finds after a long period of paucity may be seen as a sign of economic expansion, founded in agricultural conditions. But one must also bear in mind which research has been intensively pursued, and how sources and theories will probably come to look different after just a few years.

The evidence that rural settlement in Denmark may have varied both chronologically and regionally is important. It is otherwise far too easy to take the well-documented material from western Jutland as a model for other areas.

Chapter 5, *The First Towns.* In the Viking period a new settlement-form is introduced to Scandinavia, the town. These are defined here as large, compact, permanent settlements with diverse functions as a central-place within greater or lesser areas. The criteria for identifying a 'town' and evidence of the fulfilment of these criteria are amongst the major problems within Viking-period research. Were one to be particularly critical, it is not necessarily the case that even the criteria Else Roesdahl sets up here are really fulfilled by the examples given. The author also argues that the picture of the earliest Danish towns is a varied one and that the archaeological data vary in character and scope. It is argued that most probably these towns differed from one another in form. They emerged at different times and from different backgrounds. A concise summary underlines the variations in the earliest urban material, with a substantial and awkward body of material usefully surveyed in just three pages.

In Chapter 6, an account is given of the material remains of *Trade, Industries and Crafts.* Amongst the trade goods, soapstone vessels, slate whetstones, quernstones and iron are noted. There is not a great quantity of material. It would have been interesting here to have seen a discussion of the possibility of estimating the level of trade and what role exchange of goods may have held in the society.

Chapter 7, *Daily Life.* The best information on how dwellings were internally appointed comes from Hedeby. Similar buildings, rather small, built of wood or wattle-and-daub, housed other Viking-period urban communities. Benches fixed into the ground and a hearth in the middle of the floor are features which recur in other buildingtypes. Furniture was probably limited, but finds of locks indicate that lockable chests often were a part of the inventory. Grave finds, such as that from Mammen, include textile remains. Costumes of the early Middle Ages are known from Sweden and Norway. Else Roesdahl does not go too far in supposing that communal rooms were decked with brightly-coloured textiles for special occasions.

Many other aspects of daily life are also considered, food, drink, domestic equipment and hygeine. In the section on hygeine various pictorial representations of people with well-groomed hair and beards are noted. It is well to remember that combs and various forms of toilet equipment occur amongst the known finds rather than relying primarily upon various Arabic sources' accounts on the subject of Vikings' care of themselves.

Chapter 8, *Armies and Fortifications.* The warrior's armament is known principally through weapon graves. In the Danish area most of these are from the first half of the tenth century. After the Danish evidence fails the next most informative source is Norway. Else Roesdahl takes care to extinguish a recurrent myth that the Vikings' principal weapon was the axe.

Viking-period Denmark is particularly rich in fortifications of various forms. New facts and theories concerning the *Danevirke*, town ramparts and the ring-forts are presented here. Discussion of the latter has taken on new momentum in and through the dendrochronological datings which leave it probable that they were built by Harold Bluetooth, and in any case have nothing to do with the raids upon England. The military character of the forts has also been diminished. Craftsmen, women and children were included in the fixed population.

A structural type of defensive character which is receiving increasing attention is the sea-barrier, the majority of which are dated to the Viking period or early Middle Ages.

Chapter 9, *Pagans and Christians.* There is little known about Scandinavia's pre-Christian religion. Those sources which describe it were written by Christian or Muslim foreigners, or set down long after the relevant period. Again the archaeological evidence may confirm or illuminate this information.

Picture stones, statues and so on depict gods or scenes from pagan mythology. Cult-sites however are harder to identify. No heathen cult-buildings are known from Viking-period Denmark. Place-names such as Viborg and Odense indicate how old cult-sites and presumably thing-places took on new functions during the course of the Viking period.

The conversion is reflected, amongst other things, by new burial rites and crosses and saints' names on rune-stones.

There were probably several reasons for the conversion, both practical and emotional.

Chapter 10, *Art and Ornament.* Both decorative art and poetic art were equally subject to definite rules. It is these rules which enable us to differentiate particular styles in the material. All of the styles Viking art has been divided into are briefly described here. By way of introduction the lack of interest in Viking-period art within art history is considered. This is founded upon an out-of-date belief that this vital art is a derivative reflex of foreign models.

Chapter 11, *Foreign Contacts.* As has been mentioned, the foreign contacts are viewed here from a Danish perspective. The character of the written sources provides us with a great deal of information on the Scandinavians' warlike activities in western Europe, while trade and other peaceful activities have only exceptionally left any mark here. Scandinavian settlements abroad, and the colonists' nationality, are best indicated by place-names. Various sources show that Denmark had substantial connections to the east. According to a runic inscription, Harold Bluetooth was married to a Slav princess. The massive influence of Slav pottery on Danish implies strong contacts. Bridge construction, which gains momentum in this period may very well be inspired from the Slav side, as may be the construction of the ring-forts.

The written sources concerning Scandinavian activities in western are extensive and of varying character. Else Roesdahl draws a comprehensive picture of military expeditions, missionary undertakings and marriage alliances. The material traces left by these extensive contacts are occasionally direct but usually indirect. Aspects as varied as the administrative organisation of the towns and the forms of dress-jewellery may be influenced by them.

In England, Scandinavian-influenced material has been recovered in York. In eastern England additionally a special hybrid Anglo-Scandinavian culture emerges with many manifestations in ornament and art.

It is an almost impossible task in the limited space available here to give a just picture of Else Roesdahl's *Viking Age Denmark.* Although bursting with factual data, it conveys a living picture of a dynamic period. This book will provide a starting point and a stable foundation for research into the Viking period in Denmark for a long time ahead. [Translated by John Hines.]

Birgitta Hårdh.

Recent Excavations and Discoveries

The following survey is based on summary reports of archaeological activities in 1985, submitted by the Danish museums to *Rigsantikvaren.* A review of all field investigations and major finds, including treasure trove and 370 notes on excavations, is published in Danish in *Arkæologiske udgravninger i Danmark 1985* (Det arkæologiske Nævn, Copenhagen 1986).

The reports for this section were selected and edited by Torsten Edgren and P.O. Nielsen.

Please observe the following abbreviations:

s. *sogn*, Danish parish

a. *amt*, Danish county

All places mentioned in this list can be located on the map p. 271 and identified by their no.

MESOLITHIC

1. SPARREGÅRD, Falster. Brarup s., Maribo a.

Settlement site. Trial excavation of a shell heap from the middle and latest Ertebølle Culture, found on an inlet now pinched off from Guldborgsund. With systematically placed trenches and bore-probes, the extent of the shell layers has been established, comprising 2 shell heaps along the foot of the same headland. The larger, western, heap measures c. 60 m in length, with a maximum width of 20 m. The eastern heap is smaller, c. 10 × 20 m. The thickness of the shell layers varies from 1 to 50 cm, but the excavation revealed no chronological differences in the artefact inventory between the upper and lower parts of the kitchen midden. The large shell-heap has yielded a large amount of thick-walled, pointed-based pottery, and flint and bone artefacts from the middle and latest Ertebølle period. Among the bones are several human ones, but remains of graves or clear traces of cannibalism have not been observed. A couple of Neolithic flint objects have been found on the surface, but there are otherwise no signs in the culture layers at Sparregård of more recent occupations of the site. – *Nationalmuseet*, Prehist. Dept., no. 1121/75. [Peter Vang Petersen]

2. RINGKLOSTER, East Jutland. Hylke s., Skanderborg a.

Inland **settlement site** of the Ertebølle Culture. Excavation continued from 1984 and concluded in 1985, comprising an area of the settlement on land, measuring 5 × 7 m. Under a c. 15–20 cm thick culture layer with charcoal and artefacts of Ertebølle type, a number of bowl-shaped stone- and charcoal-filled pits were found in the subsoil. In addition, there were a number of small, circular changes in soil colour and consistency (dia. 40–60 cm), which are perhaps post-holes. The pits containing charcoal measured c. 1–15 m in diameter and had a depth of c. 20–40 cm. The fill was sandy and contained a large amount of charcoal with scattered "fire-embrittled" stones. In the SW-corner there was a round stone-bedded fireplace with a diameter of c. 120 cm. All structures must be dated to the late Ertebølle Culture. – *Forhistorisk Museum*, Moesgård, no. 1592. – Lit. *KUML* 1973–74. [Søren H. Andersen]

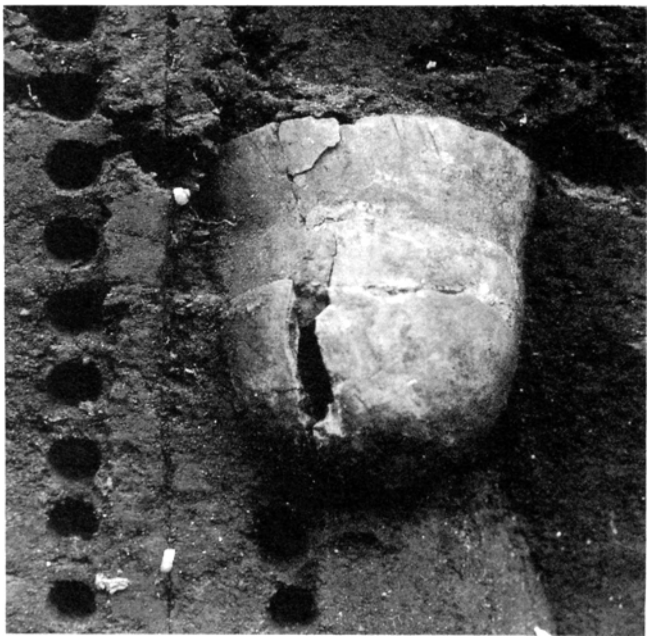


Fig. 1. Funnel beaker found *in situ* at the late Ertebølle/early TRB settlement, Kongemose L, Western Zealand (no. 3). A preliminary pollen analysis indicates that the vessel was deposited (sacrificed) in the lake close to the settlement at the very beginning of the elm decline (photo by A. Fischer).

MESOLITHIC AND NEOLITHIC

3. KONGEMOSE A and L, West Zealand. Stenmagle s., Sorø a.

Settlement sites. As a result of systematic reconnaissance in the Store Åmose basin carried out by the National Agency for the Protection of Nature, Monuments, and Sites, a number of

Late Mesolithic and Early Neolithic settlement sites were found. The site 'Kongemose A' from the late Ertebølle Culture was excavated in 1984. A trial excavation took place at another site, 'Kongemose L', in 1985 (fig. 1). It was extremely rich in well-preserved finds of organic materials. An up to 30 cm thick heap of settlement rubbish was present, the main components of which were hazelnut shells, fishbones and -scales and shells of freshwater mussel. Wood and bark were also present, and numerous bones of birds and in particular mammals. Flint implements comprised rectangular transverse points, surface-chipped flake axes and specialized core axes. The considerable pottery material comprised sherds of blubber lamps, flared Ertebølle vessels and funnel beakers of typologically early form. The main purpose of the excavation was to investigate the stratigraphical placement of Ertebølle and Funnel-Beaker pottery. – *Nationalmuseet*, Prehist. Dept., no. 4886/83. [Anders Fischer]

4. BJØRNSHOLM, Northern Jutland. Ranum s., Ålborg a.
Settlement site from the Late Mesolithic (Ertebølle) and the Early Neolithic. An excavation of the kitchen midden was carried out by the National Museum in 1931, after which the site was protected. In 1985, a new investigation was started with a view to obtaining an absolute dating, sample of artefact material, and material to illuminate economy. A N-S trench measuring 27.5 by 1 m was opened through the midden. Under an up to 70 cm thick covering layer of secondary, sandy topsoil was found a c. 10 cm thick culture layer with post-holes, floors and remains of paving, assigned to the late Pre-Roman/ earliest Roman Iron Age. This layer was again separated from the kitchen midden by a c. 20 cm layer of sandy topsoil. The shell heap was found throughout the length of the trench and showed in the eastern part a stratigraphical sequence in the uppermost and most recent layers consisting mainly of cockles with artefacts from the Early Neolithic Funnel-Beaker culture of Volling type. Under this were shell layers dominated by oysters with Ertebølle artefacts. The shell layer apparently continues both east and west of the protected area. A large artefact material of flint, antler and pottery was unearthed. Preservation conditions for organic remains were obviously excellent, and large amounts of animal bones, especially fishbones, were found. In both the Ertebølle and the Early Neolithic culture layers, fireplaces were found in the form of patches of varying size (dia. 30–100 cm) of charcoal and burnt, caked shell-mass. – *Forhistorisk Museum*, Moesgård, no. 2911, and *Aalborg historiske Museum*, no. 972. [Søren H. Andersen/ Erik Johansen]

NEOLITHIC

5. LIMENSGÅRD, Bornholm. Åker s., Bornh. a.
Settlement site. Continued investigation of settlement from late Funnel-Beaker Culture, Late Neolithic and Early Iron Age. In 1984, 1 long-house with partly preserved wall trench from the late Funnel-Beaker culture, 4 Late Neolithic long-houses and 2 long-houses from the early Iron Age were investigated (*JDA* vol. 4, pp. 101–14). In 1985, a further long-house from the late Funnel-Beaker culture (fig. 2) and centre-post rows belonging to another 8 houses of the same type were found, with 7 new Late Neolithic long-houses and 4 Iron Age houses, several of which have been only partly examined. The houses from the Funnel-Beaker Culture belong to the same house type as at Grødbygård (no. 6), and represent a period corresponding to Middle Neolithic V, which has not been documented before on Bornholm. The Late Neolithic long-houses are, like the Funnel-Beaker houses, centre-post houses. They attain a length of 44 m and are the largest Late Neolithic buildings to be found in South Scandinavia so far.

Grave finds were a cist grave from the Battle-axe Culture, cremation graves, and inhumation graves from the early Iron Age and early Germanic Iron Age. (See also no. 21 and 26.) – *Nationalmuseet*, Prehist. Dept., no. 5166/83. – Lit. *Fra Nationalmuseets Arbejdsmark* 1986. [Finn Ole Nielsen/Poul Otto Nielsen]

6. GRØDBYGÅRD, Bornholm. Åker s., Bornh. a.
Settlement site. Continued excavation of house remains from the late Funnel-Beaker Culture. The houses are two-aisled with interior supporting posts and – in the better preserved – wall channels with closely set small posts. Parts of 3 houses from the end of the Funnel-Beaker Culture were found. A number of pits in a row close to the houses contained material from the Early Neolithic/Middle Neolithic I. The site was found in connection with the investigation of a cemetery from the Roman Iron Age. – *Bornholms Museum*, Rønne, no. 948. – Lit. *JDA* vol. 4, pp. 87–100. [Lars Kempfner-Jørgensen/ Margrethe Watt]

7. SKAGHORN, South-west Funen. Helnæs s., Odense a.
Settlement site. Excavation of rubbish layer bedded in peat. The rubbish derives from a small and apparently short-lived occupation in period Ia of the Middle Neolithic. Almost the entire layer – about 200 m^2 – has been excavated, from which 14,701 objects have been obtained and registered, including 1,613 well-preserved animal bones, some carbonized corn and a varied flint and pottery material. This material, which is contemporaneous with that from the nearby Sarup site, exhibits a marked difference in its make-up, which must be interpreted as a sign of differing activities at the two sites. – *Forhistorisk Museum*, Moesgård, 2872; *Fyns Stiftsmuseum*, Odense, no. 4087. [Niels H. Andersen]

8. NAB-KILDEGÅRD, South-west Funen. Astrup s., Svendborg a.
Grave. In an area with stray finds and settlement traces from the Viking Period, an Early Neolithic grave measuring 1.60 × 0.96 × 0.42 m was found. At the east end of the modest E-W oriented structure, which had no lining of stones or other construction traces, a well-preserved decorated collared flask and a vertically striped lugged beaker were found, while the western end yielded the remains of a delicate skull – an infant? Based on its pottery, the grave may be dated to the Early Neolithic C Fuchsberg Phase. *Fyns Stiftsmuseum*, Odense, no. 954. [Niels M. Jensen]

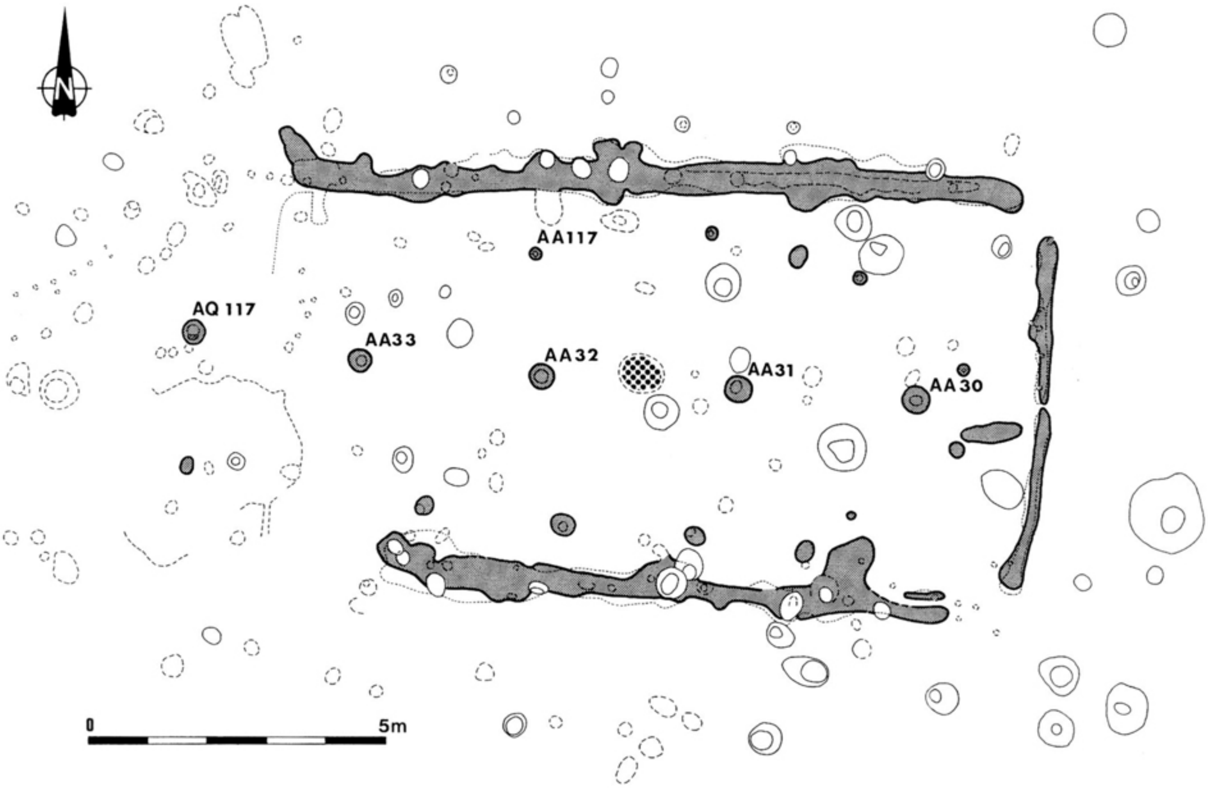


Fig. 2. Plan of house-site AA from the late TRB Culture excavated at Limensgård, Bornholm (no. 5). Wall trench and post-holes are shaded.

9. MORTENS SANDE 2, Northern Jutland. Lodbjerg s., Thisted a.
Settlement from the Single-Grave Culture. The excavated area comprises 63 m^2. Several stakes, standing partly in rows, were found. These rows delimit the rich part of the culture layer, but give no unambiguous structures. The finds consist of flint, pottery, amber and charcoal, the last-mentioned containing considerable amounts of carbonized corn. Above this and separated from one another by layers of drift sand are secondary culture layers, though without traces of structures. The pottery refers these to the Single-Grave Culture and Late Neolithic. The entire stack is sealed by drift sand and was exposed by coast erosion. – to be published in *JDA*. – *Nationalmuseet*, Prehist. Dept., no. 1250/75. [D. Liversage]

10. LI. BINDERUP, Northern Jutland. Binderup s., Ålborg a.
Grave. Ploughed-down barrow with the remains of a large North Jutish cist from the Single-Grave Culture. All uprights and cap-stones from the cist have been removed in recent times, but the shape of the cist was distinctly marked in the subsoil, oriented SW-NE. The inside length was 6 m, the width 2.6–1.5 m. The entrance faced SW. A large part of the burial layer was preserved and contained a beaker of Glob's type I, tanged arrow-heads, and amber beads. The cist itself was dated to the Single-Grave Culture, while the grave finds reveal Late Neolithic burials. – *Aalborg historiske Museum*, no. 1720. [Erik Johansen]

11. MØLLEHØJE, Central Jutland. Kobberup s., Viborg a.
Passage grave with secondary chamber in a round barrow. The passage grave is of the usual type found in Central Jutland, consisting of N-S oriented rectangular chamber measuring 5 × 2 m, with rounded ends. The stone-marks show that the chamber itself was constructed of 13 orthostats. The secondary chamber, which is placed slightly to the left of the entrance passage, consists of a rectangular chamber oriented N-S and measuring 1.8 × 1 m, with rounded ends. The stone-marks show that it employed 6 orthostats, 2 of which are shared by the rear wall of the passage grave, which also forms the entrance to the secondary chamber. The investigation of chamber and passage yielded virtually only amber beads and a few potsherds. Fanning out from the entrance, potsherds and amber beads have been found, deriving from extensive offering and clearance. Behind the passage grave, in the corner between primary and secondary chambers, a black patch was exposed, containing sherds from many vessels, among them sherds from several pots, including a Troldebjerg bowl. This find should undoubtedly be regarded as a kind of building offer. – *Skive Museum*, no. 296A. [Agner Nordby Jensen/John Simonsen]

12. KONGENSHØJVEJ, East Jutland. Mariager s., Randers a.
Round dolmen with traces of 12 orthostats, forming a pyriform chamber with inside dimensions 3 × 1.3 m. A compact stone packing surrounded the chamber. Remains of a low circular barrow were found, diameter c. 8 m, with a cap of large fieldstones. The dolmen has not had kerb-stones. The skeletal remains of 9 persons were found; grave goods comprised 7 amber beads and a spiral copper tube. In the SW-oriented entrance to the chamber, under a thin shell layer, the sherds of several pots were found which dated the structure to Middle Neolithic Ia. – *Kulturhistorisk Museum*, Randers, no. 182/184. [Ole A. Schmidt/Niels T. Sterum]

13. LINDEGÅRDENS MARK, East Jutland. Sem s., Randers a.
Settlement site. Under a ploughed-down barrow were two sets of ard-marks, under which settlement remains in the form of 27 post-holes, 1 fireplace and 2 pits were exposed, together forming a house measuring c. 17.5 × 5.5 m, oriented NW-SE. Despite an indistinct outline and construction, a centre-post construction seems to be present. The house is dated by Late Neolithic pottery with Bell-Beaker inclusions – *Kulturhistorisk Museum*, Randers, no. 324/84. [Ole A. Schmidt/Niels T. Sterum]

14. NØRREMARKSGÅRD, East Jutland. Hatting s., Vejle a.
Passage grave. The chamber was a rounded oval and measured 3.3 × 3.1 m. On the south-east side it had a 2 m long passage, and it was placed in a barrow with a diameter of 18.5 m. This barrow was apparently later augmented with a Bronze Age barrow. All stones in the grave had been removed and the remains measured at excavation only c. 0.5 m in height. The chamber area, passage and south-western quadrant were much disturbed, and here only a few finds were recovered. The area east of the passage was, however, preserved intact. Here 2 stratigraphically separate, sealed layers of offering sherds were found. Within the layers, separate groupings could be observed. Originally, a number of vessels seem to have stood on the kerb-stones, from which they had fallen, and now lay entire or in fragment concentrations. Other vessels were with certainty placed on the surface outside the kerb-stones. The sealing of the pottery, which seems to have been deliberate, occurred in two ways: partly (the lower layer) with sterile sand and partly with stone capping.

In connection with the stone cappings, a direct contact could be observed between sherds and stones, revealing that the sherd layers were quite open and still in large groups, when the stones were placed over them in a homogeneous layer. A special phenomenon was seen in a pit measuring c. 1.0 × 1.5 m, which was dug obliquely down through the layers, partly in under the kerb-stones to a depth of 30 cm under the original surface. The pit was packed tight with stones and pottery, and a tendency to layered alternation between stones and pottery hinted at a sequence in filling in. – *Horsens Museum*, no. M.102, and *University of Århus.* [Torsten Madsen]

15. GLIBSTRUP, West Jutland. Lyne s., Ringkøbing a.
Stone-packing graves. During excavations in 1985, 3 complete sets of stone-packing graves, each consisting of 2 graves and a so-called mortuary house, were found. 2 of these sets formed a row, immediately west of and parallel to a row investigated in 1984. Between the grave rows, a pair of narrow pale stripes was demonstrated, running about 1 m away from and parallel to the stone-packing graves. This phenomenon is interpreted as a "negative impression" of ancient, presumably contemporaneous road tracks. Artefacts were recovered from all three mortuary houses: a total of 1 thick-butted and 3 thin-bladed flint axes, dating the graves to period IV-V of the Funnel-Beaker Culture. – *Museet for Varde by og Omegn.* [Anders Horsbøl Nielsen/Ole Faber]

16. BØRSMOSE, South-west Jutland. Ål s., Ribe A.
Graves. An investigation of megalithic structures, consisting of 2 separate round constructions, each with a diameter of c. 8 m, lying close together and connected by a stone setting. Both structures consisted of low, turf-built mounds, the sides of which had been covered with stones. Partly centrally in the western circle (structure I), a number of narrow ditches and several stone-marks were demonstrated – presumably a chamber, apparently incorporating both timber construction and megaliths. The chamber was oriented SW-NE and measured c. 4 × 3 m.

Centrally in the eastern circle (structure II), a regularly shaped, 5 m long and 1.5 m wide almost oval chamber was exposed, constructed of large stones. This stone chamber, which was oriented NW-SE, was set deeply into the subsoil. No traces of any passage were found, and the chamber shape must be regarded as quite atypical. Both structures were at some stage covered by a single large barrow, constructed of grass turves.

Centrally in structure I, a number of amber beads were found and sherds of a number of pots. In the north-west side of the structure, further sherds of some decorated pots from an early phase of the Middle Neolithic/Funnel-Beaker culture were found. In the chamber of structure II, a secondary burial with distinct traces of a skeleton and an associated Single-Grave battle-axe of Glob's type K were found. In a larger area south of structure II were found numerous concentrations of potsherds and a few fragments of fire-embrittled flint implements, all dated to Middle Neolithic/Funnel-Beaker Culture. Near the top of the barrow, a depot was found consisting of 2 unused, semilunar flint sickles of Late Neolithic type, and secondary graves. – *Museet for Varde by og Omegn.* [Ole Faber]

NEOLITHIC AND BRONZE AGE

17. RUNEGÅRD, Bornholm. Åker s., Bornh. a.
Grave mound with graves (cists) from the Boat-Axe Culture, Late Neolithic and Early Bronze Age. The mound was surrounded by concentric, stone-filled ditches. Within the foot of the mound, the remains of several large cists were found, at

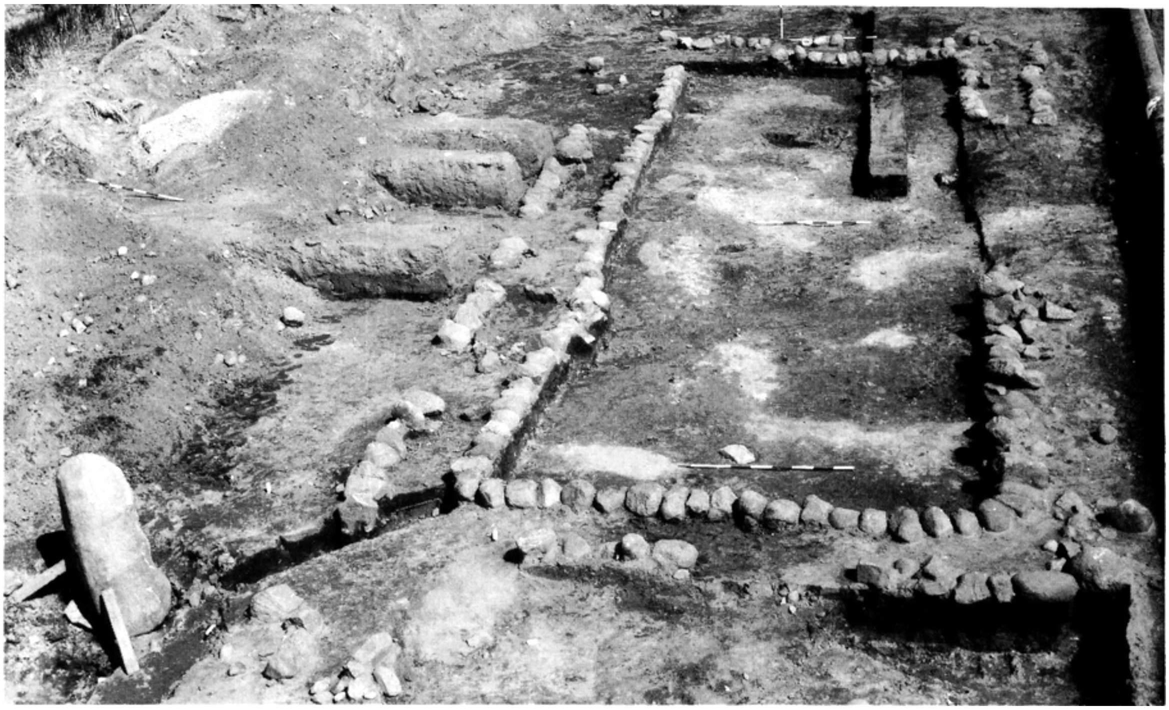


Fig. 3. View of the Bronze Age ceremonial site at Sandagergård I in Northern Zealand (no. 20). One of the menhirs is seen erected in the foreground to the left (photo by F. Kaul).

least 2 of which seem to belong to the Battle-Axe Culture. In connection with the ring ditches, several cists were found, one of which was a child's grave with a bronze ring and remains of an oak coffin (without finds). Close to the barrow were pits with Late Neolithic pottery. – *Bornholms Museum*, Rønne, no. 677. [Margrethe Watt]

18. RESENLUND, Central Jutland. Skive s., Viborg a.
Grave and settlement. In connection with construction work, the upper part of a lugged beaker, a piece of a double-edged axe, and a little oval stone with biconical perforation – a club? – were found in an oval, elongated patch of soil. The patch was almost 1 m long, c. 30–35 cm deep, bath-shaped, and oriented E-W. At the west end, a tripartite beaker with shoulder, tall neck and handle was found in an inverted position. Near the middle of the patch, a tubular amber bead was found, and a little tooth enamel. The patch – a grave – was dated to the early Middle Neolithic Funnel-Beaker Culture. Trial trenches did not reveal other graves, but settlement traces in the form of post-holes and pits – settlement pits and cooking pits. The settlement is dated to the Late Bronze Age. Systematic scanning with a metal-detector revealed a bronze sickle and a piece of a bronze sword. These objects belong to the large depot find made in the area in 1974, the Resenlund depot. – *Skive Museum*, no. 63A. [Poul Mikkelsen]

19. DIVERHØJ, East Jutland. Homå s., Randers a.
Burial mound and settlement. Under the barrow were three E-W oriented centre-post houses measuring c. 18 × 6 cm. There was a shallow depression at the eastern end of these structures and four sturdy roof-bearing posts at intervals of 1–2 m. Ard-ploughing could be observed across and in the rich culture layers of the houses. Quantities of flint swarf and implements and pottery (including bell beakers) date the houses to Late Neolithic A.

Over the middle of the southern house were traces of a plank construction measuring c. 5 × 5.5 m, with carbonized planks, covering a Late Neolithic A grave with lancet dagger and fragments of amber beads.

Over this building/grave again was a circular earthless cairn, c. 15 m in dia. and 0.8 m high. The cairn had in the Early Bronze Age been the centre of a flat barrow, c. 20 m in diameter and c. 1 m high. The central grave of this barrow consisted of a stone-packed grave measuring 3.4 × 1.5, set into the cairn. It contained the decomposed remains of an oak coffin containing an ornamented flanged axe with shaft button, two round-headed pins with sharp-oval point-decorated bows, strike-a-light blade and lump of iron pyrites. In the packing of the grave was found a stone with a cup-mark, and in the surface of the cairn a rock with 12 cup-marks. The objects date the grave to period IIa. Closely set ard-marks were seen around the cairn. A fragment of a broad-headed fibula may derive from a destroyed grave belonging to the latest phase of the barrow, i.e. the nicely turf-built and rounded top, which still stood at a height of c. 3.5 m with a dia. of more than 15 m. – *Djurslands Museum*, Grenå, no. 2025. [Pauline Asingh]

BRONZE AGE

20. SANDAGERGÅRD I, Northern Zealand, Ferslev s., Frederiksberg a.
Ceremonial site, stone carvings and menhirs. The main structure, which is from period IV of the Bronze Age, consists of a rectangular setting set in two rows of large, rounded stones, and oriented N-S (fig. 3). The inside dimensions were 16 × 4.5 m, the outside ones 18.5 × 7.5 m. Within the stones was a thin culture layer with potsherds and fragments of crucibles and moulds. The distribution of the finds, and the shape and dimensions of the structure, suggest a house. Set under the thin culture layers, 3 urn graves were found with the same dating (period IV) as the finds from the culture layer. C. 3 m south of the rectangular structure, 4 stones each carved with a picture of a hand under 4 strokes were found close together (fig. 4). C. 2.5 m west of these was a c. 1.75 m long and c. 1 m wide pointed stone, which marks show to have been a menhir. At an equal distance on the other side of the carved stones were marks from a stone of the same shape and dimensions. Closer to the house structure were marks from a slightly smaller third stone.

The investigation also yielded a small number of urn graves from the later Pre-Roman Iron Age. – *Gilleleje Museum*, no. 3063. [Flemming Kaul]

21. RÆVEKULEBAKKE, Bornholm. Åker s., Bornh. a.
Barrow with ring ditch. In connection with the remains of the barrow, several stone cists, most of them devoid of finds, but presumably from the Late Neolithic, were examined. In a cremation cist from Early Bronze Age period III, a set of ornaments consisting of a "Bornholm fibula", two arm-rings and spiral ear-rings was found. *Bornholms Museum*, no. 1081. [Jens Nyberg/Margrethe Watt]

22. LINDØ, Northern Funen. Munkebo s., Odense a.
Bronze hoard. In the track of a natural-gas installation, an amateur archaeologist found the top of a hoard from the Late Bronze Age. Parts of a neck-ring were found in spoil, the rest was found in situ. An excavation revealed a pot which had been buried in the subsoil with its contents of bronzes. Altogether, the remains of 3 pots were recovered: the large storage vessel containing the bronzes, sherds of another pot, and a bowl that had probably covered the large vessel. The metal objects are: 4 neck-rings, a West-European socketed axe, 2 West-Baltic spear-heads, 1 knife, 1 dagger, 3 pieces of a sword with kidney-shaped pommel, 2 awls, 8 sickles that seem to be packed in pairs, 1 arm-ring with gold foil, a number of spiral arm-rings of which some are entire others fragmentary, 1 bow fibula, 1 hanging vessel, 1 belt boss, 1 sheet band, 2 pieces of gold rings, several buttons and a tube. Most of the smaller objects were packed in the hanging vessel, wrapped in organic material, as the vessel had been, too. The bronzes are from period V, c. 900–700 BC. Surrounding the finding-place were traces of a coastal settlement from the same period. – *Fyns Stiftsmuseum*, Odense, no. 3370–71. [Henrik Thrane]

Fig. 4. One of the four carved stones from Sandagergård I, Northern Zealand (no. 20) (photo by L. Larsen, The National Museum).

23. LERBJERG, South-west Funen. Håstrup s., Svendborg a.
Round barrow, c. 30 m in diameter, preserved to a height of c. 0.75 m only. In the centre of this large mound were stones from a cist plundered in antiquity; only scattered burnt bones and caulk sealing were left. Partly under the grave was a charcoal layer from the cremation pyre measuring c. 3 × 2.5 m. 3 large post-holes, placed in a triangle and filled with pyre remains, are presumed to be manifestations of a pyre frame. The large mound covers a cemetery of 4 stone circles. None of these has had a domed earth barrow, but has appeared as a flat barrow filled with turves at the level of the top of the kerbstones. At the centre of the eastern stone circle was a partially preserved cremation layer on the old ground surface, into which an urn of Lausitz type had been dug, containing an amber bead and dress pin, dating the structure to period VI. – The excavation continues. – *Fyns Stiftsmuseum*, Odense, no. 6201. [Henrik Thrane]

24. DALSGÅRD, Northern Jutland. Tømmerby s., Thisted a.
Grave mound and settlement site. Investigation of stone cist in ploughed-down barrow. The cist comprised 7 massive uprights and 5 large cap-stones. It was oriented E-W and covered by a packing of rocks. The length of the packing was 3.8 m, the width 3.0 m and the height 1 m. The inside dimensions were

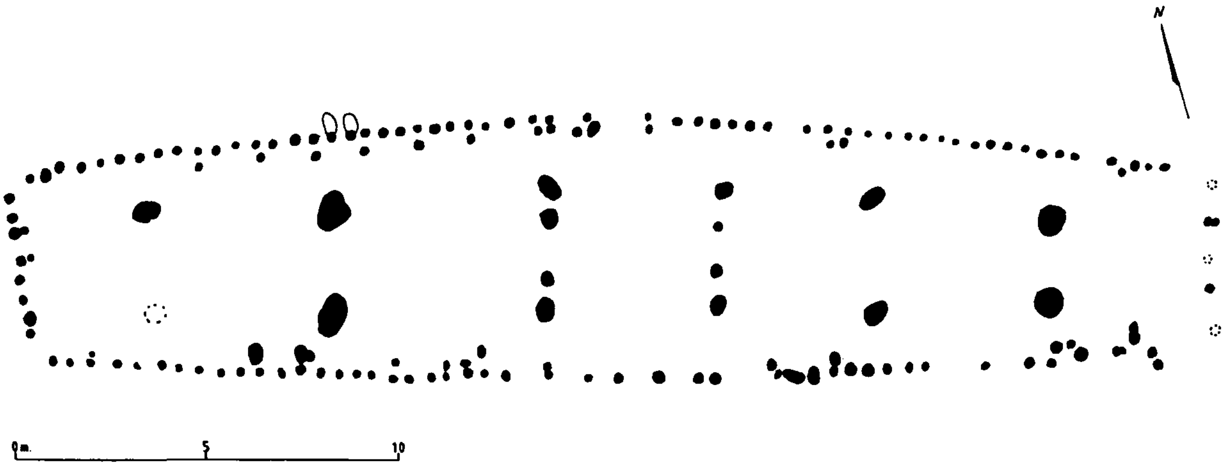


Fig. 5. Plan of house VII in farm 8 at Torstorp-Nørreby, Eastern Zealand (no. 25), from the late Early Germanic Iron Age.

2.2 × 0.55 m. The cist, which was partly soil-free, contained a female burial from the Early Bronze Age period II with a spiral-decorated belt-plate, 2 tutuli and 2 smooth bracelets. Under the barrow were culture layers from the Early Bronze Age with pottery and surface-chipped tools including pieces of asymmetrical flint sickles. – *Museet for Thy og Vester Hanherred*, no. 2150. [Jørgen Seit Jespersen]

IRON AGE

25. TORSTORP-NØRREBY, Eastern Zealand. Høje Tåstrup s., København a.
Settlements. Within an area of 160,000 m^2, 8 farms were found:

Farm 1, house IV is the oldest and dated to the late Bronze Age/early Iron Age. The house is E-W oriented with 4 sets of roof-bearing posts and a few wall- and door-posts preserved. It has been c. 16 m long and 6 m wide.

Farm 2, house I is an east-facing house with 3 sets of roof-bearing posts, and a few preserved wall- and door-posts preserved, which give the house its dimensions of 16 × 6 m. Renovation of house I occurred with rebuilding on the same spot and is called:

Farm 3, house II. Construction and orientation is as in house I, but house II has been c. 14 m long and 6 m wide. Houses I and II are dated to Pre-Roman Iron Age period II and earliest Roman Iron Age, respectively. Farms 2–3 are situated about 185 m north of farm I.

About 115 m south-east of farms 2–3 lies *farm 4*, consisting of houses X and XI. The E-W oriented house X is the main building, which consists of 4 sets of roof-bearing posts and has originally measured 19 × 6 m. West of this house is a small U-shaped outhouse oriented N-S. Farm 4 should probably be dated to the Roman Iron Age.

Farms 5–6 lie c. 80 m north-west of farm 4 and are dated to the late Roman Iron Age. Farm 5, *house VIII* is an E-W oriented house with 4 sets of roof-bearing posts, measuring c. 17.5 × 5.5 m, but no wall posts have been preserved. West of the house there has been a N-S oriented outhouse, c. 38 m long and 4 m wide with an open east side. *House IX* is a renovation of house VIII at the same spot and constructed in the same way. It has thus been longer than house VIII and measures c. 22 × 5.5 m. The outhouse continued in use.

Farm 7 is likewise dated to the late Roman Iron Age, but lies a good 170 m south-west of farms 5–6. The farm is dated by its house construction. The E-W main house V with 4 sets of roof-bearing posts has originally measured c. 20 × 6 m. The roof-bearing posts' position shows that the house has had curved long sides. West of this house was a N-S oriented outhouse.

The most recent and best-preserved house is *house VII in farm 8* (fig. 5), dated by pottery from the post-holes and pits to the end of the early Germanic Iron Age. The farm is in an isolated situation c. 70 m north of farm 7. House VII has had curved long sides, 6 sets of roof-bearing posts and a completely preserved wall-post row. The house is 30 × 7 m, E-W oriented. The isolated position of the farms is one of the most important problems of the excavation. The investigations have shown that it was probably a case of single units moving round in the terrain. – *Søllerød Museum*, no. 204. [Preben Rønne]

26. RÆVEKULEBAKKE, Bornholm. Åker s., Bornh. a.
Graves. In connection with the investigation of a barrow from Late Neolithic/Early Bronze Age (see no. 21), a number of Iron Age graves turned up around the base of the barrow. The graves, which were placed almost radially around the older barrow, were inhumation graves from the late Roman Iron Age. Among these, one in particular is mentioned with remains of a leather belt with a bronze buckle, 6 double-buttons, a knife, an awl, strike-a-light stone, various beads and the remains of a purse with 4 denars. A grave from the late Germanic Iron Age contained 2 zoomorphic brooches. (See also no. 5 and 21.) – *Bornholms Museum*, no. 1081. [Jens Nyberg/ Margrethe Watt]

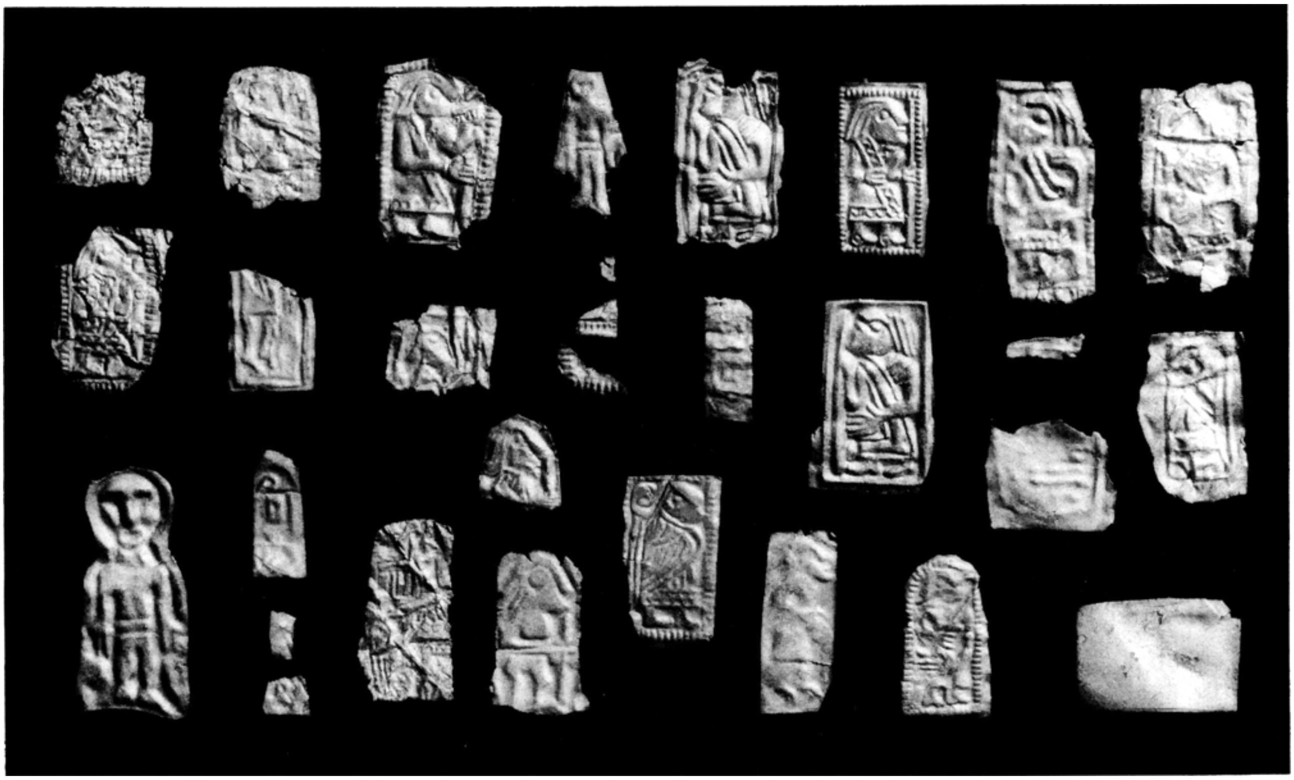


Fig. 6. Fifty-five of the over 1300 gold plaquettes found at Sorte Muld, Bornholm (no. 28) (photo by L. Larsen, The National Museum).

27. GRØDBYGÅRD, Bornholm. Åker s., Bornh. a.
Graves. Continued and final investigation of a large cemetery with 200 cremation graves and 36 inhumation graves, covering the period early Roman Iron Age to late Germanic Iron Age. Among the graves, which were revealed in 1985, was a large chamber grave, built of sturdy, vertical planks. A packing of large stone blocks and a bauta stone, which stood in a setting of smaller stones, had subsided into the chamber. Among the finds may be mentioned 5 silver brooches, 2 of which are gilt, a large silver pin, the remains of a casket (?) and c. 70 amber and glass beads. (See also no. 6.) – *Bornholms Museum*, no. 948. [Lars Kempfner-Jørgensen/Margrethe Watt]

28. SORTE MULD, Bornholm. Ibsker s., Bornh. a.
Gold plaquettes. In connection with amateur archaeologists' reconnaissance of a large settlement area, Sorte Muld, a collection of *guldgubber* was found (fig. 6). In an ensuing investigation of the area, 38 m^2 of topsoil were searched, yielding a number of *guldgubber* and several other objects (brooches, weights, etc.), showing that the settlement extended from the Roman Iron Age to the late Viking Age at least. Altogether, c. 50 gold plaquettes were obtained in 1985 (incl. 2–3 of silver or silver-gold alloy). The investigation was continued in 1986, bringing the total number of gold plaquettes found in Bornholm to over 1300. – *Bornholms Museum*, Rønne, 1191; *Nationalmuseet*, Prehist. Dept., no. 6255/85. [Margrethe Watt].

29. LUNDSGÅRD II, Funen, Åsum s., Odense a.
Settlement site. South of the settlement complex at Lundsgård, investigated in the 1940s (see E. Albrectsen, *Aarbøger* 1946) extensive settlement remains from the late Roman Iron Age were found in the track of a natural-gas installation. The structures comprised remains of culture layers, small settlement pits and an area with many post-holes. 2 houses could be clearly distinguished, both of the type with double wall posts. – *Fyns Stiftsmuseum*, Odense, no. 6065. [Jørgen A. Jacobsen]

30. GUDME, Funen. Gudme s., Svendborg a.
Hoards and settlement sites. Private scanning with a metal detector in the Gudme area resulted in 1984 in the finding of a treasure with 1.28 kg broken silver from the early Germanic Iron Age, at Stenhøjgård (see *Nationalmuseets Arbejdsmark* 1985 p. 203, fig. 7).

Also in 1984, an excavation of 700 m^2 at the place where Roman solidi and denars were found (Gudme I) was carried out, revealing traces of a settlement with houses from the period late Roman Iron Age to late Germanic Iron Age (*ibid.* pp. 203–04).

In 1984–85 *Fyns Stiftsmuseum* performed systematic surface reconnaissance at Stærkærvej in Gudme, resulting in the finding of 7 siliquae and various metal objects. Due to imminent building, major excavations were carried out at the site in 1985–86, during which a concentration of a further 272 sili-

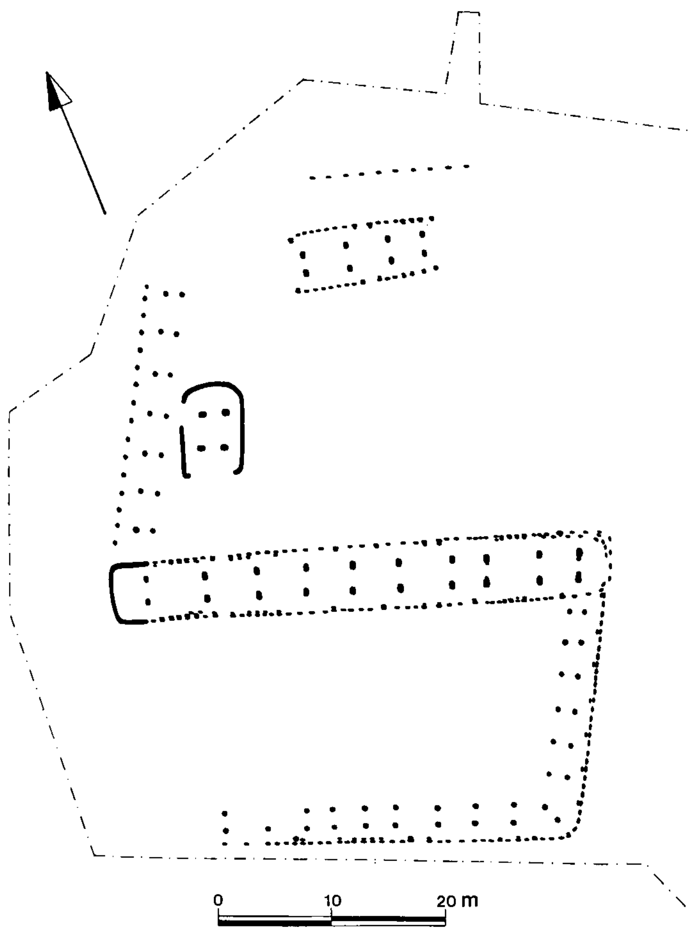


Fig. 7. Farm complex from the Early Germanic Iron Age at Mørup, Central Jutland (no. 36).

quae (AD 337–375) was found. The remains of a coeval settlement with houses in several phases were excavated at the same site. – *Nationalmuseet*, Prehist. Dept., no. 6320/85, and *Fyns Stiftsmuseum*, Odense. [Peter Vang Petersen]

31. LYNGGÅRD, Northern Jutland. Tødsø s., Thisted a.
Settlement site from pre-Roman Iron Age period IIIA. Traces of 20 houses were investigated in an area of c. 2,500 m^2. All houses were E-W oriented and had walls of grass turves. 8 houses could be identified as long-houses with a stable occupying one end and a dwelling the other, and two opposed side-entrances. 2 long-houses also had an entrance in the west end. 2 houses, each with one entrance, had a square ground plan. Both had mud floors and one of them also a fireplace. Nearly all entrances were nicely cobbled. Several houses also had stone footings and channels to collect rainwater. A few farm units could be differentiated by means of paths between small houses and long-houses. – *Morslands historiske Museum*, no. 781. [Per Bugge Vegger]

32. STENSBJERGGÅRD, Northern Jutland. Kongens Thisted s., Ålborg a.
Grave and settlement site. Investigation of an E-W oriented stone-sat inhumation grave with pots, shield boss, iron fragments, and silver and bronze fragments. Pots and shield boss date the grave to the early Roman Iron Age. The grave was set in an up to 0.5 m thick settlement layer from the early Roman Iron Age. – *Aalborg historiske Museum*, no. 1811. [Erik Johansen]

33. TOLSTRUP, Northern Jutland. Års s., Ålborg a.
Settlement site. In 1985 6 house remains and a stone-set inhumation grave were investigated. Among the houses, a complex with associated smithery deserves special mention. So far 65 houses have been investigated: 22 from the Pre-Roman Iron Age period IIIa, 36 from the early Roman Iron Age, and 7 which could be dated only to an undetermined part of the early Iron Age. The settlement is characterized by unusually well-preserved house remains with floors, fireplaces and traces of turf walls. Outside the houses are paved yards and paths. The good conditions of preservation are due to the presence of extensive layers of drift sand. – *Vesthimmerlands Museum*, Års, no. 58. [Mogens Hansen/Chr. Åbo Jørgensen]

34. ILLERUP ÅDAL, Eastern Jutland. Skanderup s., Skanderborg a.
Weapon-offering. Altogether, almost 40,000 m^2 have been excavated. The remaining unexcavated part of the find is scattered over 60,000 m^2, and is a scheduled area. A total of more than 15,000 objects at 3 sacrificial sites have been excavated. The oldest and most extensive site dates to the late Roman Iron Age period C1b, the middle one to the beginning of the early Germanic Iron Age, and the youngest to the later part of the early Germanic Iron Age. – *Forhistorisk Museum*, Moesgård, no. 1880. [Jørgen Ilkjær/Jørn Lønstrup]

35. NØRRE SNEDE, Central Jutland. N. Snede s., Skanderborg a.
Settlement site. Altogether, 18,000 m^2 have been excavated, 8,000 m^2 of the oldest part of the village complex being from the 3rd–4th cent. and 10,000 m^2 of the latest part of the settlement from the 6th–7th cent. Of the oldest, southern part of the village, a total of 6 farms have been investigated, represented by 36 buildings. The individual farms can be followed in 4 phases. The long-houses in the oldest part are very long, often around 35 m. The long-houses, the smaller houses and various buildings nearer the fences correspond to those previously excavated in the area to the west from the 5th cent.

In the most recent, northern part of the village complex, a total of 17 long-houses, 17 smaller houses and 8 barns have been excavated, and between them 2 graves and 1 well. As is usual in the Nørre Snede village, the individual farms are bounded by fences. The long-houses in this part of the village were very complex, 5 houses often being found one above the other. The long-houses of this 6th–7th cent. occupation differ from the earlier excavated houses of the 4th–5th cent. They now often have perfectly straight gables with sharp corners and strongly curved sides. These houses are in construction close to the houses of the Viking Age, lacking only the roof-bearing posts of the gables. Both the house construction and the pottery show that the latest part of the village complex at Nørre Snede derives from the century immediately preceding the Viking Age.

The area between these two parts of the village complex was excavated in the years 1980–84 with complete exposure of the 4th–5th cent. settlement (cf. *JDA* vol. I p. 181 no. 52 and fig. 9). – *Vejle-kulturhistoriske Museum*, no. 211. [Torben Egebjerg Hansen]

36. MØRUP, Central Jutland. Nørup s., Vejle a.
Settlement site. In 1984–85, a total of 5,300 m^2 have been excavated, revealing an isolated farm (fig. 7). This farm covers an area of 45 × 58 m and consists of 1 long-house, 2 smaller houses and associated fences. The long-house is 45 m long and 6 m wide, preserved with holes for roof-bearing posts, partition walls and wall-post holes. There has been a stable in the centre of the house. Slightly north of the long-house was a small house measuring 8 × 5.5 m with an open south gable. Finally, further north-east, another small house measuring 13 × 5.5 m without gable-post constructions was found. To this farm belong most of the surrounding fences with double rows of inner supporting posts. Immediately east of this farm, 3 smaller houses were found which could have belonged to the same farm. The trial trenches outside the farm show that it is an isolated farm and not part of any village complex, which is otherwise common in the neighbouring coeval settlements, both in Vorbasse and Nørre Snede. The farm is dated by shape and pottery to the early Germanic Iron Age, and is probably the best-preserved structure of its kind we know from the late Iron Age. – *Vejle kulturhistoriske Museum*, no. 979. [Dorthe K. Mikkelsen]

37. LØNHØJVEJ, TARM, Western Jutland. Egvad s., Ringkøbing a.
Cemetery and settlement site. Extensive Iron Age cemetery from the late Pre-Roman Iron Age and beginning of the early Roman Iron Age (fig. 8). Altogether, 150 cremation graves, mostly patches, have been excavated. Most important are the 20 graves that contained weapons: single- and double-edged swords, chaplets, shield bosses and spear-heads. Several of the swords are surprisingly well preserved. Most of the weapon graves are about 10 cm deep and are therefore preserved only because the area has never been cultivated with modern agricultural machinery. The cemetery is rectangular, measuring about 70 × 30 m, and probably completely excavated: altogether, 7,000 m^2 have been investigated.

In the early Roman Age, 2 farms were built on the site of the cemetery. One of them consists of a long-house and two smaller houses, connected by fences (fig. 9). The other farm consists of a long-house, a smaller house and 2 barns, without preserved fencing. The two farms are probably part of a larger settlement. – Lit. *'FRAM' Fra Ringkøbing Amts Museer* 1985, pp. 93–102. – *Skjern-Egvad Museum*, no. 175. [Torben Egebjerg Hansen]

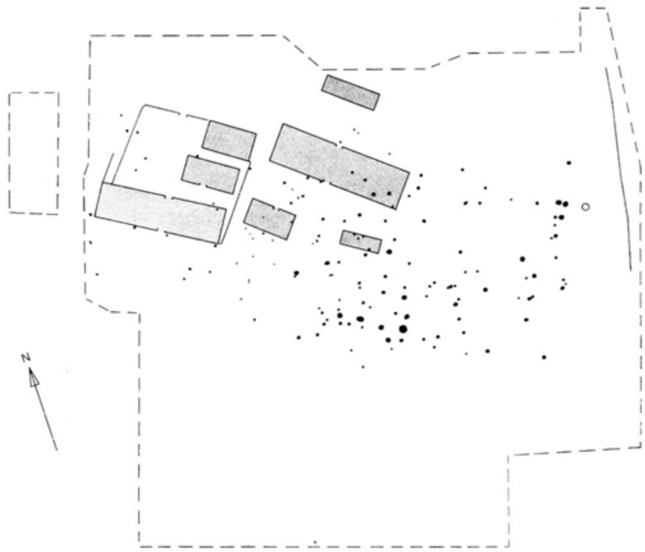


Fig. 8. Lønhøjvej, Western Jutland (no. 37). Plan of the excavation showing cinerary graves (dark spots) and two Early Roman Iron Age farms.

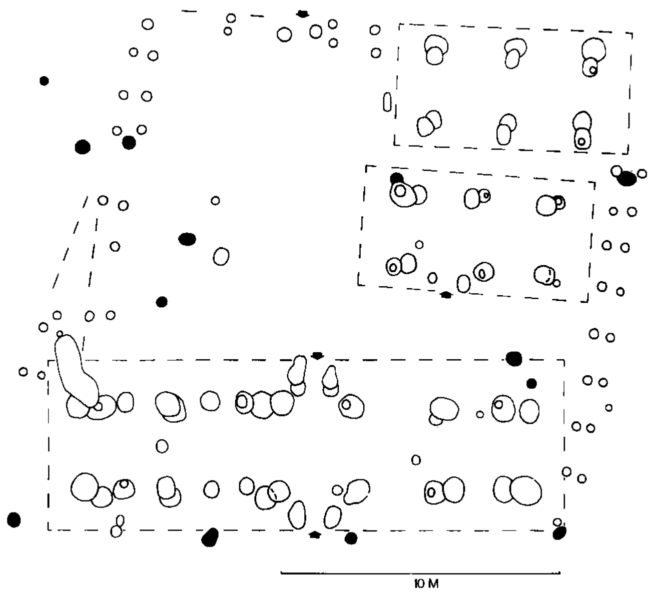


Fig. 9. Lønhøjvej, Western Jutland (no. 37). Plan of farm complex from the Early Roman Iron Age.

38. PRÆSTESTIEN, South-west Jutland. Sdr. Tobøl s., Ribe a.
Settlement and graves. Within two areas, northern and southern, together making up 15,000 m^2, settlement remains from 4th–9th cent. AD have been exposed, consisting of long-houses, fences and pit-houses. Up to 6 occupation phases can

be distinguished. A few urn graves from Pre-Roman and Roman Iron Age and a larger number of inhumation graves from the 3rd–5th cent. have been found. The graves contain pots, brooches, iron knives and textile remains. – *Esbjerg Museum*, no. 1421. [Palle Siemen]

39. STARUP SKOLE, South-west Jutland. V. Starup s., Ribe a.
Iron-smelting. 338 slag pits from the early Iron Age have been investigated, forming 3 groups of 128, 36 and 174, respectively. – *Museet for Varde By og Omegn.* [Sv.E. Albrethsen]

40. SELAGER, South-west Jutland. Ål s., Ribe a.
Settlement site. Houses and a cobbled street have been preserved under sand drift. The settlement begins in the Pre-Roman Iron Age period III and continues in the early Roman Iron Age. The later phase comprises a well-preserved house measuring about 23 × 5 m, with remains of turf walls, mud floors, cobbled entrances and paved stables with a dung channel and cistern (cf. the houses from Myrthue and Sjælborg, see *KUML* 1959 pp. 13–27 and 1964 pp. 15–30). – *Museet for Varde By og Omegn.* [Sv. Aa. Knudsen]

IRON AGE AND VIKING AGE

42. RUNEGÅRD, Bornholm. Åker s., Bornh. a.
Settlement site. Continued investigation of a large settlement area with house remains from the Stone and Iron Ages. In 1985, an area covering c. 3,000 m^2 in extension of the investigation area of 1984, where ploughing had revealed paving, was investigated. The excavation unearthed parts of several large houses of late Iron Age type and 2 houses from the transition Viking Age/Middle Ages (dated by finds of middle and late Slav pottery). The houses are three-aisled with large stone-lined post-holes. The largest house was 22 m long. A smaller shed had been built on the ruin of a Late Neolithic barrow. – *Bornholms Museum*, Rønne, no. 677. [Margrethe Watt]

43. VORBASSE, Central Jutland. Vorbasse s., Ribe a.
Settlement site. 11,000 m^2 of the Iron Age villages were excavated in 1985 including 2,000 m^2 of the Viking village and 9000 m^2 of the preceding village from 5th–7th cent. In 1985, the total excavation of the Viking Age settlements at Vorbasse was completed. Among other things, one of the hitherto best-preserved long-houses was investigated: 33 m long with completely preserved byre with box partitions for 20 animals. In addition, 5 smaller houses, 5 pit-houses and 2 large wells, again with a good deal of wood preserved, were found. The Viking Age village from the 8th–10th cent. has consisted of 7 separately fenced farms with a uniform structure; in the middle the large long-houses with stable in the east end are found, and a few smaller houses, placed inside the farm fence, often standing gable to gable, and with all the pit-houses placed near the middle of the village. The succeeding village from the 11th cent. is today completely excavated. It, too, consists of 7 farms of varying size. The last village to be excavated at Vorbasse is from the 5th–7th cent. Here the eastern part with 2 complete farms has been investigated. – *Vejle kulturhistoriske Museum* and *Nationalmuseet*, Prehist. Dept., no. 1124/75. [Steen Hvass]

VIKING AGE

44. VALLENSBÆK TOFTER, East Zealand. Vallensbæk s., København a.
Settlement site. Farms from the late Iron Age have previously been excavated south of Vallensbæk village (cf. *JDA* vol. 4, pp. 157–63). In 1985, excavation was carried out only 300 m north-east of the first site. At the top of a boulder clay plateau, a Viking Age house was excavated which is known in a corresponding type from Trabjerg and Vorbasse. The house has not had any recognizable roof-bearing posts, only wall posts, which formed two slightly curved rows, roughly E-W oriented, and with shallow post-holes in the gables. The house has been about 20 m long and 8.5 m wide. A couple of settlement pits and some ditch structures are dated by pottery to Late Viking Age/Early Middle Ages. In addition, the site exhibited pits from period V of the Middle Neolithic, Late Bronze Age, early Roman Iron Age, and a later part of the Middle Ages, and undated ditch structures. – *Søllerød Museum*, no. 218. [Fl. Kaul]

45. SNOLDELEV, East Zealand. Skoldelev s., København a.
Cemetery. In connection with gas installation, parts of a Viking Age cemetery have been excavated, c. 10 km south of Roskilde. At the same site a runestone – the Snoldelev stone – was found about 200 years ago, which according to contemporary reports was associated with 2 parallel rows of stones (a ship-setting?). Excavation revealed, besides the graves, 2 overturned stones 1.4 m long – one of them dressed – which had probably been part of the rows. In addition, 4 inhumation graves and a large number of pits with burnt bones were excavated. The richest of the graves – a woman's grave – contained 2 tortoise-brooches, 2 knives, 1 belt buckle and 1 amber bead. – *Roskilde Museum*, no. 627/84. [Tom Christensen]

46. BØGELUND, VARPELEV, East Zealand. Varpelev s., Præstø a.
Settlement site. In connection with a factory expansion, a trial excavation was made of an area covering 20,000 m^2. 1000 m of trial trenches were laid out and a larger area measuring 2,000 m^2. 3 long-houses and 3 smaller houses were exposed. One of the long-houses was preserved with the greater part of the holes of wall-posts and roof-supports, oriented E-W, 22 m long and 7.75 m wide. The two others were preserved with the roof-post holes and a few of the wall-post holes. In two of the long-houses, pottery from the Viking Age was recovered. The latest pottery found in the trenches can be dated to the 11th cent. – *Køge Museum.* [Sv.Å. Tornberg]

47. KAAGÅRDEN, Langeland. Lindelse s., Svendborg a.
Graves. Continued excavation of a cemetery where 60 inhumation graves from the Viking Age have been localized. A total of 32 graves have been investigated. The skeletons were

well preserved – apart from 1 child, all adults. Grave goods were sparse – a few iron knives, whetstones, glass beads, ring- and dress-pins of bronze (11th cent.) and (in a man's grave) a dog. One of the graves contained a fibula of the Germanic Iron Age. About half of the burials were under rectangular and pyriform stone settings – *Langelands Museum*, Rudkøbing, no. 11563. [Annemarie Kruuse]

48. GAMMEL HVIDING, South-west Jutland. Hviding s., Ribe a.
Settlement, found by aerial reconnaissance and a limited probe west of Hviding Church, and exhibiting among other things post-holes from a Viking Age house of Trelleborg type and a well. The well, which has been only partially excavated, has yielded a great number of finds. Besides a lot of pottery, it contained a cruciform fibula, a bronze brooch with enamel inlay, glass, Rhenian quern-stones of basalt lava, whetstones, and a Hedeby coin from around 950. – *Den antikvariske Samling*, Ribe, no. 440. [Stig Jensen]

MEDIEVAL AND LATER

49. KØGE. BROGADE/FÆNDEDIGET
Urban excavations. Major excavation near Køge's old river harbour and southern gate. Several drainage canals and traces of a dyke from c. 1288, when the town was founded, were found. The remains of about 10 houses were found, deriving from the High Middle Ages to recent time. The oldest were post-built halled houses. A well, a Renaissance cellar and paved slips between the houses were also found. Nothing was found from the Early Middle Ages or Viking Age. – *Køge Museum.* [Ulla Fraes Rasmussen]

50. ROSKILDE, BREDGADE
Urban excavations prompted by building construction. Knowledge of Roskilde's earliest settlement and topography has been considerably augmented by the investigation. With respect to the topographical conditions at the site, it has been found that the eastern part of the excavation was originally a marshy area. Not until the 12th cent. was this area taken into use, among other things for a bronze foundry. It shows considerable signs of infilling and grading, presumably serving to make it habitable. In addition to the structures mentioned, a copious material from the 12th–13th centuries has been found. The most important finds are parts of a long-house with wall channel, lying parallel to the present street. This house is dated to the 12th cent. and is thus the city's oldest profane structure. In the wall channel and the area in front of the house a number of finds have been made which should also be assigned to the 11th cent. Among these may be mentioned a soapstone mould for silver bars, a mould of fired clay for an equal-armed cross and a silver coin of Sven Estridsen. Besides these objects, large amounts of pottery, slag, bone implements, etc. and several wells, the oldest of which is 12th cent., have been found. – *Roskilde Museum*, no. 608/84. [Mette Høj]

51. NÆSTVED. VINHUSET
Urban excavations. In 1985, a pit with traces of bronze-casting was investigated. In the pit, several hard-fired clay linings with intermediate ash layers were demonstrated. The pit contained some Baltic pottery with a small inclusion of older pottery, and the pit is dated by this to the period around the year 1000. In addition, the remains of a brick-built house from the Late Middle Ages were found. – *Næstved Museum*, no. 84:700/85. [Carsten Ljungkvist]

52. EGHOLM, Northern Jutland. Skørping s., Ålborg a.
Fortifications, consisting of a motte and tower, placed in a bog. The motte, about 18 m in diameter, is made of peat turves cut in the surrounding bog and carefully laid in circles. The construction is strengthened with stakes and wattling on the outside. Only parts of the bearing posts, stake walls and floor of the tower, 7 × 7 m in diameter, were preserved. The foundation material dates the structure to 14th cent. AD – *Aalborg historiske Museum*, no. 794. [Jan Kock]

53. BARMER, Northern Jutland. Sebber s., Ålborg a.
Pottery kilns from around 1300 AD, one of which was especially well preserved. The kiln was slightly sunk into the subsoil and had an extent of 5.5 × 2.5 m. It was divided into two practically equal parts: in front a roomy fuel chamber, at the rear a firing chamber raised about 30 cm above the front part and separated from it by three sturdy piers. The base of the kiln was lined with a carefully burnished layer of clay. The body of the kiln was made of clay plastered onto a skeleton of thin branches. In front of the kiln was a considerable quantity of pottery material. – *Aalborg historiske Museum*, no. 1623. [Jan Kock]

54. VIBORG
Urban excavations. Construction and drainage work have prompted the completion of excavation of a Viking-Early Medieval settlement at Søndersø, of a section through part of the city's fortifications at Reberbanen, of the investigation of the northern wing of the Franciscan friary and of parts of a ring wall around the friary, and the excavation of the foundations of a large Medieval brick house in Nikolajgade and of a well in Ibsgade. *Viborg Stiftsmuseum.*

55. TOVSTRUP, Eastern Jutland. Dallerup s., Skanderborg a.
Watermill. In 1985 the investigation of the Medieval watermill "Hulpiberen", initiated in 1983, was completed, and the mill has now been totally excavated. During the 1985 investigation, the deepest-lying parts of the area below the wheel were excavated. Among other things, a mill-axle, parts of a waterwheel with paddle blades, and part of a mill-race were found here. In addition, the foundations of a mill cellar measuring c. 5 × 5 m and the miller's dwelling with thick, alternating layers of mud-stamped floors with ovens, fireplaces and a well were found. The mill dam was apparently established in connection with the transition to a small, ordinary undershot wheel, which according to dendrochronological datings was

apparently introduced here at the end of the 15th century. – *Silkeborg Museum*, no. 358/1983. [Chr. Fischer/K. Bjerring Jensen]

56. KOLDING
Urban excavations. At Rendebanen the remains of a total of 7 buildings were found, the oldest of which, containing both oven and fireplace, was dated to the 13th–14th cent. Above this were house remains oriented in accordance with the Late Medieval street. Parts of a watermill from the 13th–14th cent. AD were investigated. – *Museet på Koldinghus*, no. 361 & 417. [Lennart Madsen]

57. H.M.S. "ST. GEORGE". The North Sea off Torsminde.
Wreck of British ship of the line. History's worst wreck on the west coast of Jutland was the stranding on Christmas Day 1811 of the great British ships of the line "St. George" of 98 guns and "Defence" of 74 guns, with the loss of about 1400 men.

The hulk of the "St. George" was found in 1969 by skin divers. Since 1980 it has been seriously threatened on account of changes in the coast conditions. In 1983 *Nationalmuseet* (Skibshistorisk Laboratorium) carried out a trial investigation, which showed that the wreck contained large amounts of well-preserved fittings and equipment and the officers' private possessions. In 1984, the National Museum initiated a major salvage campaign. Responsibility for the continued investigations passed in 1985 to *Ringkøbing Museum* in close collaboration with the National Museum. During the 1985 campaign, the find material was supplemented in a number of important points, ranging from navigation instruments to personal effects. Considerable quantities of leather goods were found, a flageolet, and a number of wooden pegs with names of crew. Simultaneously with the salvage of objects, survey and description of the wreck were continued. *Ringkøbing Museum*, no. 6000. [Michael Teisen/Gert Normann Andersen]

58. H.M.S. "DEFENCE". The North Sea off Torsminde.
Wreck of British ship of the line. A block pulley with the emblem of the Royal Navy has been recovered. In accordance with old descriptions only the bottom of the hull remains on the sea-floor, with large concretions of rusted ballast iron and cannon-balls. – *Ringkøbing Museum*, no. 6310. [Gert Normann Andersen]

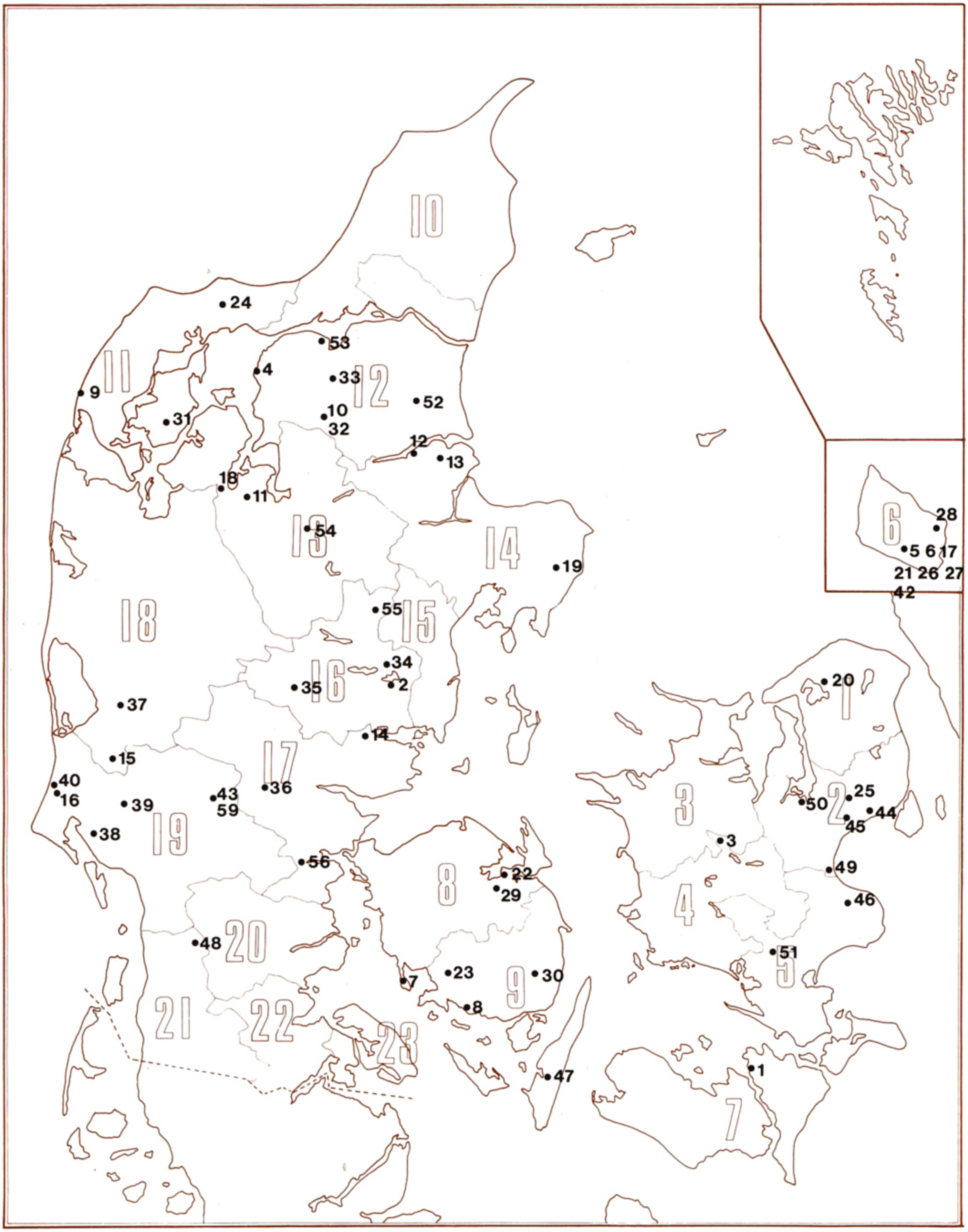
59. VORBASSE, Central Jutland. Vorbasse s., Ribe a.
Early Medieval village. West of the Medieval church, 12 houses with posts set into the ground, a cellar of stone boulders, and 3 wells were found. The 2 stratigraphically oldest houses were c. 22 m long and 5–6 m wide. There are no roof-supporting inner posts. Both wall lines curve slightly. This type of house is known from the excavation north of Vorbasse (no. 43), where it is found in the most recent phase and can be dated to 11th and 12th cent AD, a dating that probably also applies to 2 houses in Vorbasse village. The other houses are all later and are dated by pottery to the period from the 15th to the 17th cent. AD – *Vejle kulturhistoriske Museum*, no. 953. [Jacob Kieffer-Olsen/S. Hvass]

60. H.M.S. "CRESCENT". Jammerbugten.
Wreck of British ship of the line. In 1808, the British frigate "Crescent" sank off Lønstrup on the west coast of Jutland. The wreck has in recent years been investigated in collaboration with local skin divers. In 1985, some of the material exposed by nature was salvaged. Among the most important finds may be mentioned items of clothing, shoes, stoneware, glass, porcelain and coils of rope. – *Bangsbomuseet*, Frederikshavn, no. 100–141. [Hans Runge Kristoffersen]

Translated by Peter Crabb

Map showing the location of sites mentioned in the section 'Recent Excavations and Discoveries'. The counties (Danish *amter*) are numbered in the following way:

1. Frederiksborg
2. København
3. Holbæk
4. Sorø
5. Præstø
6. Bornholm
7. Maribo
8. Odense
9. Svendborg
10. Hjørring
11. Thisted
12. Ålborg
13. Viborg
14. Randers
15. Århus
16. Skanderborg
17. Vejle
18. Ringkøbing
19. Ribe
20. Haderslev
21. Tønder
22. Åbenrå
23. Sønderborg



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